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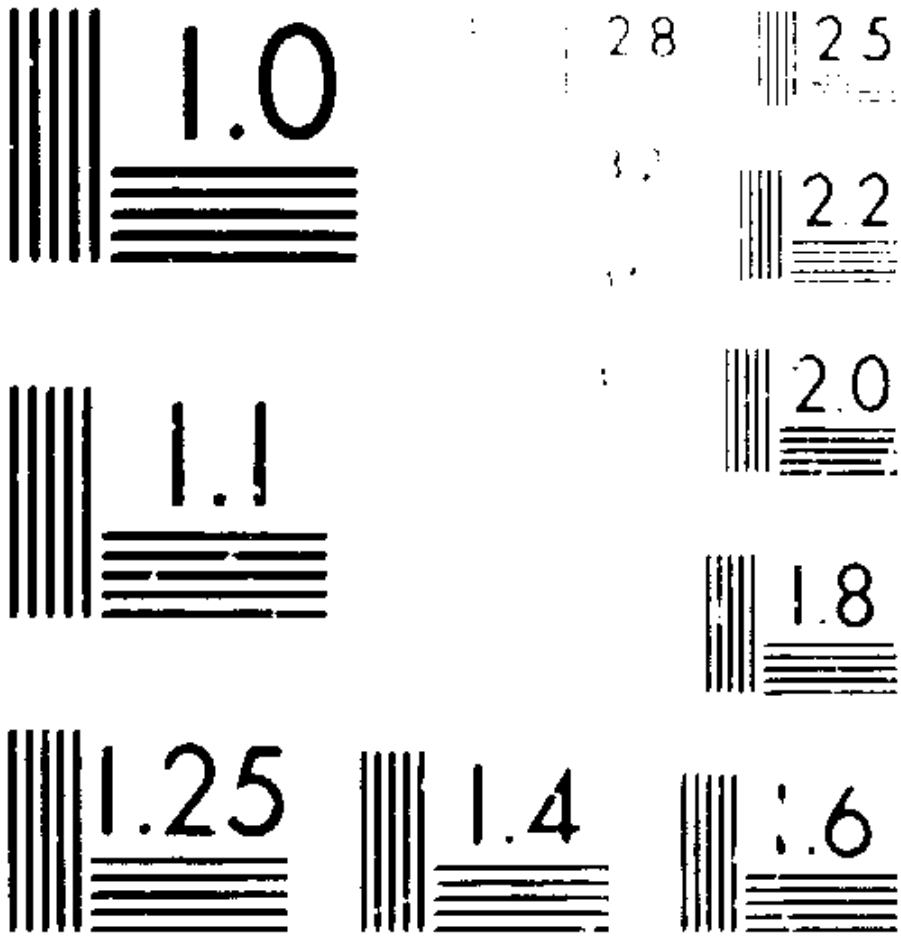
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POLICY RESPONSES TO TECHNOLOGICAL ADVANCES*

Some Illustrative Cases

Note by
UNIDO Secretariat

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Contents

INTRODUCTION

1. This paper attempts to describe illustratively selected types of policy responses of governments, individually or in groups, to emerging technological advances. No attempt is made to be exhaustive or to analyse or critically evaluate the responses. The emphasis is not on technology policies in general but on those aspects of policy which constitute the response to emerging and anticipated technological advances. Such response usually involves assumptions about the future.

2. In what follows, the policy responses by governments or groups of governments will be discussed under three headings:

(a) Attempts to look at the future in the context of development as a whole;

(b) Policy responses based on institutionalized or integrated approaches to technological change; and

(c) Policy responses to selected advances.

Some general remarks will be made in conclusion.

I. ASSESSMENT OF FUTURE DEVELOPMENT TRENDS

3. Many such assessments have been made and those that are mentioned here are meant to be illustrative as being particularly commissioned by or addressed to policy makers.

4. One example at the national level is the global report on the year 2000, commissioned by the President of the United States.[1/] At the level of groups of governments one illustration is provided by the

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1/ The Global 2000, Report to the President of the United States. (Pergamon Press, New York, 1980). This was concerned essentially with population, natural resources and environment.

