UNITED NATIONS
ECONOMIC AND SOCIAL COUNCIL

Distr.
LIMITED

E/ECWA/NR/SEM.3/13
27 July 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 POLICY RESEARCH AND THE ARAB STATES

by

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

81-4268

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Most of this conference has been devoted to the presentation of papers which have explained how technology, in one way or another, has contributed to to the attainment of national objectives. These papers are for the most part the result of detailed empirical studies. It is the knowledge generated by such studies which ultimately provides the understanding which enables policy makers to make policy, and to have some confidence that the policy will achieve its objectives.

Many of the studies reported at this conference would fall under the rubric of technology policy research. It is my intention in this paper to consider the growth of this area of inquiry, discuss some recent studies carried out in other parts of the world, and to assess their implications for the Arab world. Finally, I will consider some of the problems which must be faced in developing more technology policy research centres in the Arab States.

The Origins of Science and Technology Policy Research

Science and technology policy research dates back to the immediate post Second World War period. At that time, the governments of the industrialised countries were concerned about how they could harness science for peaceful purposes, just as it had been used for military objectives during the war. The early policy studies were mainly concerned with science rather than technology and, within science, the focus was on 'research and development'. It was claimed, at that time, that science policy studies had the twin objectives of throwing light on both government policies for science and on science in policy. A differentiation was thus made between the welfare of the scientific

establishment itself and the ways in which the putputs from this establishment contributed to national welfare.

As the interests of governments focused more on economic growth as a national objective, the science policy studies became increasingly preoccupied with technology. This switch in emphasis led to a semantic problem which persists to this day. Many of the research groups which were established in the 1950s and 60s had the words 'science policy' within their titles. This did not prevent them from studying technology policy issues, but it does occasionally lead to some confusion, particularly for those who view 'science policy' in the more restrictive sense of the words.

Although science and technology policy research is a post Second World War phenomenon, the interest of some of the social science disciplines in science and technology is much older. Questions of the role of technical change in economic growth have been debated by economists from the time of Adam Smith. Ricardo, Malthus, Marx and Schumpeter all wrote extensively about technology, and the economics literature is still an important source of knowledge for science and technology policy-makers. To a lesser extent, the work of sociologists who have studied the sociology of science and the political scientists who have written on the politics of science is also important.

But despite the contributions of the disciplinary specialists, most of the specifically policy research has been carried out by interdisciplinary teams. By the mid 1970s, it could be claimed that a new field of policy research had emerged with its own journals, societies, and international meetings.

Policy research on science, technology, and development owes a good deal to the pioneering work of the secretariats of a number of international

organisations. UNESCO, UNCTAD, UNIDO, and the ILO have all carried out substantial research on topics pertaining to their specialised responsibilities. But it was with the Organisation of American States in the mid 1960s which did the most to encourage national groups of developing country researchers to become involved in science and technology policy research. This led to a research capability in Latin America which has made important contributions not only to the body of knowledge but also to national decision-making capabilities on matters relating to science, technology and development.

Outside Latin America, the main developing country centres of science and technology policy research have been India and South Korea in Asia; Egypt and Kuwait in the Middle East; and Nigeria in Africa. Important work has also been done in the Caribbean, but elsewhere the build-up of local research capability in this area has been slow.

Examples of Science and Technology Policy Research

It is a contention of this paper that studies carried out on the process of technical change in certain industries and in certain countries do have a value for policy makers concerned with other industries and other countries. However, that value is limited. The international studies are useful to inform policy makers, and as a help to the making of judgements about policy. They should, however, be seen as a complement to, and not a substitute for National technology policy studies and research.

In the following sections examples will be given of four different types of studies, all of which are concerned with National technology policy as it relates primarily to industry. The purpose of describing these studies is partly to indicate the main results to have emerged, but also to describe

how they were carried out. The relevance of both results and procedures for the Arab States will also be considered.

1. TECHNICAL CHANGE AND ECONOMIC POLICY[1]

(a) Method of Preparation.

