



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

20160

59N

R S Ganapathy
Zoltan Szabo

} Consultants

29 January 1993

Industrop. Eff. Ms. Saorain
ICT/TDP/TP/AT

A Group Training Programme on

Management of Technology

1. INTRODUCTION

With growing liberalization and globalization of the economies of developing countries, technology will be a major instrument for industry to gain competitive advantage. Effective management of technology is, thus, a significant national task to promote industrial growth. National capabilities in this area are diffused and fragmented. Education (linked to research and technical assistance) is an important way in which we can build up this capability. This note identifies the rationale for organizing a group training programme on "Management of Technology" by UNIDO and develops the elements of the programme structure. It is intended as a basis for approval with feedback so that the design can be modified and expanded. Section 2 of this note explores the rationale and objectives of the proposed programme. Section 3 links this proposal to related UNIDO efforts in the recent past. Section 4 develops a programme design. Section 5, in conclusion, looks at the implications of the course and the need for related and follow-up efforts in building up a UNIDO Programme on Technology Management in the coming years. Annex 1 outlines a conceptual framework of technology management. Annex 2 outlines the course content (modules) in greater detail. Annex 3 lists the resource material, that can be useful in detailed course design.

2. RATIONALE AND OBJECTIVES

In a broad sense, technology management represents decision making processes and implementation of different kinds, relating to the technology variable in the economy. The tasks in technology management at three levels (viz. policymaking in government, top management in enterprises and chief executives of S&T institutions such as R&D labs, bureau standards, etc.)

are different but they also share a number of similar concerns. The levels constitute the main user groups for the proposed programme. A firm may be concerned with issues like technology choice, acquisition, development or use. A government agency may be concerned with import policy, tax policy, regulation, public expenditure for technological infrastructure, etc. An R & D institution may be concerned with R & D project management, motivation of staff, or commercialization of technology. For a country to use technology effectively, coordination, linkages and synergy of decisions and their implementation at all the three levels will be necessary. This calls for development of knowledge base, analytical methods, and skills as a national capability so that the country can gain access to technology and play a more effective role in world technology markets. Such a capability is inadequate in many countries now and education, research and application projects are important ways of augmenting this capability.

The field of technology management is not mature, nor is there an accepted body of knowledge, methodologies of inquiry, research approaches or paradigms. It is seen by scientific, engineering and management faculty, as lacking in rigour and yet to be fully developed. Practitioners see value in building up a knowledge base in this area, for applications. There have been various attempts by national and international organizations in the organization of short-term or long-term programmes and the programme contents cover a wide field. The need to develop a unique capability, as outlined earlier and to develop this field is thus clear.

Objectives of the Course

1. To enable a set of select participants from industry, government and S&T institutions learn the basic concepts, techniques and skills in technology management in an integrated framework.
2. To develop an understanding of technology management from multiple perspectives of different stakeholders and their linkages.
3. To clarify and develop concepts in technology management and to develop training packages and teaching materials for wider use and to promote the development of technology management capabilities in developing countries.

3. WHY A UNIDO PROGRAMME?

UNIDO has carried out a number of activities in different fields of technology development and promotion, over the years. These include training programmes relating to technology transfer, acquisition and negotiations, financing, technical information, R & D management, investment planning, sectoral industrial development, industrial restructuring, etc. Often, these programmes are accompanied by technical assistance projects, international cooperation, preparation of manuals, information dissemination and networking. Thus, UNIDO has developed over the years, a unique expertise and resource base (teaching materials, concepts, pedagogy, etc.) in technology management. It faces a major, new, contemporary responsibility in assisting developing countries to adjust to the liberalisation and globalisation processes and to build long term capacity for industrial growth, through technology management capabilities. In an era of limited resources, the need to offer a high quality, timely, strategic programme on technology management, building upon its strengths and in response to emerging national requirements, is very high. To offer such a focussed programme with a comparative advantage will be a logical move for UNIDO and a high priority task.

4. PROGRAMME DESIGN

Duration: Two weeks (10 working days)

Language: English

Time: Second half of 1993

Structure: The programme will consist of three parts.

These parts are:

- Part I: Six Core Modules,
- Part II: Three Elective, Advanced Modules, out of a set of six modules, offered in parallel,
- Part III: A small group, integrative project, preparation of a report, its presentation and discussion.

The sequencing of the parts will be:

<u>Days</u>	1	2	3	4	5	6	7	8	9	10
Part I	-----									
Part II						-----				
Part III	-----									

A brief description of the context of the modules follows.

Core Modules

1. Technology and Development:

- Concepts and Definitions: Dimensions of Technology Management
- Socio-economic policy context
- Technology and Environmental Impacts
- Technology policy instruments and Role of Government (Technology Policy - Industrial Policy linkages)
- Economics of Technical Change
- Technology, Competitive Advantage and Industrial Growth
- Infrastructure (science base, incubators, parks, standards, testing, information service, training, etc.)
- Technological Trends and Flows

2. Technology Markets:

- Trade in Technology and Comparative Advantage
- Competition and Market Structure
- Import of Technology and long term industrial development
- Packaging and unpackaging of technology (for internal capability building and multiple sourcing)
- Technological capabilities, Terms of Trade and level playing fields
- Commercial and Non-commercial transfer of technology (acquisition, negotiation, licensing, etc.)
- Access to Markets and Constraints
- Pricing and Costing
- Institutional roles: Equipment suppliers, Consultants et al.

3. Management of Research and Development:

- Goal setting in R&D
- Project Planning and Management
- Organisational structure for R&D and related Technical Services
- Evaluation of R&D output

- Human Resources Management
- External Interfaces: Government, Academic Institutions, Production units (backward and forward linkages)
- Commercialization of Technology (including dual use - civil and military - technology)

4. Technological Innovation:

- The Innovation Types, Chain and Actors
- Technology Transfer Processes
- Innovation at the firm level and its exploitation
- Roles of Design and Applications Engineering
- Forms and Processes of innovation
- National Innovation Systems (linkages among learning, research and production systems)
- Organisational Issues in Innovation
- Alternatives in Innovation Promotion

5. Technology and Corporate Strategy:

- Forecasting, monitoring and assessment of technological environment and opportunities (including technology life cycle issues)
- Corporate Goals and Technology Choices (needs, alternatives, imports, competence/resources, economics, linkages, etc.)
- Technology and other Corporate functions (manufacturing, marketing, personnel, finance, etc.)
- Human Resources Development
- Technology and Total Quality Management
- Technology Management in Small and Medium Enterprises
- Strategic Alliances, Partnerships, Joint ventures and Subcontracting
- Utilization of Technology for Competitive Advantage in a Global, Multicultural Environment

6. Technology and Strategic Planning:

- Principles of Strategic Planning
- Institutional Structure (Government, Industry and S&T institutions), roles and linkages
- Complementary strategies and shared goals among key actors
- International experience (North America, East Asia, and Europe) in Management of Technology
- Resource mobilization and allocation
- Financing and Investment options
- Organizing strategic linkages: competition and collaboration
- Management of large, complex, technological projects.

Elective Modules (three out of six to be chosen by the participants)

1. Technology Information and Analysis:

- Technology Information needs for Industrial Development
- Organization of Information systems and Databases
- Information value and utility enhancement

- Knowledge-based Decisionmaking: Applications
 - Monitoring, Forecasting and Assessment
 - Choice of Technology
 - Environmental Impact Analysis

- Information Resource management
- Technology Communication

- 2. Total Quality Management:
 - Quality control and Management functions
 - Quality and Export markets
 - Quality and Benchmarking
 - Quality management for the subcontracting firm
 - Technology development for Quality
 - Quality and Standards (ISO 9000, etc.)
 - Institutional framework for Quality Management (certification, enforcement, etc)

- 3. Leadership and Human Resources:
 - Planning for Human Resources
 - Creativity and Innovation
 - Managing Interdisciplinary R&D/Project teams
 - Leadership styles and organizational contexts
 - Matrix organizations
 - Motivation
 - Training and Development (knowledge, techniques and skills)
 - Personnel management (selection, appraisal, incentive/disincentive systems, career development)

- 4. Financing and Investment:
 - Financial policies (interest rate, international finance, exchange rate regimes)
 - Alternative financial instruments for Technology development and Use
 - Budgetary resources, Equity, Debt, Internal finance
 - Integrating Technology in Investment Planning
 - Venture Capital and Risk Management
 - Control systems for Technological performance
 - Institutional mechanisms for Technology Financing.