Interfutures Project of the OECD. [2] 19 OECD members and the Commission of European Communities contributed to the project which was established in 1976, following an initiative of the Government of Japan to study the future development of advanced industrial societies in harmony with that of developing countries. The primary purpose of the project was to provide OECD member governments with an assessment of alternative patterns of longer term world-economic development in order to clarify their implications for the strategic policy choices open to them in the management of their own economies in relationships among them and in their relationshsips with developing countries. The project, which ran for a period of three years, resulted in a report which was based on the research of an international team, guided by an advisory panel of eminent persons and a steering committee in which all contributing governments were represented.

5. The assessments referred to above and other assessments that have taken place do not in general deal with technological change. Technology is generally taken as a constant, and where technological changes are mentioned, they are not integrated as a dynamic element altering the pattern of industrial and economic development. [3] The emphasis is, understandably, more on demography, food and energy prospects and possible limits to growth. The contribution that technology could make as a dynamic instrument to alter or modify the prospects, has not been considered.

6. There are, however, some exceptions. At the national level an exercise done in the state of Quebec, Canada, by le Groupe Québecois

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2/ Facing the Future: Mastering the Probable and Managing the Unpredictable, (OECD, 1979);

3/ Based on Groping in the Dark: The First Decade of Global Modelling (by Donella Meadows, John Richardson and Gerhart Bruckmann (John Wiley and Sons, 1982), the following two views among modellers on technology is reported: (i)"It is unpredictable. Assume it is constant. It is a general, increasing tendency of an economy to use its resources more and more productively. It is the most important determinant of the future." (ii) "It is unpredictable. Assume it makes any problem easier to solve exponentially over time. It is very specific to certain sectors and problems, it progresses in spurts, it costs money, takes time, and produces bad side effects. It is really pretty irrelevant to the future." (Options, International Institute for Applied Systems Analysis, Spring 1982, p. 16)

de prospective deserves mention. [4/] The exercise (in 27 volumes, published by the government publisher of Quebec) attempts to look at the future of the Quebec society. Scenarios were built up in several fields such as external relations, the economy, ecology, technology, and urban and regional aspects. A special study on the subsystem of technology was made in this connection by a group involving five universities.[5/] The features of the exercise were a perspective approach; systems analysis; the possibility of utilizing the results for strategy formulation;and interdisciplinarity. The work done under the subsystem of technology dealt with aspects, such as resource formation, energy, availability of materials, environment and technology development and indicated tasks for the future in these areas as well as in selected industrial sectors. Recommendations were also made for policies and strategies.

7. A recent effort in Spain may also be mentioned. [6/] Under the auspices of the Instituto Nacional de Prospectiva of the Government, a study was completed in 1980 on Spain in the Eighties by a task force of consultants, and oriented by a committee of general directors from 10 different ministries.

8. The Final Report of the study includes:

(a) A chapter on the long-term social and economic goals of the country and the two specific challenges of the eighties (the entrance into the Common Market and the development of autonomous powers for the regions);

(b) A study of past trends, both in the outside environment of the country and in the internal socio-economic factors;

(c) An analysis of three scenarios of alternative futures (partly tested with an economic simulation model) and of their possible consequences; this analysis is followed by a study of future problems;

(d) A final chapter on possible policies of the public sector compatible with the long-term objectives derived from the study of future problems.

4/ See 'Le future du Québec au conditionnel' (Gaetan Morin Editeur, 1982);

5/ Prospective socio-économique du Québec, lère étape, Sous-système technologique (Office de planification et de developpement du Québec, 1977);

6/ Felix Alvarez-Miranda and Emilio Fontela, "Futures Research and Policy Formulation: The Spanish experience" in Futures, December 1980.

The publication of this study, shortly after the publication of the Spanish translation of the report of Interfutures and of the three EEC reports on the future of Europe, has contributed to a public debate on long-term issues of great importance for Spanish society.

9. In the study, the problem of technological advances was not considered as such. But the problem of developing appropriate national technology for local use or for export was considered as one of fourteen problems.

10. The cases mentioned above did not result in, and were not intended to result in, one single, well-ordered package of policy measures but served more to provide policy-makers with essential information for decisions about the future.