This report was prepared by a Committee of experts aided by the OECD Secretariat. The study took twoyears to complete. The experts were assisted by studies of technical change in four industries which were commissioned specially for the report. It is the most comprehensive and up-to-date review of the literature and of current understanding on technical change and the economy in the OECD countries. Many of the experts are leading scholars and researchers in the field and others had a wealth of experience in industry, The experts were not unanimous about all points in their report. This divergence of opinion is partly a reflection of lack of knowledge and partly a reflection of the complexity and essentially political nature of the issues.

(b) Main Issues Considered

The reports' principal value for policy makers in the Arab States are the analyses in parts two and three of the Report which consider the trends in R & D and innovation, and technical change and the economy. Although the analysis is based on empirical research and studies carried out within OECD cou countries and institutions, much of the knowledge reported and synthesised here is relevant to industry in most of the Arab States. Certainly it provides a useful starting point for which specifically Arab State problems can be studied.

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1. Technical Change and Economic Policy, OECD, Paris 1980
Science and Technology in the New Economic and Social Context.

Perhaps the most important message to come from this report is that within the OECD countries there is a need for better co-ordination between a country's scientific, technological and economic policies. This is not a new theme for the OECD, but I doubt if it has been made with such force and vigour as it has in this report.

After reviewing the economic and social problems of the OECD in the late 1970s and early 1980s, the authors of this report conclude that their analysis suggests:

"(a) It seems to us that effective demand management policies, while necessary, are not sufficient to solve the present difficulties. In particular, a number of structural problems prevent governments from using traditional methods effectively.

(b) Technical innovation, far from being peripheral, is central to the solution of these problems, and can facilitate the use of demand management policies.

(c) Technical advance cannot be taken for granted. Neither the rate nor the direction can now be regarded as satisfactory. The rate has slowed down substantially, and as we shall attempt to show, the direction has meant that it is lacking in some areas where it is vitally needed.

(d) While it is true that technical innocation depends to a considerable degree upon private initiative, governmental policies have an essential part to play. Among other things, such policies set the context and provide the incentive or constraints for private initiative.

(e) Experience of the past quarter century shows that although some of these policies have been successful (for example in agriculture or fundamental research) others have been ineffective or expensive (as for

example the subsidising of certain technological ventures without reference to market considerations or society's needs).

(f) It is imperative not only to discriminate between good and bad policies of the past but also to devise new innovation policies for the present and future.

(g) In any case, research and innovation policies must be better integrated with other aspects of governmental policy, particularly with economic and social ones."

2. SCIENCE AND TECHNOLOGY FOR DEVELOPMENT: MAIN COMPARATIVE REPORT OF THE STPI PROJECT[2]

(a) Method of Preparation.

One hundred and fifty researchers in ten developing countries participated in this ambitious collaborative research project which went on over a four year period in the mid 1970s. Its purpose was to analyse the ways and means that had been used to implement science and technology policies in the participating countries, and to assess why some ways had been more successful than others.

To do this policy research teams were established in Universities, Science Councils, Academies and Planning Institutes in the various countries and a major programme of empirical studies was carried out. From the start it was decided that each national team should pursue its own research following its own methodology. There would be no attempt to impose a rigid framework from above. This had the merit of allowing each of the national efforts to be primarily guided by the needs of local policy makers, but it had the disadvantage of making it very difficult to draw conclusions of general applicability from the research.

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2. Science and Technology for Development: Main Comparative Report of the STPI Project: IDRC Ottawa, Report 109e, 1979. See also STPI Methodological Guidelines and 12 STPI Modules all published by IDRC

Each team prepared its own reports, usually in the language of the country. These were then synthesized and a draft main comparative report prepared by Francisco Sagasti, the Field Co-ordinator. This was later amended by an editorial committee of the country co-ordinators and published by IDRC, the principal source of finance for the project. In addition, the IDRC has also published 19 other reports associated with the Science and Technology Policy Instruments project. Numerous others have been published locally by the teams themselves. Both the studies and the reports have made a major contribution towards our understanding of how Science and Technology contribute to industrialisation in the Third World and what are policy implications.