- 5. Management of High Tech Industries:
 - Nature of High Tech (policy framework, sources, flow, trends: biotech, aerospace, materials, informatics, etc.)
 - Entrepreneurship
 - Organizational flexibility and responsiveness to change
 - Manufacturing and Process tech changes
 - Marketing
 - Concurrent engineering

6. Strategies for Government:

- Macroeconomic stability and Technological Innovation
- Developing shared goals with Enterprises
- Infrastructure building (creating a "climate")
- Competition policy
- Regulation (environment, safety, consumer protection, standards, etc.)
- Building alliances and facilitative/promotional roles

Each of the topics will be covered to provide an overview of key issues and concepts. The modules (typically of three sessions each) build on each other and are complementary. There will be three formal class sessions, normally every day, of 70 minutes each. About four to five hours of additional preparatory work (readings, analysis, etc.) and one or two hours of group work per day are necessary. The programme is a demanding one and should be fully residential, for close interaction. To maximise training effectiveness, it would be preferably based in an academic institute, with adequate organisational and physical resources.

Carefully chosen participants (according to rigorous criteria such as leadership, breadth of perspective and demonstrated excellence in technology integration) from Industry, Government and S&T institutions around the world, numbering around 30, will provide considerable learning resources, based on their insights and experiences. Extensive marketing of the programme and perhaps competitive selection of the participants may be necessary. Typically the pedagogy will draw on different learning resources and will consist of:

Concepts/Theory	:	Lecture - discussions
Analysis	:	Problems and Exercises
Experiences	:	Case studies
Practice	:	Group projects and Presentations

The teaching materials for the programme will consist of articles, text of lectures, technical notes, video films, and case studies. Given the unique and original nature of the programme, some of the teaching material (in the form of reviews, case studies etc.) have to be specially prepared.

The faculty for the programme should be chosen carefully and they should form an integrated team along with UNIDO resource persons. A few guest speakers can be invited from industry and government to address the participants in the evenings.

5. CONCLUSIONS AND A PROPOSAL

The proposed UNIDO programme should be unique and differentiated from the other specialized courses in technology management (R & D, Manufacturing Management, Quality Management, Technology Marketing, etc.) offered by academic institutions, consulting groups and even UNIDO itself. Hence, it is designed to be a "niche" course with some comparative advantage. The uniqueness of the course lies in its focus and integration of technology management concerns that exist in a dynamic and synergistic way at three different levels: Government, Industry and S&T institutions. Experience elsewhere shows that if they work in tandem, coordinate their policies and develop institutional linkages, the country, as a whole, can utilize technology for competitive advantage. As the participants and teaching material come from the three groups, in exploring the relevance, interdependence and synergy of issues, the unique character of the programme emerges.

The programme, as it is conceived, is a novel one. Hence, it would take additional resources to design it, make it effective, select appropriate participants and organize it as an integrated effort. It is proposed that the first programme may be an international one focussing on awareness building of contemporary issues and the integration of technology management concerns at different levels. The relative ease of organizing an international programme and the need to pool global resources initially call for such an approach. The first programme can test out ideas and approaches that can be improved later. Its participants could then become champions, promoters and even instructors in similar programmes in their regions/countries. Subsequent programmes can focus at different levels, be regional/subregional/national in character and even be part of larger UNIDO projects of technical assistance in different countries. The modular structure of the first programme lends itself to such different designs in the future. Also, for such diverse programmes, tailored to country needs, different resources can be mobilized, to complement UNIDO resources. Over three to five years, the conceptual basis

can be fully developed and consolidation of the basic documentation for further dissemination can take place.

The following preparatory activities are proposed for the first international programme: The time estimates indicated are approximate and are intervals when the activity can take place.

a) Approval of the project proposal and funding (estimated to cost US\$ 150,000 to cover select teaching material development, faculty fees, travel costs for faculty and some participants, documentation and administration). Additional funding may be sought from donors and some participants as programme fees, as needed. (Time: 0-2 months)

b) Identification of existing faculty and UNIDO resource persons to develop the modules in detail including a few fresh case studies, review papers (Time: 0-3 months)

c) Organisation of an international survey to collect teaching material from and assess existing international programmes in technology management (through postal questionnaires as well as few select visits/study tours. (Time: 0-3 months).

d) Assessment of the massive UNIDO (in various branches) and UN system documentation that exists in Vienna for suitability of use (if necessary with some conversion/value addition) as teaching/reference material for the programme (Time: 0-3 months)

e) Preparation and consolidation of all teaching materials, programme design, and documentation. (Time: 4-5 months)

f) Identification and confirmation of participants (from all three levels) through a rigorous selection process with the assistance of an advertisement in a magazine such as The Economist and UNIDO national focal points. UNIDO may offer to some participants, fellowships to cover all costs of participation, based on demonstrated need and merit. (Time: 2-3 months)

g) Identification of a collaborating academic institution in a developing country (a potential centre of excellence) with adequate infrastructure and some faculty to locate and run the programme as a world

class effort. The institution should offer some physical resources, support personnel and facilities as their contribution to the programme (Time: 2-4 months).

h) Organisation of the Programme (7th month)

i) Finalisation of the Programme report, Evaluation and Follow up measures as well as a clear formulation of a UNIDO programme on Technology management (Time: 8-9 months).

As discussed earlier, the first programme represents the initial endeavour in a series of interrelated measures in a focussed manner with synergy, complementarity and integration with past and ongoing efforts. To sum up, what is proposed here is a precursor to a strategy for a UNIDO Programme in Technology Management, consisting of a set of training programmes, research and teaching material development, publications, information services, advisory services, communications, networking, technical assistance and national projects, leveraging UNIDO and national resources.

MANAGEMENT OF TECHNOLOGY: A CONCEPTUAL FRAMEWORK1. INTRODUCTION

Industrial technology has developed at an accelerated pace during the last few decades, based in vast human and financial resources devoted to it mainly in developed countries and impelled also by big jumps in the advance of science and its applications to technology. A strong competitive environment created the demand for constantly renewed products and process technologies. Thus, technology became a major instrument for industry to gain competitive advantage.

Meanwhile heavily protected markets, frequent occurrence of oligopolic tendencies of the local market, and models of closed or half closed economies that used to be dominant in most developing countries kept them lagging in the process of technical change. But recent global and national developments and new convictions prevailing in these countries' policies have changed the situation, leading to a new environment in them; to a new situation in which the needs of a stronger integration to the world economy and the need of improving positions in the international division of labor are commanding.

This new situation has put in the forefront the issue of economic competition and attainment of competitive advantages, and also the use of technology in the pursuit of this purpose. In the new market-friendly economic policy environment of developing countries too, the role of technology is critical in product and process innovations, cost reduction, resource and energy conservation, performance improvement, and in meeting basic needs.

Imperatives of efficiency criteria call for a rational use of resources while taking advantage of improved and new technologies in the industrial sector, and more so in developing countries where financial means and human resources are scarce. Effective management of technology is, thus, a significant task in promoting industrial growth and competitive capabilities.

This note describes briefly - in Section 2 - the new economic environment that calls for strengthening the management of technology in developing countries at all levels: nationally, in their infrastructure facilities, and, specially, at the enterprise.

Section 3 concentrates on the linkages through which different levels of the national technology system interact. This is done so that the concept of technology management and of its objectives and tasks can be shown - in Section 4 - at different levels of the national technology system, and be put in the context and perspective of the main thrust of national industrial and technology policies, consistent with an increasingly liberalized and globalized economic environment.

2. THE NEW ECONOMIC ENVIRONMENT

Policy makers at all levels and entrepreneurs face now a changed economic environment, which calls for new directions. They have to adapt to a globalized world economy; the reality of large regional and subregional blocs of economic integration (common markets, free trade zones, etc.); national economies under the effects of a pervasive trade liberalization process; and a pattern of global growth that has tended to lose momentum worldwide due to structural causes and factors of conjuncture.

These new elements create radically new conditions that bear heavily on the economic life of all countries and specially on the development prospects of developing countries, mostly through the balances of their external sector, in trade and investment. The external trade balance and positive investment flows are strongly related and dependent on the capabilities of enterprises to withstand competition in the national market and to attain, maintain and increase market shares in external markets. Thus the issue of competitiveness - in international as well as in the domestic market - become paramount.

The main avenues of competition - low and reduced costs of factors and inputs, process improvement and product diversification and improvement - have been thoroughly studied and the tight limits of strategies based on reduced factor costs only has been established; only strategies of process and product improvements and product diversification can create and maintain sustained competitive advantages in the medium and long range.

These strategies require a supply of technology assets either from international or domestic sources. Although the importance of international sources increases with the globalization of all markets, the market of technology is, typically, not a level playing field, for developing countries. Recent trends in flows of technology, trade and investment indicate growing concentration among industrialized countries, restrictive trade practices, emergence of trade blocs, and adverse terms of trade for developing countries. Hence, the importance of competitiveness and the potential of technology for its achievement.