II. INSTITUTIONALIZED OR INTEGRATED APPROACHES TO TECHNOLOGICAL CHANGE

11. We may begin with a few cases of institutions dealing with technology and the future. In France, in the Commissariat au Plan there is a Centre d'Etudes Prospectives et d'Information Internationales. In the United States, the Office of Technology Assessment was established by the Congress to provide committees with analytical assistance on difficult issues, which involve science and technology. Governed by a bipartisan, bicameral, congressional board, the office which has a multidisciplinary staff, provides a variety of services to the Congress on a broad range of issues. It makes technical findings, identifies and describes options, but does not advocate particular policies. In Japan, the chief media for policy-making have been the industrial committees of MITI, where civil servants and industrialists meet to decide on future strategies and on the means required for reaching the goals agreed upon.

12. Cases of more integrated approaches to technological change could be cited. One case is the establishment of a committee of inquiry into technological change in Australia, which submitted its report in 1980 to the Prime Minister.[7/] A three-member committee was established in 1978, with the following terms of reference:

> "To examine, report and make recommendations on the process of technological change in Australian industry in order to maximise economic, social and other benefits and minimise any possible adverse consequences.
>
> In particular the Committee would:
>
> (a) identify:
>
> (i) technological change which is occurring or is likely to occur in Australia;
>
> (ii) new technologies which have the potential for substantial impact in Australia;
>
> and conduct detailed studies of those areas identified as the most important in order to evaluate the likely effects;
>
> (b) examine relevant overseas experience and studies of technological change, and assess mechanisms used to introduce and evaluate new technologies;
>
> (c) review the effectiveness of government policies and programs in facilitating the introduction of new technology."

13. The Secretariat of the Committee included members seconded from several government departments and it did much of the analytical work. Some specific tasks were undertaken by outside individuals and organizations under contract. 258 submissions were received in response to invitations by advertisements in the national press and 80 public hearings were held. Members of the Committee also visited other countries and had discussions with a variety of institutions,

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7/ Technological change in Australia, 4 vols, (Australian Government Publishing House, Canberra, 1980)

both governmental and non-governmental. The Committee addressed its terms of reference in the context of a number of broad values and goals that it believed are generally shared within the Australian community. It made a series of recommendations concerning technological change and people; technology development; and monitoring and evaluating technological change. In making its recommendations, it considered a series of technological advances, such as microelectronics, information technology, genetic engineering and biology; new materials; robots; and energy technologies. These advances were considered in relation to sectors, viz. agriculture, mining and metals, manufacturing, building and construction, public administration and commerce, transport, communications, community services, defence and households.

14. Another case of an attempt to formulate an integrated policy for technological change is provided by Mexico through a project to establish a National System of Technology Perspectives. This project is executed by UNIDO with funding from the United Nations Financing System for Science and Technology for Development. The intention of the Mexican government is to design, organize and put into action a permanent national team in the field of industrial technology prospectives to assist the government in the formulation and implementation of development plans and policies, in particular regarding industrial development. The preparatory activities will involve, inter alia, an assessment of the experience in this field as well as the policies and industrial strategies adopted by developed and developing countries and their relevance to Mexican conditions and requirements.

15. The background to the project is the following. The Government of Mexico, which has already defined in its global development plan and its industrial plan the prospectives for accelerated growth of the industrial sector in the coming years, came to the conclusion that in view of the rapid technological developments taking place in the world, systematic activities in the field of technological prospectives is needed in order to incorporate the knowledge with regard to trends and tendencies in development of the world-economy into national strategic decision-making in the future as well as to provide Mexico with the

necessary technological readiness to react to unanticipated developments. The activity is therefore designed as a policy and strategy-oriented one so that its outputs could assist the government in its decision, inter alia, in the fields of:

(a) industrial policies and strategies;
(b) long-term technological policies;
(c) commercial and trade policies; and
(d) investments in large strategic projects.

Selected sectors will also be studied in regard to the future trends in both technology and international trade.

16. At the group-level, the importance of emerging technologies has been noted by the European Economic Summit in 1982. At a more institutionalized level, the FAST (Forecasting and Assessment in the Field of Science and Technology) Programme of the Commission of the European Communities may be mentioned. This Programme was launched in early 1970 for an experimental period of five years, following a decision of the Council of Ministers of the European Communities. The main objective of this research programme is to help to define long-term R + D objectives and priorities and thus to promote the development of a consistent R + D policy. In order to achieve this, the FAST Programme is intended in particular to highlight the possibilities, problems and potential conflicts that are liable to affect the communities' long-term development and propose alternative courses for R + D policy to help solve these problems or to render concrete these possibilities. A team of six researchers has adopted a study framework that respects the plurality of team horizons and reviews R + D activities in certain priority areas that could either directly or indirectly

- have repercussions on work and employment;
- prepare for the information society:
- seize the opportunities provided by the biosocity.