(b) The Main Results

One of the principal contributions of this study is the detailed information which was generated about how technical change takes place in industrial enterprises. This, however, is information at a micro level which does not readily lend itself to generalisations suitable for this paper. Nevertheless, some general conclusions can be suggested.

(i) It was found in all the STPI countries that policies which were applied to industry as a whole had little impact. Far more useful were policies and policy instruments which focussed on specific industrial sectors.

(ii) In any consideration of technology and industrialisation it was essetnial to consider policies for generating a local supply of technological knowledge, as well as those concerned with encouraging a demand for technical change from within industrial enterprises. One without the other would be unlikely to have the desired effect.

(iii) The complexity of the interrelations between science, technology and industrialisation was far greater than any of the teams had imagined at the beginning. In part, the complexity stems from our lack of under-

standing of the issues. This can be, and was improved by further research. In part, however, it reflects a real conflict between different interest groups. Research can highlight these conflict situations but cannot resolve them.

(iv) The studies highlighted the relatively little impact that explicit technology policies had had in influencing the decisions of industrial managers. Far more important had been social and economic policies which had been designed for other purposes - frequently with no thought or regard for their likely technological impact. These policies were referred to as implicit technology policies.

(v) The teams concluded that in the future it would be essential to have a much closer integration between economic and technology policy makers. In the past, in most of the STPI countries technology policy responsibility had been primarily the responsibility of Science Policy bodies. This, the STPI teams concluded, was not enough.. Although science and technology is related, there needs to be much greater effort made to integrate technology and economic policy making.

3. TECHNOLOGY DEVELOPMENT STRATEGIES[3]

(a) Method of Preparation

This study is different from all the rest described in this paper in that it is the work almost entirely of one man. Maximo Halty Carrere had pioneered the development of technology policy studies in Latin America when he had been with the Organisation of American States in Washington. In that position he had observed the need for a Technology Strategy on the part of the Latin American countries that he knew well and began a research project to analyse the

3. Maximo Halty Carrere, Technology Development Strategies for Developing Countries: A Review for Policy Makers, Institute for Research in Public Policy, 1979. 2149 Mackay, Montreal, H3G 2J2.

experience of other countries. He was interested in understanding the similarities and differences between the approaches to generating, transferring and utilising technology of both centrally planned economies such as the Soviet Union, Poland and Yugoslavia, as well as the mixed economies of Italy, France and Japan. He also endeavoured to compare and contrast the experiences of these "Northern" countries with those developing countries in the "South".

His first attempt at a synthesis was reviewed by a meeting of experts which took place in England in 1977. Halty subsequently expanded his ideas which were then exposed to policy makers from the Third World at a series of Seminars in 1978 and 1979. He died shortly after the Seminar for the Arab States which was held in Khartoum in October, 1978. The Institute for Research on Public Policy published his report posthumously.

Whenever Halty spoke about this ideas and findings his presentations elicited great interest and some controversy. Halty believed that his findings did have implications for the Arab States and for this reason, and also because his book is not widely available, I will quote extensively from the Summary to his book.

(b) The Main Results

The main results of Halty's analysis are presented in the Summary as a series of eleven conclusions. The first eight summarise the major findings of the country-by-country analysis, drawing general conclusions of interest to LDC policy makers. At the risk of over-simplification, they can be summarised as follows:

1. Technological strategies are not predetermined by the political system. LDC policy makers therefore need not choose between Eastern and Western models, but are encouraged to evaluate, select, and adapt strategies from both sources.