With the major macroeconomic balances assured - inflation well checked, stable growth, adequate exchange rates, investment and consumption in balance, etc. -, which is a sometimes difficult but always necessary condition expected of the economic policies of the government, real competitive advantages can be developed in specific industries and in specific enterprises or groups of them in those industries. Thus, in relation with the technology variable and its management, the action should be centered in the enterprise itself and in public policies stimulating their technological development where needed, including the area of creating or upgrading their capabilities for technology management.

3. THE NATIONAL TECHNOLOGY SYSTEM

The effective management of technology, for national competitive advantages, thus, call for actions that correspond to different institutional levels which present great variety in their nature. The distribution of actions among the wide range of actors of the technology management process can be explored with reference to the levels of 1) government policy making, (2)

technology infrastructure institutions, and (3) enterprises. These levels together with all the linkages and interactions among the entities composing them represent the technology system of a country.

Figure 1, below, shows schematically the elements of a simplified model of the national technology system. The linkages and interactions are signalled by flows of information, technology resources and finance.

With the new economic environment described in the former Section, the requirements of technology for achieving national competitiveness and competitive advantages present themselves as a guiding line for the level of national technology policy making, while this policy may take into account other national and social objectives as well, according to national circumstances and priorities, including those of occupational policies, general welfare aspects, and others.

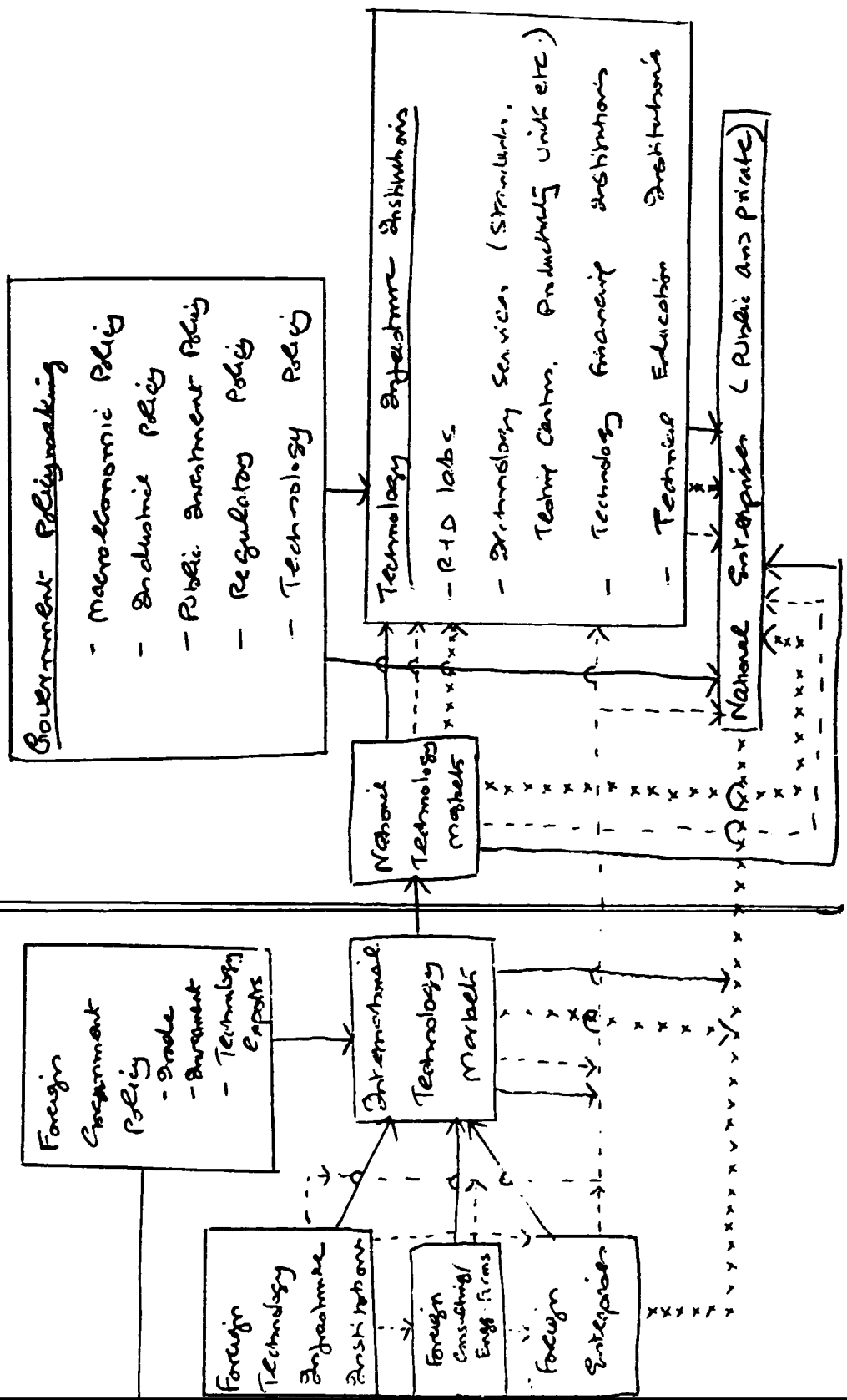
At the next level of the technology system, from top to bottom, the development potential of competitive advantages has to be enhanced by strengthening the national science and technology infrastructure. This should include, among other high priority elements, well oriented research and development centres, be they independent of the academic sector or working within it.

The need of the strongest linkage of the activities of these centres with the needs of the national manufacturing sector has to be underlined, pointing out that as for today great weaknesses can be observed in this aspect of the national technology system of most developing countries. Worldwide experience indicates that investments in R and D, to be productive, have to be accompanied by investments in complementing assets, i.e. manufacturing, quality assurance, marketing, human resources, etc. Often, these linkages are ignored.

The extent and adequacy of this linkages depends equally of the orientation and management of the research and development centre and of the strength and orientation of the technology management applied by the enterprise sector. The onus for solving this problem - together with several other outstanding problems

Figure 1

THE NATIONAL TECHNOLOGY SYSTEM



Legend: 1. → Influencing behaviour through policy and action
 2. - - -> Flow of technological resources (knowhow, information, technical advice etc.)
 3. x x x -> Flow of finances

that may be identified in the systems as observed in specific countries - should be shared by programmes of development and diffusion of national technology management.

An overview of the priority, scale and the distribution of actions needed considering other angles is also facilitated with the vision of the whole system in mind. The major issues of a priority list can be considered in the following way:

Actions are needed, first of all, for creating awareness of the need for technology management, dissemination of its concepts and techniques, and training in its applications. Different institutions of the national technology system - productivity centres, industrial technology institutes, technology financing institutes such as capital goods financing funds, research and development and industrial technology service centres, institutes of industrial promotion, management centers and others - are often proficient in performing this task.

Second, the extension of proper technology management at all levels might be stimulated or catalyzed by efforts of international cooperation, regional actions, external technical assistance, networking and joint project development. These efforts may be developed through intergovernmental actions, technology infrastructure institutions' international cooperation, or international cooperation or international market relations of enterprises.

Third, motivation for technology development, technical change, technological innovation and technology management is enhanced by macroeconomic stability and the promotion of a competitive economic environment. This depends, of course, of national macroeconomic government policies and actions; it is outside of the field of technology management proper but it should be kept in mind and stressed at the level of the national technology policy making too.

The former fields of actions relate to stimulating the actual demand for a specialized knowledge of technology management. The need of this promotion is due to the fact that the role of effective and efficient technology management, although acute and important, does not become recognized spontaneously as fast

as it is required for the fulfillment of goals of a gradual closing of the technology gap between developed and developing countries.

The following main fields of action enumerated below have been emphasized as geared toward fostering technology management with increased and improved services to the different actors of the technology system, most importantly to satisfy technology management needs at the enterprise level, which is paramount for the development of national competitiveness.

- Capability and infrastructure building at government, enterprise and institutional levels.
- Strengthening human resources capability in technical fields at high and intermediate levels (with the areas of technology management and quality management included).
- Development of technical standards and other quality development instruments (manuals, publications, studies on methodologies, etc.).
- Effective cooperation and interaction with synergy building among all levels involved in the technology development and technical change process, including government, research and academic institutions, services and enterprises.

4. THE CONCEPT OF TECHNOLOGY MANAGEMENT

In the broadest term technology management represents the decision making process applied to the acquisition, development and choice of technology, and the operational methodology applied to the execution of those decisions. It is a set of concepts, techniques, skills and practice that spans the interface of science, engineering, economics and management in organizations. It is crossdisciplinary and problem/application driven.