The time horizons for the three elements above are considered to be ten, twenty and thirty years. The subprogramme on work an employment has some

11 research projects, involving 25 centres, and that on biosociety 12 research activities involving eleven centres formally and a larger number in terms of an informal network. About 60 per cent of the costs are met by the Commission of the European Communities and the rest from a variety of institutions in the member states.

III. POLICY RESPONSES TO SELECTED ADVANCES

17. It will be useful to review such actions briefly. Illustrations of policy responses to microelectronics and genetic engineering and biotechnology are provided below.

Microelectronics[8/]

18. Following, among other things, the report of the Advisory Council for Applied Research and Development (ACARD), the Government of the United Kingdom has undertaken a microelectronics drive, with £400 million in public funds, devoted to the microelectronics industry support programme (£70 million) to stimulate production; the software products scheme; the school's awareness project; and the microprocessor applications project (£55 million), administered through the Department of Industry. In addition, a further £250 million are channelled through the National Enterprise Board. The Government of the United Kingdom has put into operation a four-point programme comprising:

(i) an awareness campaign with the aim of reaching 50,000 key decision-makers in three years;

(ii) a concentrated programme for education and training;

(iii) direct support to industry, including support to manufacture of electronic components and use of microelectronics in factories and offices; industrial awareness and training and feasibility studies and consultancy support for public procurement;

(iv) public procurement.

8/ See "Implications of microelectronics for developing countries: A preliminary overview of issues", UNIDO/IS.246.

19. The Government of the United Kingdom has declared 1982 as the Information Technology Year. Government budget allocations to information technology span the areas of: [9] robotics; CAD/CAM, CAD MAT; MAP, micros in schools [10]; software products scheme; IT training centres; fibre optics; health; microelectronics industry support programme; space technology; IT equipment and systems; and capital allowances for purchase of teletext and view data televisions.

20. The practice of the Government of the United States is to support the microelectronics industry in two ways, namely, through:

(i) procurement;

(ii) direct support for devices to meet defence requirements.

The support of the Government of the Federal Republic of Germany appears to be essentially through funding of R + D.

20. As far back as 1971 Japan adopted a national policy for the promotion of selected industries including microelectronics, defined the parameters of the promotion plan, laid down guidelines for production technology and rationalized the production. The promotion plan involved:

(i) financial aid for research and development of major technologies;

(ii) financing projects for improvement of production technology and rationalization of production.

Up to 1977, over 21 areas had been promoted in the semi-conductor industry, involving over 60 different projects.[11]

9/ See "Microelectronics and Government policies: the case of a developed country" by Ernest Braun, Kurt Hoffman and Ian Miles (UNIDO, ID/WG.372/2);

10/ Every secondary school is entitled to half the cost of one of two machines, the BBC computer or the Research Machines 380 z. By the end of 1982 all schools are expected to have advantage of this scheme. (Microelectronics Monitor, Issue 3, page 35);

11/ The Japanese strategy is considered as an "offensive" catching up strategy, continuously acting upon variables like licensing policies and international transfer of technology, international trade, direct foreign investment, and the size and technological strength of domestic companies, in order to reduce technological and commercial lag times. "Japanese electronics policy can be summarized in three propositions: a country's position in the international division of labour need not be accepted but can be conquered; what is thought good for the country has to be made profitable for the companies; market competition is a powerful stimulus as long as it occurs among national companies on foreign markets" (p. 199, Giovanni Dosi, "Institutions and Markets in High Technology: Government support for micro-electronics in Europe" in Industrial Policy and Innovation, ed. Charles Carter, Heinemann, London, 1981)

21. Starting from 1977, when it decided to take action to encourage development, production and use of integrated circuits, the French Government has undertaken to:

(i) inform industry about the ways in which microelectronics could improve the products;

(ii) facilitate training in microelectronics for managers and engineers in the firms concerned, to enable them both to communicate with component manufacturers and to master the utilization of microelectronics;

(iii) promote the creation of specialist agencies in microelectronics applications which will play the same role as computer service and consultancy companies.