2. Major elements of similarity between Eastern and Western approaches can be taken as "rules of the game" for establishing a process of technological development:
   - The reinforcement of the science and technology infrastructure
   - The emphasis on linkages between the scientific and production systems
   - The concentration and specialisation of technological efforts
   - The existence of gradually converning technology profiles between East and West

3. There are also major differences in the capabilities of the East and West:
   - The West is better at quantitative innovation, while the East can regulate the transfer of technology more effectively
   - The West is better prepared to establish the rate of innovation ("how much"); the East, its orientation ("what kind" of innovation and "where").

4. Similar objectives for, and orientation of, technological progress in the East and West are leading to converging life-styles.

5. Technological strategies in the East and West are converging along four lines:
   - Sectoral concentration: from basic industry in the East and research-intensive sectors in the West, towards a common profile
   - Diversification: from the highly selective and concentrated (predominantly vertical) technology profiles of the Soviet model and the diversified (largely horizontal) Western profiles, towards a balanced profile

- Moderation of extremes: the closed-centralised systems and open-decentralised systems evolving towards more equilibrated positions
- Supply-demand: from the traditional supply-push Eastern orientations and the demand-pull Western orientations, towards an equilibrium

6. The convergence of technological strategies between East and West shows LDC policy makers the danger of extreme positions but also the advantage of following equilibrated orientations in the establishment of technological development strategies and technology profiles.

7. Low levels of development require greater measures of interventionism and protectionism. Countries gradually move along a path of "technologisation" away from earlier periods of interventionism and protectionism towards more decentralised and open approaches. This evolution is accompanied by a shift from predominantly concentrated industrial approaches towards more diversified ones.

8. Larger, more developed economies are tending towards greater diversification, while smaller, less developed economies are tending towards specialisation. For LDCs, this means that policy makers should select a path that will bring them to the "fully technologised" stage with a balanced profile appropriate to the size of the economy. The author found the Japanese model particularly applicable to LDCs, since it followed a "middle-of-the-road" approach and maintained a balance between horizontal and vertical components of its technology profiles.

The ninth conclusion draws together the elements of the first eight in proposing a set of four components of an evolutionary strategy for "technologisation":

a) Regulation of technology imports in order to move from a position of dependence on foreign technology towards increased self-reliance through imitative, defensive, and offensive strategies

b) Maintenance of a balanced "vertical-horizontal" technology profile that equilibrates industrial diversification and selectivity

c) Progressive buildup of the national technology capability (to enlarge the "horizontal" component).

d) Evolution of sectors of specialisation towards increased technological complexity and intensity (to select the "vertical" components)

The four components are then analysed from the point of view of an LDC policy maker, and a series of major suggestions are presented for their implementation. These are:

a) Effective institutional linkages between the foreign technology regulating mechanisms and the science and technology infrastructure should be established, in order that technology evaluation be incorporated into the decision-making process.

b) Developing countries should simultaneously improve their horizontal technological capacity and concentrate on one or two "easy" sectors, gradually specialising in more complex technological sectors as they add progressively more specialities and upgrade their horizontal base.

c) They should build up the horizontal component of their technology base with a gradual increase in technical skills: from technicians, to basic engineering, to industrial engineering and management, to design and consultancy and, finally, from adaptive to innovative research.

d) Their technological vertical component should be built up through gradual entry into fields of increasing technological complexity by selecting those fields that can be mastered at the current level of development of the country.

The tenth conclusion sets the stage for the final one by briefly summarising the major results of the country-by-country analysis and posing the question, "What sort of strategy can be established from these results, to suit the needs of the least developed countries?"

The eleventh conclusion answers the preceding question by providing six general guide-lines for an evolutionary technological development strategy for LDCs:

a) Start out following in interventionist protectionist, selective path, and subsequently initiate a progressive liberalisation process appropriate to the size of the country and the potential of its economy.

b) Evolve gradually in the use of foreign technology through dependent, imitative, defensive, and offensive stages, while matching the technological resources required with the technological development levels achieved and the technological development strategies to be followed.

c) Move progressively away from technological dependence by building gradually the technological capability of the country. To this end, technological resources must be incorporated into the technology decision-making process to implement the corresponding alternative strategies. At the same time, importation of foreign technology must be regulated and internal technology stimulated.