This term conforms to the macro level of public policies and to the micro level of the technology management in the enterprise as much as to the levels of institutions aimed at supporting or promoting technology development, be it a research and development center, a chain of metrology laboratories, a quality testing and certifying laboratory or institution. etc.

At the macro level technology management tends to identify with the concept of technology policy although it goes beyond it, mainly for the fact that it as well includes the operational aspects of that policy. In the special case of centres and other institutions related to technology development, like R and D institutes, technology management identifies with their whole management and administration.

Finally, at the enterprise level technology management resolves in the fulfillment of a number of tasks executed in relation to decisions on technologies that are being applied or under consideration. These tasks include the following:

TECHNOLOGY MANAGEMENT TASKS AT THE ENTERPRISE

- Supply of technical information
- Supply of technology resources (specific technologies, know how, etc.)
- Recruitment of technical experts and advisors and development of human resources in the technical field
- Supply of equipment and instruments for R and D and Quality control
- Management of technology development financing problems
- Monitoring, assessment and forecasting
- Formulation of strategies and strategic planning of technology
- Evaluation and choice of technologies
- Acquisition, negotiation and contracting of technology
- Development of conditions for reverse engineering
- Organization for technology adaptation and innovation
- R and D management
- Technology innovation management
- Patenting and identifying and preventing patent infringement

- Marketing proprietary technologies of the enterprise
- Promotion of technology oriented toward the fulfillment of total quality control goals
- Acquisition of laboratory instruments for research and development and for quality control

Figure 2, below, shows graphically the different tasks of technology management in the enterprise and the main relations that link them.

While the specific tasks of technology management differ among the three levels indicated above technology management for developing competitive advantages in the context of national development policies, require their linkage in a unity, reflecting the need of public policy support to entrepreneurial action, the understanding of institutions of the technology infrastructure of the needs of the productive sector, the entrepreneurial trust and goodwill toward both, and a general partnership and alliance among all of them with avoidance of feelings of an adversary nature. For a country to use technology effectively, coordination and synergy of decisions and their implementation at all the three levels indicated will be necessary.

Figure 2

TECHNOLOGY MANAGEMENT IN THE ENTERPRISE

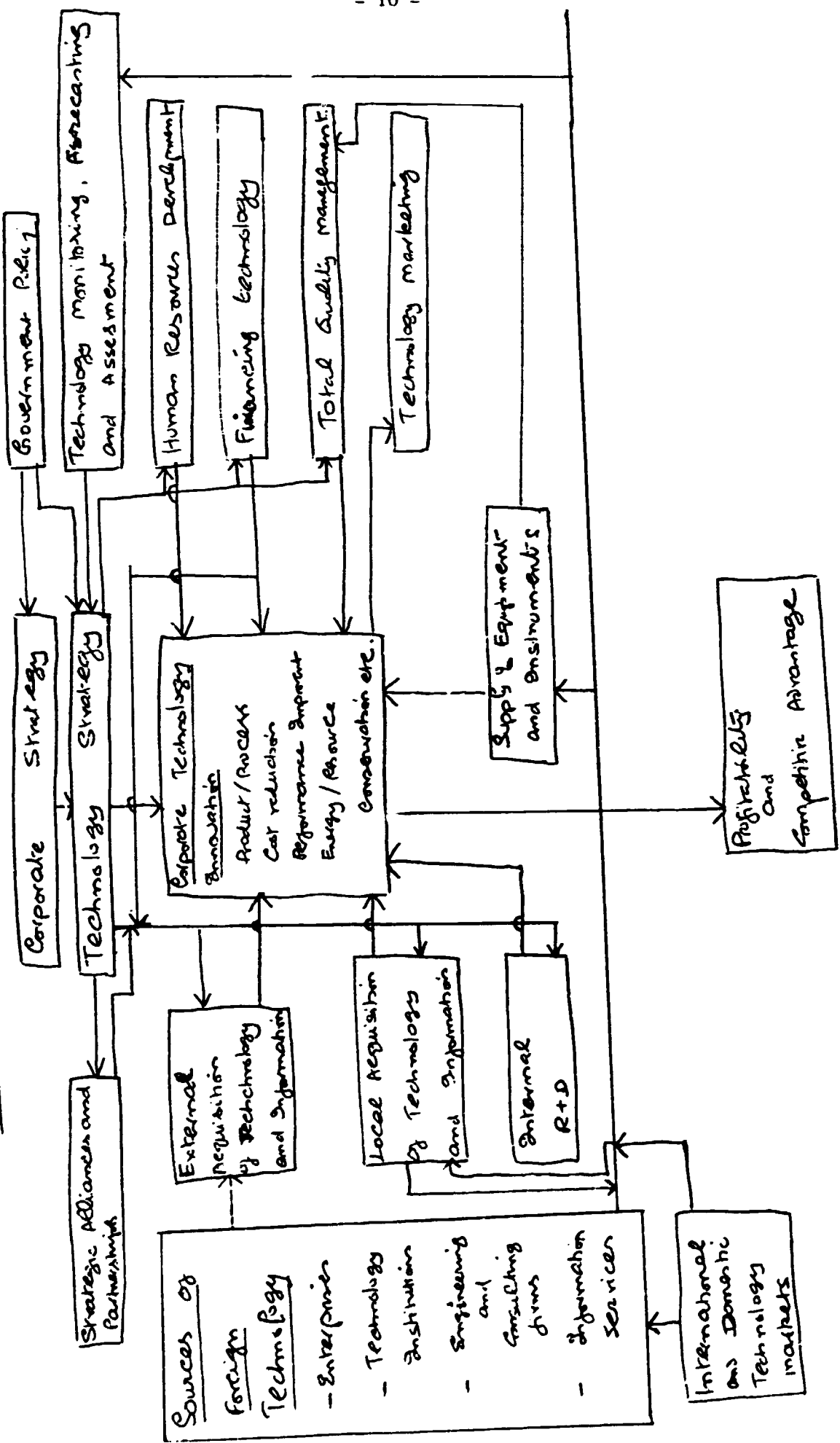
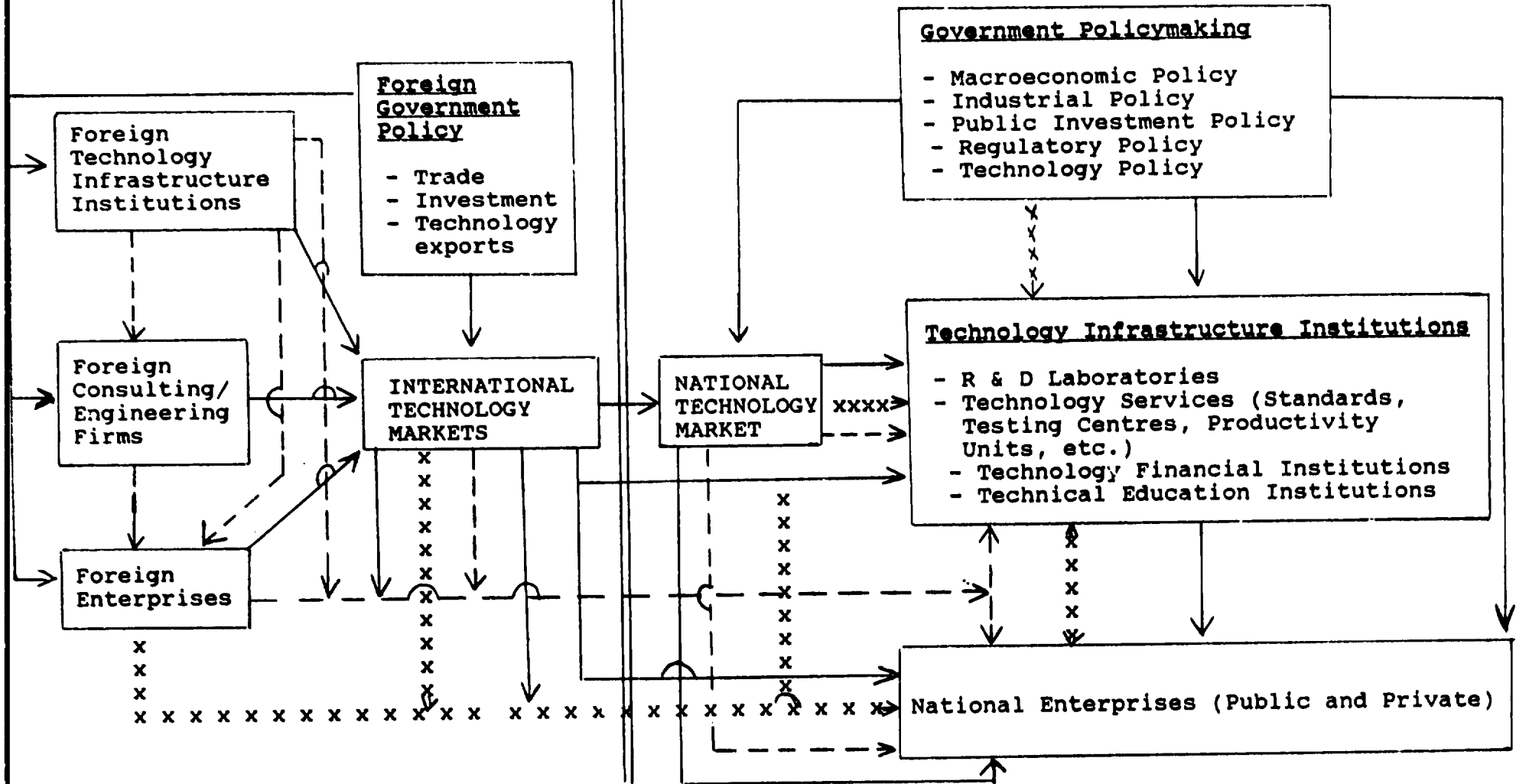