The French Government also set up a special Electronics Channel Commission to obtain guidelines for its ambitious five-year microelectronics plan. It has also promoted the establishment of a World Centre for computer science and the development of human resources.

22. In Ireland, the National Board for Science and Technology has undertaken a major study on the trends in microelectronics technology and its applications and to assess its impact on the Irish economy over the period up to 1990. The agriculture, industry and services sectors have been investigated with regard to specific activities in each of them. The policy issues being examined include:

- education and training;
- re-training;
- promotion awareness;
- infrastructural requirements;
- consultation with workers; and
- planning.

23. Work on the study was of two kinds. On the one hand, relevant literature from a wide range of international sources was collected and reviewed, and the policies and programmes of governments, inter-governmental bodies and other institutions examined. On the other hand, a number of detailed studies of the economy were carried out, at a sectoral level, to establish the rate of uptake of microelectronic

technology, and the effects that it would have. A consultative committee representing industry, trade unions, Government Departments and State Agencies, and the Commission of the European Communities advised on the conduct of the study throughout.

24. In the sense that European nations have also had to adopt a strategy of "catching up", their policy responses are of relevance to developing countries. Their policy instruments could be broadly summed up as: [12/] R and D support through subsidies, research contracts and low interest loans; procurement policies, mainly in the military and telecommunication fields; investment grants, subsidies and transfers on capital account; tariff and non-tariff protection; promotion of structural change (mergers, the constitution of new firms, nationalization, the planning of the areas of activity of individual firms, etc.). Technology policies are tending to become a part of a larger set of structural policies.

25. At a group level, certain activities of the European Economic Community are worth noting. [13/] The EEC has launched a £24 million fund to grant aid research projects in five key areas of microelectronic technology. It will be giving 50 per cent grants to research carried out by firms and universities in the Community. The areas concerned are:

- step and repeat on wafer;
- electron beam for direct-writing on wafer;
- plasma etching and deposition;
- testing equipment;
- computer aided design for Very Large Scale Integration circuitry (VLSI) in the domain of architecture, language and data structure, testing, and device modelling.

26. The regulations also provide for a flow of information from EEC member states to the EEC Commission on progress made in the promotion and development of micro-technology. The aim is to co-ordinate more effectively European effort in the exploitation of microelectronics.

12/ Giovanni Dosi, op. cit.

13/ Information from Microelectronics Monitor, Issues Nos. 2 and 3.

27. The EEC has brought together Europe's major electronic companies to consider a £650 million proposal for pan-European co-operation on electronics research and development. The funding, to be made over the next 10 years, is one of the main proposals to come out of a massive two-and-a-half years study, whose brief was to come up with a plan for a viable European electronics industry by the 1990s. The EEC hopes that by more effectively co-ordinating the European effort a more efficient use of financial resources as well as the better exploitation of existing technologies and future developments will be achieved. Two of the options proposed by the initial study were the setting up of European 'centres of excellence' and joint development projects.

28. Having completed its consultation with industry, the EEC is almost ready to put firm proposals before the European Commission and involving the member states of the Community. There is already a timetable which involves the first phase of the project being launched in January 1983, with full implementation in 1984.

29. In regard to developing countries, a few cases of government programmes on which information is readily available are cited below. The steps taken in Singapore are worth quoting in extenso:

> "To begin with, computer studies as an examination subject will be offered to all A-level students with effect from this year. Over 200 mini and microprocessors will be installed in all secondary and pre-university schools within the next 18months. Teachers have been undergoing training since mid-80 to ensure proper staffing in the schools. The National University of Singapore has revamped its syllabus to include a large element of computing in its curriculum in addition to pure computer science. This will ensure that graduates would be suitably trained to be productive almost immediately. Teaching of computer usage is also included in other disciplines such as engineering, science, business administration, commerce, economics and so forth."