d) Build up an evolutionary technological development strategy by gradually establishing a balanced technology profile: the "horizontal component" should be concentrated on the critical technological skills required for improving technological capability, while the "vertical component" should be gradually concentrated in those sectors of increasing technological complexity as indicated by the balanced supply-push (technological capability) and demand-pull (technological market) of the country.

e) Follow the evolutionary strategy through the concept of a technology spiral, to breakaway from the "vicious circles" of technological dependence. Note that such a strategy can be applied on any scale, from sectoral to international.

f) The final element of the last conclusion provides a fitting closing remark: it stresses the intellectual and operational interest of comparing and combining Eastern and Western approaches to identify those elements and components of the national strategies that are of direct relevance to the LDCs."

4. FORGING THE LINKS: A TECHNOLOGY POLICY FOR CANADA[4]

(a) Method of Preparation

This report is another Committee document. It was prepared by the Industrial Policies Committee of the Canadian Science Council and consists of a set of recommendations to the Canadian Government. It is not the official policy of the country. The report took 3 years to prepare, and in the process a number of more detailed studies were commissioned. These resulted in two further Science Council reports on the problems of Canadian manufacturing industry , and their technological implications [5, 6].

The Committee made recommendations to three sets of policy makers - those in the Federal and Provincial Governments, and those in Canadian industry.

4. Science Council of Canada, Report 29. Forging the Links: A Technology Policy for Canada. 1979.
5. Science Council of Canada, Uncertain Prospects: Canadian Manufacturing Industry 1971-1977, 1977
6. Science Council of Canada, J.M. Gilmour and J.N.H. Britton, The Weakest Link: A Technological Perspective on Canadian Industrial Underdevelopment, 1978.

The report starts by identifying the problems of the Canadian economy which it considers are mainly those of unemployment, trade imbalance and a falling currency. This is followed by a more detailed analysis of industry and a thorough diagnosis of the technological issues. Only then does it go on to make recommendations.

(b) The Main Results

The Committee point out that because so much of industry in Canada is foreign owned it is highly truncated. This results in a low demand for local technology, and in effect Canada does not have sufficient control over its life blood industry. This is a familiar enough story for many developing countries. The proposed Science Council solution of a strategy based on Technological Sovereignty also sounds remarkably like the strategies of Technological Self-Reliance that are so frequently heard in the Third World.

The Science Council Committee urged that policies should be enacted which would

1) Increase the demand for Canadian Technology
2) Expand Canadian capability to develop its own technology
3) Strengthen the capacity of firms to absorb technology
4) Increase the ability of Canadian firms to import technology on terms which are favourable to Canada.

Without such policies the Committee argues that Canadian industry will be unable to innovate and without innovation it will become increasingly uncompetitive.

However, one of the main messages to come from the report was the recognition that technological issues and technology policy for industry

cannot be considered in isolation from industrial policy nor that from more general economic policies.

The report is similar to those previously discussed in that it represents a synthesis of a large number of detailed empirical studies which helped the authors in making a thorough diagnosis of the existing situation, before policy recommendations were made

IMPLICATIONS FOR THE ARAB STATES

The four studies and reports referred to above are presented merely as 'samplers' of recent technology policy research which has been done - for the most part outside the Arab States.* Other examples will be presented by other authors at this conference. What relevance - if any - does all of this work have for policy makers and policy researchers in the Arab States? Can the knowledge which has been researched and written about be of immediate use to those responsible for formulating technology policy in other parts of the world?

I believe these studies do have a very definite value, even though most of the problems of industry in the Arab States are very different from those facing Canada, the OECD, or even most of the STPI teams. I would suggest at the most general level the evidence from these recent studies suggests a number of conclusions with universal applicability:

1. The formulation of a technology policy in isolation from economic and industrial policies is not likely to have much effect. There must be much closer links between decisions about technology and the general decisions about industry and the economy.