Figure 1

THE NATIONAL TECHNOLOGY SYSTEM



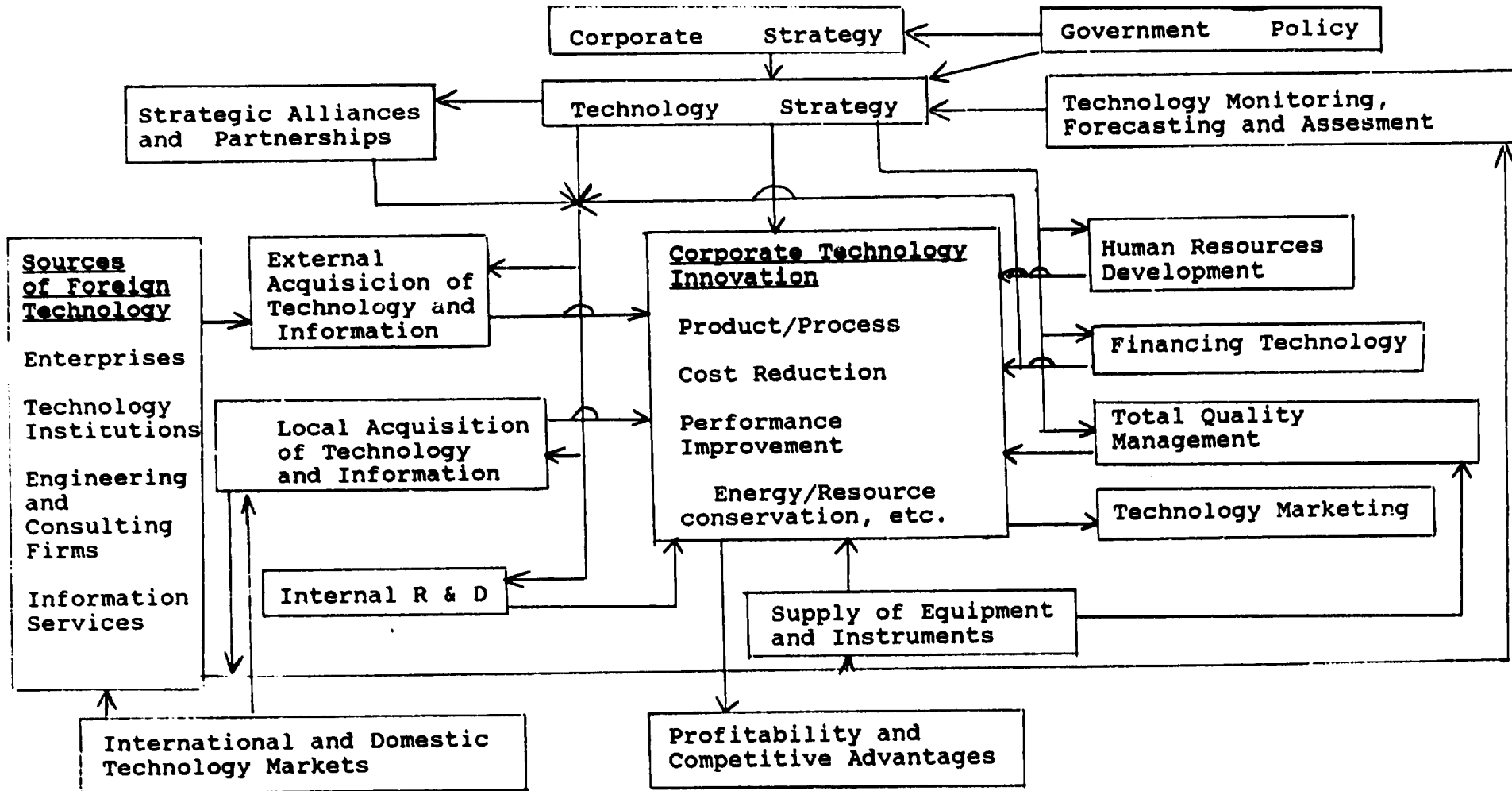
LEGEND: 1. — Influencing behavior through policy and actions

2. --- Flow of technological resources (know-how, information, technical advice, etc.)

3. xxx Flow of finances

Figure 2

TECHNOLOGY MANAGEMENT IN THE ENTERPRISE



DESCRIPTION OF COURSE MODULES

CORE MODULES

1. Technology and Development

This module explores the nature, concepts and tasks of technology management, provides a brief introduction to its various dimensions and outlines the socioeconomic policy context of technology generation, transfer and use as well as the main institutional actors. The macroeconomic framework, the worldwide trends in technological change, the nature of technological infrastructure, environmental impacts and the roles of government are analysed. The economic impacts of technological change (productivity, cost reduction, employment, comparative advantage etc.), together with the context, provide the boundary conditions (possibilities and limitations) for technology management. Finally, the role of technology in influencing competitive advantage of a firm / industry and hence industrial growth is reviewed.

2. Technology Markets

Like commodity markets, technology markets are becoming increasingly global. International trade in technology is complex and has unique structural features. The role of technology in comparative advantage is changing and needs to be viewed in a dynamic context. The technology market structure is undergoing rapid changes in the nineties and the terms of trade and constraints / barriers for developing countries are worsening. An understanding of how technology markets function and the need for development of technological capabilities (necessary to be effective actors in the international markets) are focussed in this module. Issues like institutional roles; promotion of competition; the strategies for import (in relation to self reliance) and their long term industrial impacts; packaging and unpackaging of technology and modalities of transfer of technology (acquisition, negotiation, licensing, etc.) are discussed. The objectives of this module is to enable participants play effective roles in technology markets.

3. Management of Research and Development

Generation of knowledge through R & D is an important initial activity in the innovation chain. Managing the R&D process calls for unique management policies, structures and practices. This module analyses the R&D goal setting process, project management, human resources, external interface management (eg. backward linkages with educational and R&D institutions and forward linkages with production and marketing organisations) are addressed. How to make R&D more relevant and a basis for innovation is the focus of this module, which seeks to develop an understanding of how R&D works and of some practical tools for managing this crucial activity and its linkages in different organisations.

4. Technological Innovation

Innovation has been recognised as the source of competitive advantage in many industries. Product differentiation, process improvement, performance enhancement, cost reduction and resource / energy conservation are important outcomes of technological innovation. This module looks at the elements and linkages in the innovation chain, actors and technology transfer processes. Different forms and processes of innovation as well as causal factors and determinants of its effective use at the firm level are analysed. How to organise the activities in the innovation chain and alternative strategies for promotion of innovation at different levels are addressed. Finally, the national systems of innovation are analysed in a comparative framework.

5. Technology and Corporate Strategy

Technology is an important ingredient of corporate strategies of R&D, investment, modernisation, expansion, diversification, marketing, exit, human resources, sourcing, etc. This module looks at the relationship of technology to corporate strategy formulation. Identification and assessment of technological opportunities based on information and analysis, translating corporate

goals into technological choices, organisational location and human resources of the technology function are covered. The relationship of technology to Total Quality Management and the special role of technology in small and medium enterprises are analysed. Finally, the module addresses the issues of strategic alliances, partnerships, joint ventures and subcontracting in technology management as well as the utilisation of technology for competitive advantage (eg. growth, market share, exports, niche markets, etc.) in a globalised and multicultural, corporate environment.