30. "A training institute known as "The Japan Singapore Institute of Systems Technology" will be set up by the end of 1981. This institute, a joint venture between the Japanese and Singapore Governments, will train software personnel for both the large and the mini computer systems. It will also offer training courses for non-computer professionals such as engineers, managers and upgrading courses for existing computer personnel in the market. A second institute known as "The Institute for Systems Studies" will also be set up. The initial objective of this institute is to concentrate its training to basic entry level software personnel but the institute will work closely in future with the National University of Singapore and computing professionals on software at the leading edge of the technology. Computing studies have recently been introduced into the two technical colleges in Singapore. Another two technical colleges are expected to be established by mid 80's and they will have computing included in their curriculum."

31. "On the business side of the coin, various incentives in financial support and tax-holidays will be introduced by the Singapore Government. Purchased computer equipment can be written off against corporate tax over three years. Organizations who send their EDP staff for upgrading courses either in Singapore or overseas could be subsidised by the Government up to a maximum of 70 per cent of the total training cost. Guidelines are being prepared to allow income from software developed in Singapore and marketed overseas tax-holidays or lower rates of tax and Government will also liberalise the issue of professional and employment pases for computer experts who wish to set up offices or work in Singapore." 14/

32. In Brazil, a Special Secretariat of Informatics was established in 1979 with the objective of formulating a strategy for informatics development. A Presidential Decree in 1981 called for the elaboration of a plan for the development of microelectronics. As a result, plans have been developed or are under consideration in several key areas. One concerns the establishment of an R and D institution to lead technological development in the field of microelectronics,

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14/ Robert Iau, "The Computer Knowledge Industry - a Look at the Economic Rationale of a New Phenomenon from the East". Paper prepared for the International Conference on Informatics and Industrial Development, Dublin, March 1981.

working closely with both the universities and industries. Another proposal relates to industry, where two Brazilian companies have prepared a detailed plan of their activities in the field. A systematic approach for the development of microelectronics technology is thus being evolved.

33. In Mexico, a development programme for the manufacture of computer systems, their main modules and peripheral equipment has been formulated. It stipulates, inter alia, formulas for increasing the local technology content (T factor) and requires that 5 per cent of the value of sales in the country of each enterprise in this field should be devoted to R and D.

34. In India, the Electronics Commission of the Government of India maintains a sizable planning group, one of the functions of which is to assess technological trends in industrialized countries and develop appropriate national strategies for dealing with these trends in areas such as microelectronic and photovoltaic technologies. A Technology Development Council, operating through various working groups, concerns itself with overall R and D planning, projects formulation/implementation and their management.

Genetic Engineering and Biotechnology [15/]

35. To realize the potential of biotechnology, several develop ies give priority to three main issues. These are:

(a) Education in basic sciences and training in specific skills;

(b) Stimulation of industrial initiatives via financial support;

(c) Improvement of communication channels among institutions involved (industry, research organizations, universities and governments).

15/ See also "Elements of some national policies for biotechnology" (UNIDO/IS.276/Rev.1).

36. In Canada, the Report of the Task Force on Bio-technology (TFB) to the Minister of State for Science and Technology [16/] recommends that the Federal Government should signify its commitment to bio-technology by establishing a ten year National Bio-technology Development Plan with a long-term development strategy.

37. In regard to education and training the TFB considers that biotechnology will develop and mature only if built on a firm interdisciplinary science base. To create the appropriate climate for industrial growth in biotechnology, the Canadian TFB recommends the establishment of tax credits both for current industrial R and D expenditures and for new investors. To encourage small and medium-size bio-technological industries, direct government assistance is recommended. To promote effective transfer of biotechnological advances from government laboratories to the private sector, specific budgetary allocations are proposed.

38. In the United Kingdom, in March 1981, a white paper on biotechnology was presented to the Parliament.[17/] The white paper emphasized the importance of biotechnology in the British economy and its value in the production of food, pharmaceuticals and industrial chemicals. The fact thst biotechnology reduces the demand for fossil energy was also highlighted. The white paper called for early consideration and action because lead times are long and developments are slow to make an impact.

39. The white paper welcomed the increasing recognition and investment given by private firms, however, it realized that some encouragement from the government was necessary. [18/] The white paper felt that bio-technology should be given high priority among university research activities. Furthermore, it urged that adequate manpower be trained from a variety of backgrounds to deal with the multidisciplinary nature of biotechnology. Safety and health were emphasized, product testing

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16/ "Bio-technology: a Development Plan for Canada", Minister of Supply and Services, Ottawa, February 1981;

17/ Her Majesty's Stationary Office, London, March 1981;

18/ A public sector company called Celltech was formed.

and the control of experiments had to be monitored. International collaboration was encouraged at the industrial, academic and government levels.