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* The exception was Egypt which participated in the STPI Project

2. Both policies and strategies must deal with both the supply of technical knowledge as well as help to create the demand for technical change.

3. General policies which apply to industry as a whole are rarely as effective as those which refer to specific industrial sectors - (or branches).

The reports also contain a wealth of more detailed information which is not easily summarised, but which would be of value to a policy maker concerned with specific issues. However, despite the relevance of some of the material, the specific experience of different countries is not directly transferable to the Arab States. The economic, political and geographical conditions are greatly different. What is transferable, however, is the approach to diagnosis of problems and the methodologies which are developed for carrying out technology policy research. It is then possible to use the knowledge generated to formulate policies appropriate to the local situation. This may seem self evident, but neither the assimilation of work and studies done elsewhere, nor the diagnosis and analysis of local problems can be carried out without the existence of a local technology policy research capability. To what extent does this capability currently exist in the Arab States and how best can it be further developed? It is to this last question that the remainder of this paper will be devoted.

The OECD report also illustrated the extremely important catalytic and synthesis roles that can be played by an international organisation in this area. There appears to be no similar body which has played an equally effective role for the Arab States. UNESCO, UNCTAD, UNIDO and ILO would all claim to be able to play such a role, and their contributions have been important, but their mandates prevent them from covering the entire spectrum of issues.

The Development of Technology Policy Research Capability in the Arab States

There do exist teams and individuals in several Arab States that have already been engaged in the sort of studies and analyses referred to in this paper. I have not done a systematic survey, but I personally know of individuals and groups in Egypt, Jordon, Iraq and Kuwait who have carried out technology policy research. However, by comparison with other regions of the world, the cadre of researchers in the Arab States appears to be few.

There appear to be five essential ingredients for any successful technology policy research activity. And here success is defined not only in terms of the academic excellence of the work, but also in the ability to interact with and influence policy makers. These ingredients are:

1. A group of policy makers who are aware of their need for a deeper understanding of the technology issue as it relates to their own decision making. Without such a group there will be no demand for the results of policy research and any studies which are done are likely to have little impact.

2. An institutional base where the research can be carried out. One of the characteristics in technology policy research is that it is on interdisciplinary activity. It requires the combined skills of both natural and social scientists, as well as access to library facilities and sources of information.

   There is no single institution which is in some sense best. Universities have the advantages of being able to field interdisciplinary teams, but often have problems of access to data. Science Councils

have sometimes provided a base for this sort of work - but their analyses tend to be discounted by economic planners since they are sometimes seen as representing a vested interest - i.e. the wellbeing of the scientific community. Scientific societies, (such as the Royal Jordonian Scientific Society) or research institutes (such as the Kuwait Institute for Scientific Research) can also be the base for technology policy research.

What seems to be more important than the location of the base is the ability to enable a few people from different disciplines to work together on a full-time basis for periods of up to two to three years.

3. A cadre of trained researchers. Researchers in this area have usually obtained their first degree in some other subject - which may be a science or technology degree, or somewhat more frequently in one of the social sciences. Most require some form of further training which introduces them to the interdisciplinary aspects of technology policy research and to the previous literature on the subject. ECWA could play an important role in organising such training courses.

4. A programme of research. A programme of research needs to be drawn up by a process of consultation between policy researchers and policy makers. This programme should reflect local priorities, but it should also reflect the work which has been carried on elsewhere.

5. The final ingredient is money. Without the allocation of financial resources it will not be possible for the other four ingredients to

be blended together into an integrated whole. Without it, there can be no successful technology policy research activity. The necessary funds will most likely come from national sources, but international organisations can help.

It will be for the conference to discuss the ways in which the Arab States, and their regional organisations, should build up their local technology policy research capability. The role of other agencies in this endeavour should also be discussed. The need for an enhanced capability is clear. It represents an essential component of scientific and technological self-reliance and without it the Arab States will not only have difficulty in analysing their own problems, they will also have no adequate means of evaluating work done elsewhere.