6. Technology and Strategic Planning

This module is a capstone module, building upon the five core modules. Its focus is on integration of technology management issues at the three levels (industry, S&T institutions and Government) in a strategic planning framework. The institutional structures at the three levels, roles and linkages are analysed. The complementarity of strategies of the three main sets of actors and the nature of shared goals are covered. Based on a review of international experience, the module seeks to look at the key issues of resource mobilisation and allocation, financing options, and the challenges of organising strategic alliances. Finally, the lessons from organisation of large, complex technological projects (eg. space technology, computers, energy) specifically focussing on dual use / spin off technologies are addressed.

ELECTIVE MODULES

1. Technology Information and Analysis

In this advanced module, use of technological information as a key resource for decisionmaking is addressed. The links among sources, services and users of knowledge are explored. Information needs identification and organisation of information systems/data bases are initially covered. Then, value additions to information for decisionmaking and the nature of knowledge based decision systems are looked at. Three specific applications of information:

use viz: (a) Monitoring, Forecasting and Assessment, (b) Choice of Technology and (c) Environment Impact Assessment are discussed. Technology communication and dissemination methods and barriers are then addressed. Finally, the larger question of information resource management and its dimensions as well as the information market place are covered.

2. Total Quality Management

Quality, Technology and Competitiveness are integrally related and Total Quality Management has emerged as a global movement, having its origins in Japan, North America and Europe. The need for quality management and certification have become essential for many exporting enterprises in developing countries. This module looks at quality control/assurance, the relationships between quality and benchmarking (best practice) as well as standardisation and quality. The special case of quality management in the subcontracting firms is addressed. Finally, the institutional framework for quality management (both within and outside the firm) as well as technological strategies to improve quality are explored.

3. Leadership and Human Resources

A key finding of technology management experience of the last two decades is that leadership and human resources are the most important determinants of the effectiveness of technological change. This module looks at issues of human resource planning, creativity, management of interdisciplinary teams and effective leadership styles. The role of matrix organisations in temporary/project mode tasks and the importance of motivation are, then addressed. Human resource management functions in technology intensive organisations (at all the three levels) like recruitment, training and development, career growth, performance appraisal, are described and strategic options in this important area are identified.

4. Financing and Investment

Experience worldwide, indicates that financing and investment of technology through the innovation chain is a critical area for decisionmaking. It is also an area, not well understood.

The impacts of alternative financial instruments are often not considered in making technology choices. This module explores the dimensions and impacts of finance in technology management. First, the impact of macroeconomic financial policies (interest rate, exchange rate, foreign investment and access to international capital markets) on technological innovation is analysed. Next, the sources of finance and the integration of technology in investment planning (feasibility studies, sectoral reviews, etc.) are discussed. The importance of venture capital for new technologies, with uncertain outcomes, is then studied. Finally, management control systems for assessing technological performance and institutional mechanisms for technology financing are discussed.

5. Management of High Tech Industries

It is generally accepted by many that high tech areas (informatics, new materials, aerospace, biotech, renewable energy, etc.) have high growth potential and are technology intensive. The rate of change in these sectors is rapid and technology development is very resource intensive and risky. This module looks at the experience in the area and develops appropriate concepts and skills. Entrepreneurship, organisational flexibility, manufacturing technology changes (like computer integrated manufacturing), the blurring of distinctions among elements of innovation chain, the close interaction of R&D, design, engineering, manufacturing, marketing, personnel and the customer in such industries are explored. Finally, high tech management is differentiated from conventional technology management as a special case, calling for new management capabilities.

6. Strategies for Government

In a liberalised and globalising economic environment, the role of government in technology management has to be strategically and positively redefined. This is a great challenge for many developing countries. This module looks at some important dimensions of this strategic change. First, the relationship of macroeconomic policies to innovation is analysed. Then, the importance of playing catalytic, facilitative, promotional and regulatory roles (different

from the past) is highlighted. Infrastructure and capability building (energy, transport, communication, education, standardisation, etc.) to create a "climate" for technological innovation and attracting new investment is reviewed. Competition policy to create a level playing field for all enterprises is essential to promote innovation and instruments to achieve this are discussed. In the altered economic context, a new regulatory framework (environment, safety, consumer protection, etc.) has to be evolved and elements of this framework are, then covered. Finally, the role of government in developing shared goals and in promoting strategic alliances among the three stakeholders is explored.

MANAGEMENT OF TECHNOLOGY : A SELECT BIBLIOGRAPHY

Prof. R.S. Ganapathy

ACME, MADRAS.

February 1993

A Select Bibliography on Management of Technology

Subject Index

(corresponding to modules in the course design)

- A. Technology and Development
- B. Technology Markets
- C. Management of R + D
- D. Technological Innovations
- E. Technology and Corporate Strategy
- F. Technology and Strategic Planning
- G. Technology Information and Analysis
- H. Total Quality Management
- I. Leadership and Human Resources
- J. Financing and Investment
- K. Management of High Tech Industries
- L. Strategies for Government

- 1 Ben R. Martin and John Irvine
C,F Research Foresight: Priorities setting in Science
Pinter Publishers, London, 1989.
- 2 Peter Sprent
A,G Taking Risks: The Science of Uncertainty
Penguin Publishers, London, 1988.
- 3 National Research Council
A,F Competitiveness of the US Minerals Industry
Washington Dc, 1990.
- 4 Ron Johnston et al
E,K Technology Strategies in Australian Industry
Dept. of Industry, Technology and Commerce
Canberra, Australia, 1990.
- 5 OECD
A,L Information Technology and Economic Prospects
Paris, 1987
- 6 R.S.Ganapathy et al
F,L Technology Planning for Petrochemicals
Indian Institute of Management
Ahmedabad, 1989.
- 7 Christopher Freeman
F,L Technology Policy and Economic Performance:
Lessons from Japan
Pinter Publishers, London, 1987.
- 8 Daniel Okimoto
E,K Between MITI and the Market: Japanese Industrial
Policy for High Technology, Stanford University
Press, Stanford, CA, 1989.
- 9 Douglas K Macbeth
E,K Advanced Manufacturing : Strategy and Management
IFS Publications, London 1989.
- 10 UN-ESCAP
F,L An Overview of the Technology Atlas Project (vol.1)
APCTT, Bangalore 1988.
- 11 Helmut Schutte
D,F Strategic Issues in Information Technology
Pergamon Infotech, U.K. 1988.
- 12 Alan Porter et al
F,G A Guidelook for Technology Assessment and Impact
Analysis, North Holland, New York, 1981.

- 13 Eric Von Hippel
A,G The Sources of Innovation
Oxford University Press, New York 1988.
- 14 Mark Bonoush et al
A,G Technology Assessment : Creative Futures
North Holland, Oxford 1980.
- 15 Carl Dahlman et al
F,L Managing Technological Development
World Bank Staff Working Paper 717
Washington DC 1985.
- 16 R.S. Ganapathy
F,L Managing Technology Missions
Indian Institute of Management, Ahmedabad, 1988.
- 17 Richard Whaley and Brian Burrows
E,K How Will Technology Impact your Business?
Long range planning October, 1987.
- 18 Richard Nelson
F,K High Technology Policies : A Five
Nation Comparison
Washington DC: American Enterprises Institute
for Public Policy Research, 1984.
- 19 Airnold Heertje (ed)
D,J Information, Technology and Finance
Basil Blackwell, London, 1984.
- 20 Jeffrey James (ed)
E,L The Technological Behaviour of Public Enterprises
in Developing Countries, Routledge, London, 1984.
- 21 Robert J Ayres
F,G The Future of Technological Forecasting
Technological Forecasting and Social Change
1989 (pp 49-60)
- 22 Michael L.Tushman and William L. Moore,
D,K Editors: Readings in the Management of Innovations
Ballinger Publishing Co., Cambridge,
Massachusetts, 1988.
- 23 UNIDO: Manual on Technology Transfer Negotiations,
B,J Industrial Technology Promotion Division, Vienna,
Austria, 1993.
- 24 Office of Technology Assessment US Congress:
D,G Intellectual Property Rights in an Age of Electronics and
Information, GPO, 1986, Washington, DC, USA.