40. Several recommendations to the United States Congress can be found in the recent report issued by the Office of Technology Assessment (OTA). 19/ The following is of particular relevance:

(i) Establishment of a new Institute for Bio-technology and creation of interdisciplinary research groups within major universities;

(ii) Stimulation of industrial activities via tax reliefs and other fiscal actions;

(iii) Continued support to Federal Agencies already involved in bio-technology;

(iv) Funding of specific projects;

(v) Improve communications industry and research institutions.

41. In France 20/, the Government released plans in July 1982 which described their aims at giving special support to at least seven disciplines that may be commercially exploited (including genetic engineering, microbiology, enzymology and immunology) and should win a 10 per cent share in the world market by 1990. The core of the plan is a 300 per cent increase in Government support to research organizations. Alongside, it is the Governments's wish to encourage firms to donate more money towards biotechnology research and development. Talks are also under way on international collaboration with other countries, possibly Canada, Japan and the United Kingdom.

19/ Impacts of Applied Genetics (Washington, 1981);

20/ Information on France and FRG is taken from Genetic Engineering and Biotechnology Monitor, Issue nos. 2 and 3.

42. The French Government are anxious to attract more biotechnologists to the field of industry and their campaign includes technology transfer centres, an industrial fellowship scheme, financial incentives and promotion prospects. They will create four technology transfer centres near existing concentrations of research, where scientists will be able to carry out projects with engineers and technologies from local companies. Biotechnology is considered one of the seven priority areas in the research and development budget.

43. The Federal Republic of Germany is aiming at catching up on the biotechnology leaders such as the United States and Japan and plan to nearly double their current annual expenditures by 1985 on genetic, biochemical and microbiological projects. German industry is also expected to more than match the growth rate. Bonn's Research Ministry is involved in drawing up a joint research programme in selected areas of biotechnology (probably in culture collecting and process safety) with the United Kingdom's Department of Industry in efforts to avoid duplication of efforts. Agreements were also being negotiated with Japan and Sweden, and an arrangement has just been renewed with the United States National Institutes of Health for joint cancer-drug research. German companies have entered into ventures with universities in Germany and abroad to fund research. The main aim of both German Government and industrial efforts will be to attract German molecular biologists, bioengineers, chemists, physicists and other scientists involved in biotechnology programmes abroad to return home.

44. Activities have also been initiated in several developing countries but more to promote institutional capability than industry.

45. On a recommendation by the Science Advisory Committee to the Cabinet (SACC), a National Biotechnology Board was established in India in January 1982. The Indian Council for Agricultural Research (ICAR), the Indian Council for Medical Research (ICMR), the Council for Scientific and Industrial Research (CSIR), the Department of Science and Technology, the Department of Electronics and some universities are be represented in the Board. The Board is expected to give a new thrust and initiative to research in biotechnolgoy.

46. National centres are being established in Brazil, India, Mexico and Pakistan.

IV. CONCLUDING REMARKS

47. The foregoing description of illustrative cases shows that policy responses have ranged from sectoral and limited actions to comprehensive assessments, in some cases leading to a measure of public debate. Generally speaking, policy decisions have been evolved on the basis of interdisciplinary assessments involving experts and detailed consultations with industry and other sectors of the economy. Except in a few cases, the assessments are made, once-for-all, with no in-built mechanisms for monitoring.[21/]

48. Two questions arise:

(a) What kind of national approaches should developing countries adopt?

(b) What kind of group action could they take either regionally or globally by way of co-operation among themselves?