- 25 Michael E. Porter : The Competitive Advantage of Nations, The Free Press, New York, 1990.
- 26 Michael L. Dertouzos, Richard K. Lester and Robert F, L M. Solow: Made in America, Regaining the Productive Edge, The MIT Commission on Industrial Productivity Cambridge, Massachusetts, MIT Press, 1989.
- 27 F.R. David : How Companies Define their Mission, Long E, K Range Planning, Oct. 1989.
- 28 H.W. Gottinger : A Strategy Management Decision Support Tool for Technology Management, International Journal of Technology Management, 1989.
- 29 L.A. Van Gunsteren : Planning for Technology as a Corporate Resource : a Strategic Classification, Long E, G Range Planning, April 1987.
- 30 J.M. Juran : Planning for Quality, The Free Press, E, H 1988.
- 31 Armand V. Feigenbaum : Total Quality Control, 1991, E, H American Society for Quality Control, Milwaukee, WI, USA.
- 32 Arnold D. Kerr and R. Byron Pipes: Why we need Hands-On Engineering Education? Technology Review, October 1987, C, I MIT, Cambridge, Massachusetts, USA.
- 33 National Academy of Engineering : Globalization of Technology, Washington DC, 1989. A, K
- 34 National Academy of Engineering : Cutting Edge Technologies, National Academy Press, Washington, DC, 1984. D, K
- 35 Charles F. Sabel, et al, How to keep Mature Industries Innovative, Technology Review, April 1987, MIT, D, K Cambridge, Massachusetts,
- 36 The Carnegie Commission on Science, Technology and F, G Government: Technology and Economic Performance: Organizing the Executive Branch for a Stronger National Technology Base, A report of the Carnegie Commission, Washington, DC, September 1991.
- 37 Clyde Prestowitz: Japanese vs. Western Economies, F, G Technology Review May/June 1988, MIT, Cambridge Massachusetts.
- 38 Edward J. Malecki : Hope or Hyperbole? High Tech and Economic Development, Technology Review, October 1987, K, L MIT, Cambridge, Massachusetts.

- 39 Applied Systems Analysis: Engineering, Planning and
E,K Technology Management: R. de Neufirilla McGraw Hill
New York 1990.
- 40 Edward B Roberts: Generating Technology and Innovation
C,D Oxford University Press 1987.
- 41 William Souder: Managing New Product Innovations:
D,E Lexington Books, 1987.
- 42 Lowell Steele Managing Technology : The Strategic View,
E,F McGraw Hill, 1988.
- 43 David Teece: The Competitive Challenge : Strategies for
D,E Industrial Innovation & Renewal, Cambridge: Ballinger
1987.
- 44 Andrew Van dan Ven, Harvard Angler and Marshall Poole
C,D Research and Management of Innovations NY: Harper and
Row, 1988.
- 45 Hiroyuki Itami, Mobilising Invisible Assets, Cambridge:
E,F Harvard University Press, 1987.
- 46 Marai Tyre "Managing the Introduction of Process
D,K Technology: An International Comparison, MIT Conference
on Transforming Organisations, 1990.
- 47 Kim Clark: What Strategy can do for Technology, Harvard
E,F Business Review, Nov-Dec. 89.
- 48 Michael E Porter "Technology and Competitive Advantage"
F,K in The Competitive Advantage, The Free Press, 1985.
- 49 Michael A Cusumano, Manufacturing Innovation: Lessons
D,K from the Japanese Auto Industry: Sloan Management
Review, (Fall, 88)
- 50 DD Dill (1990) University-Industry Research
C,I Collaborations : An Analysis of Interorganisational
Relationships R&D Management 20 (2).
- 51 Jerry Howells (1990) Location and organization or R&D :
C,I New Horizons Research Policy 19, 133-146.
- 52 Roland Van Dierdonck (1990) The Manufacturing Design
C,D interface, R&D Management 20 (3)
- 53 Marce Tyre and Wanda Ovlikouski : Creating Windows for
A,D Technological Changes in the Production Environment,
Sloan School Working Paper, MIT, January 1991.

- 54 Robert J Thomas: Organisational Change and
C,I Decisionmaking about New Technology in Kochan and
Useem "Transforming Organisations" Oxford University
Press, 1991.
- 55 Ramchandran Jaikumar (1986) Post Industrial
D,H Manufacturing, Harvard Business Review, Nov. - Dec.
- 56 Vladimir Pucik: Strategic Alliances, Organisational
C,I Learning and Competitive Advantage : The HRM Agenda
Human Resources Management, Spring, 1988.
- 57 James Utterback: The Dynamics of Innovation in Industry,
D,G Cambridge: HBS Press, 1991.
- 58 Guile and Brooks (ed) Technology and Global Industry :
F,L Companies and Nations in the World Economy, Washington
DC, National Academy Press, 1987.
- 59 Martin Baily and Alok Chakrabarti : Innovation and the
D,F Productivity Crisis, Washington DC, Brooking Institution
1988.
- 60 Chris de Bresson: Understanding Technological Change,
A,F Montreal: Black Rose Books, 1987.
- 61 Don Kash: The Perpetual Innovation: The New World of
D,I Competition NY: Basic Books, 1989.
- 62 David Mowrey and Nathan Rosersberg Technology and the
G,L Pursuit of Economic Growth, Cambridge University Press
1989.
- 63 C.Freeman and C.Perez: A Taxonomy of Innovations (ch3)
D,L in Dosig et al Technical Change and Economic Theory,
NY: Columbia University Press, 1988.
- 64 Katharene Barker and Luke Georghiou Evaluation of
C,G Economic & Social Impacts of Publicly funded R&D
Programme of Policy Research in Engineering Science and
Technology, University of Massachusetts, 1990.
- 65 Abita J.L. "Technology: Development to Production",
A,D IEEE Transactions on Engineering Management, 1985.
- 66 Adler, P. "New Technologies, new skills", California
D,I Management Review. Fall, 1986.
- 67 Agarwala, S.K.
B,L "Transfer of technology to LDCs - Implications of the
proposed guide," Indian Journal of International Law.
Apr-Jun 1983.

- 68 Ahlbrandt, RS & Blair, AR
D,I "What it takes for large organisations to be innovative",
Research Management. Mar-Apr. 1986.
- 69 Alagh Y.K,
A,F "Process of industrialisation and technological
alternatives, Lancer International, New Delhi, 1988.
- 70 Ghayur Alam,
F,L "India's technology policy and its influence on
Technology Imports and Technology Development",Economic
& Political Weekly, Nov. Special Number, 1985.
- 71 Alfthan T
C,I "Developing skills for technological change - some
policy issues" International Labour Review, 1985.
- 72 Allen T.J.
C,I "Organisational structure, information technology and
R&D productivity",IEEE Transaction on Engineering
Management. Nov. 1986.
- 73 Allen T.J. et al
D,E "Transferring technology to the small manufacturing
firm: a study of technology transfer in three
countries", Research Policy, Aug. 1983.
- 74 Allen, Thomas J,
C,G "Managing the flow of technology, technology transfer and
the dissemination of technological information within
the R & D Organisation, Cambridge, MIT Press, 1982.
- 75 Avard, S., Catto, V., and Davidson, M.
D,J "Technological innovation - key to productivity,"
Research Management, July, 1982.
- 76 Applegate L.M. et al
E,G "Information technology and tomorrow's manager",Harvard
Business Review. Nov-Dec. 1988.
- 77 Ashford, R.W. et al.
C,J "The capital investment appraisal of new technology -
problems, misconception and research direction",Journal
of the Operational Research Society, July 1988.
- 78 Ayres R.V.
F,L "Technology - the wealth of nations", Technological
Forecasting & Social Change, July, 1988.
- 79 Bagchi, A.K,
A,F "Inventiveness in society",Social Scientist,
Dec.80-Jan.81.

- 80 Bagchi, A.K.
A,R "Formulating a science and technology policy. What do we know about third world countries," Economic & Political Weekly (Annual #) Feb. 1980.
- 81 Banerjee, U.K.
A,K "High technology: choices and forecasting", Economic Times, Jul.8 & 9, 1986.
- 82 Barke, Richard,
A,L Science, Technology and Public Policy, Affiliated East West Press, New Delhi, 1988.
- 83 Beathy C.A,
D,H "Tall Tales & real results: implementing a new technology for productivity," Business Quarterly, Nov. 1986.
- 84 Becker H.S.
F,G "Scenarios: A tool of growing importance to policy analysts in government and industry," Technological Forecasting & Social Change, May, 1983.
- 85 Bell, Martin and Scot Kemmis, D.
B,L "Technology Import Policy: Have the problems changed?" Economic & Political Weekly, Special Number, Nov. 1985.
- 86 Bhalla A.S. and Fluitman A.G
A,G "Science and Technology indicators and socio-economic development", World Development Feb.1985.
- 87 Bhalla A.S.
F,L "Can High technology help third world to take off?" Economic & Political Weekly, Jul.4, 1987.
- 88 Bhalla, A.S. & Janner, D
F,G "Towards new technological frontiers," Productivity, Oct-Dec.1984.
- 89 Bhanuja B. et al
B,C "Technology transfer from government laboratories to industry: Canadian experience in the communications sector", R&D Management, April 1982.
- 90 Bhatt, V.V.
F,J "Project evaluation criterion and technology policy," Economic & Political Weekly, May 29, 1982.
- 91 Bhatt, V.V.
F,J "Financial Institutions and Technology Policy," World Development, Oct. 1980.
- 92 Bickerstaffe G,
E,J "Who's afraid of new technology?" International Management, May 1982.