49. The problems involved in formulation and implementation of national policy responses should not be oversimplified. Developing countries already suffer from certain weaknesses and shortcomings in regard to technology transfer and development. [22/] These are likely to be aggravated in the case of transfer and development of new technologies. The capacity for selection and acquisition of new technologies requires an information base which can be built up only by assessment of the implications of new technologies with specific reference to national conditions. Otherwise the costs of inappropriate selection of technology

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21/ The inquiry committee on technological change in Australia recommended the encouragement of monitoring and evaluation at enterprise and industry levels and the establishment of a Standing Committee of the Australian Science and Technology Council (ASTEC) with representatives from industry, trade unions, scientists and technologists (from the natural and social sciences) and government, (including state governments). It also suggested a ministerial standing committee on technological change. See Technological Change in Australia, op. cit., vol.1, pp. 198-9. For suggestions on monitoring technological advances and their impact, see also pp. 24-26, UNIDO/ECLA Expert Group Meeting on Implications of Microelectronics for the ECLA Region, ID/WG.372/17.

22/ For a review see pp. 3-9, Development and Transfer of Technology, including the Industrial and Technological Information Bank (ID/B/281).

are bound to be high in view of the wide-ranging social and economic impacts that some of the new technologies are likely to have; and the terms and conditions of its acquisition are bound to be onerous. The actual induction of new technologies will be governed by a number of technical, social and economic factors, involving, inter alia, acceptance of new products and technologies by producers and users. Such acceptance will in turn be governed both by economic and social considerations. The growth of innovations and innovative enterprises will have to be fostered in a socio-economic context.

50. The foregoing means that a national policy response to technological advances has to be integrated both with the technology policy of a country and its industrial and economic policies. The new technologies are also to be integrated in a technological system where a plurality of technologies including traditional technologies exist.

51. The policy response cannot thus be designed on the basis of technological considerations alone. Considering the converging impact of several new technologies, policy responses may have to be undertaken as a part of a larger set of structural policies. Reorientation, and sometimes fundamental revision, of a wide range of policies, such as education and training, may be required, including the general upgrading of the technological level of the population. Both short-term and long-term tasks are obviously involved.

52. In such a context, the starting point for a developing country may be to adopt a framework for national action. Such a framework would require a comprehensive assessment of the likely impact of new technologies on the national situation and the manner in which the new technologies, wherever possible, could be taken as a new opportunity to galvanize national development efforts. In other words, the response should not be totally seen as a defensive response. The approach should also be to see in a positive manner what best could be made out of the new technologies. Once the assessments are

made there must be mechanisms for continuous monitoring and updating. But the actions have to go far beyond assessments. The assessments have to be fed into decision-making channels so that appropriate policies and programmes are initiated over a wide front. Methodologies for developing a framework for national action would need to be evolved.[23/]

53. Group actions may be in the form of exchange of experience and sharing of tasks, such as assessments and monitoring efforts. More importantly, group actions will provide an opportunity for adoption of group strategies. A formal or informal institutional effort in group strategies by developing countries may be required just as several developed countries are also proceeding to adopt group strategies.

54. Developing countries could also enter into co-operation with the developed ones, particularly in those areas of action within the purview of the governments of developed countries. Such co-operation may extend to access to information and institutional services in the public domain and to institutional and financial assistance for education and training. [24/]

55. The developing countries have time and again stressed the need for application of modern technology to solve their development problems. Though the convergence of new technologies now provides an opportunity to develop unique applications to match developing countries' needs and conditions, efforts in that direction are hardly noticeable. A new large-scale effort in this regard has to be mounted. On the other hand, unless they adopt appropriate policy responses, developing countries are not only likely to continue with the same pattern of technology transfer and development which they have had in the past but also they are likely to face a situtation where the existing patterns and the problems they gave rise to will

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23/ cf. UNIDO's contribution to the UNCSTD, "Strengthening the technological capabilities of developing countries: A framework for national action" (A/CONF.81/BP/UNIDO). Such a framework could be revised to include the dimension of technological change .

24/ cf. Ravi Chopra and Ward Morehouse, Frontier Technologies, Developing countries and the United Nations System after Vienna (UNITAR, 1981), p. 65.

be exacerbated, leading to greater technological dependence. Alertness to new technologies has to go hand in hand with serious appraisals. The development of the international technology market in regard to new technologies requires a close watch by the developing countries and their capacities of selection and acquisition of new technologies need to be strengthened. Otherwise, the impact of inappropriate selection and acquisition of technology is likely to be much greater and wide-ranging in the case of new technologies.

56. It would thus appear that in the context of emerging technological advances, concepts of the transfer and development of technology have acquired further dimensions, particularly for the developing countries. To come to grips with these dimensions is the task of technology policy for the 1980s.