- 93 Biranbaum, P.H.
D,E "Strategic management of Industrial technology: a review of the issues,"IEEE Transactions on Engineering Management, Nov.1984.
- 94 Blake, R.R & Mouton, J.S
E,K "High-tech management; back to the future?"SAM Advanced Management Journal, Spring 1986.
- 95 Bornestein M,
B,L "West-East technology transfer, Impact on USSR" OECD Observer Sept. 1985.
- 96 Brookman, H
B,G "Models of know-how and technology transfer in the international order",Science & Public Policy, Oct.1983.
- 97 Brown, L.A,
B,D Innovation diffusion : a new perspective, Methew, New York, 1981.
- 98 Brown, W.D and Karagozoglu,
D,G "A system model of technological innovation",IEEE Transactions on Engineering Management, Feb. 1989.
- 99 Burgelman, R.A & Maidique M.A
D,E Strategic management of technology and innovation, Irwin., 1988.
- 100 Chakrabarthi, A.K. et al
D,G "The cross-national comparison of patterns of industrial innovation", Columbia Journal of World Business, Fall 1982.
- 101 Charles, Weiss and Nicolas Jequier
A,J Technology, finance and development: an analysis of the World Bank as a technological institution, Lexington Books, Lexington, 1984.
- 102 Choi Hyung Sap,
A,G Technology Development in developing countries, Asian Productivity Organisation, 1986.
- 103 Chris De B.,
A,G "The evolutionary Paradigm and the Economics of Technological change,"Journal of Economic Issues, Jan. 1987.
- 104 Coates, V.T and Fabian T
G,J "Technology assessment in industry: a counter productive myth?" Technological Forecasting & Social Change, Dec. 1982.

- 105 Cohn S.G. & Tury, R.M.
D,I "Organisational structure, decision making procedures and the adoption of innovation," IEEE Transactions in Engineering Management, Nov. 1984.
- 106 Craig, S.R.
B,E "Seeking strategic advantage with technology: Focus on customer value", Long Range Planning, Apr. 1986.
- 107 Crow, M.M.
C,L "Assessing government influence on industrial R&D", Research and Technology Management, Sept.-Oct. 1988.
- 108 Davidson W.H
B,L "Structure and Performance in international technology transfer". Journal of Management Studies, Oct. 1983.
- 109 Davidson, A.
B,F "Opportunities in technology: redefining the market". Business Quarterly, Oct. 1983.
- 110 De Leon P
F,G "The evaluation of technology R&D: a continuing dilemma, "Research Policy" Dec. 1982.
- 111 De Meyer V.
G,I "Technological life cycle approach to the organisational factors determining gate keeper activities", R&D Management, Oct. 1984.
- 112 Desai, Ashok V,
A,L "India's Technological capability: an analysis of its achievements and limits," Research Policy, Oct. 1984.
- 113 Desai, A.V,
A,B "Indigenous and Foreign Determinants of Technological Change in India," Economic & Political Weekly, Nov. Special Number 1985.
- 114 Desai, Ashok V, ed.
B,D Technology absorption in Indian industry, Wiley Eastern, New Delhi, 1988.
- 115 Donald N.Michael
A,G "Forecasting and Planning in an innocent context", Technological Forecasting & Social Change, 1989.
- 116 Drucker, P.F.
D,F "Principles of successful innovation," Research & Management Sept.-Oct. 1985.

- 117 Edquist. Charles
D,F Social carriers of techniques for development : a comparative economic systems approach, appropriate technology; myths reality, Swedish agency for research corporation, 1979.
- 118 Ettlíe, J.E & Bridges W.P
A,E "Environmental uncertainty and organisational technology policy", IEEE Transactions on Engineering Management, 1982.
- 119 Evans, A,
D,J "Framework for a policy on new technology," Personnel Management Aug. 1988.
- 120 Fairtlough G
F,G "Can we plan for new technology?" Long Range Planning, June, 1984.
- 121 Ford D & Ryan C
B,D "Taking technology to market," Harvard Business Review, Mar-Apr. 1981.
- 122 Forester, T (ed)
G,K Information Technology Revolution, Oxford, Basil Blackwell, 1985.
- 123 Forhman, A.C,
C,E "Meshing technology with strategy, Research Management" Dec. 1984.
- 124 Frohman, A.L.,
C,E "Putting technology into strategic planning," California Management Review, Winter 1985.
- 125 Foster, J F
E,I "The effect of technology on Institution" Journal of Economic Issues, December, 1984.
- 126 Freeman C.
B,D Economics of industrial innovation, MIT Press, Cambridge, 1982.
- 127 Gatiker, U.E & Larwood, L
D,I Managing technological development strategic and human resources issues, Berlin: Walter De Gruyter, 1988.
- 128 Gold, Bela
E,I "Strengthening managerial approaches to improving technological capabilities", Strategic Management Journal, July-Sept. 1983.

- 129 Gould, J.M.
D,F "Technological change and competition," Journal of Business Strategy, Fall 1983.
- 130 Guerard J.B. et al
C,J "R & D Management and corporate financial policy", Management Science, 1987.
- 131 Gustafsson, H
A,F Technology Policies for development, Research Policy Institute, Sweden, 1986.
- 132 Haggerty, P.E.
D,E "The Corporation and innovation", Strategic Management Journal. April - June 1981.
- 133 Hall, Peter (ed)
D,E Technology, innovation and economic policy, Heritage Publishers, New Delhi, 1986.
- 134 Harvey, M.G.
C,G "Comparing R & D productivity strategies," Research Management, Nov-Dec. 1984.
- 135 Hilbrink J.O.
B,D "Economic Impact and Technical change," IEEE Transactions on Engineering Management. Feb. 1989.
- 136 Hill, Stephen
B,D "Eighteen cases of technology transfer to Asia/Pacific region countries," Science & Public Policy, Jan. 1986.
- 137 Horwitch M
E,F Technology in the modern corporation - a strategic perspective, Pergamon Press, New York, 1988.
- 138 Iyer E.S, & Ramprasad A
D,E "Technical and management notes: strategic postures toward innovation," IEEE Transactions in Engineering Management, May 198.
- 139 Juma, Calestous
B,D "Market restructuring and technology acquisition," Development and Change, Jan. 1985.
- 140 Kamoda F.
B,F "Japanese studies on technology transfer to developing countries: A survey," Developing economies, Dec. 1986.
- 141 Kan Chen et al
A,G "Long-Range scenario construction for technology assessment", Technological Forecasting & Social Change, 1981.

- 142 Kantrow, A.N,
E,F "Strategy-technology connection,"Harvard Business Review, Jul/Aug. 1980.
- 143 Kim B.Clark & et al (ed.)
D,E The uneasy alliance: managing the productivity -
technology dilemma, Boston, Harvard Business School
Press, 1985.
- 144 Krishnaiah, VSR & Singh P.
C,G "What we have learned managing R&D projects",
Productivity, April-June, 1988.
- 145 Lacroix R & Martin F
A,L "Government and decentralization of R&D",Research
Policy, Dec. 1988.
- 146 Larry, E.W, and Yung W.R
C,E "Choice of technology in Industry,"International Journal
of Development Banking. July. 1984.
- 147 Lasserre P.
C,I "Training: key to technological transfer",Long Range
Planning, June 1982.
- 148 Leonard, D Barter
D,E "Implementing new technology,"Harvard Business Review,
Nov-Dec 1985.
- 149 Link, A.N. and R.W. Zmud
B,D "Additional evidence on the R&D/marketing interface,"
IEEE Transactions in Engineering Management, Feb. 1986.
- 150 Link, Albert N,
E,F Strategies for technology based competition - meeting
the new global challenge, Lexington Books, 1987.
- 151 Linstone, H.A. et al.
F,G "The multiple perspective concept with applications to
technology assessment and other decision areas"
Technological Forecasting and Social Change, 1981.
- 152 Lower, M.D
A,E "The concepts of technology within the institutionalist
perspective" Journal of Economic Issues, Sept. 1987.
- 153 Maidique, M.A. & Hayes, Robert H
H,K "The art of high-tech management,"Sloan Management
Review, wint. 1984.
- 154 Mansfield E.
F,K "Industrial R&D in Japan and the United States - a
comparative study". The American Economic Review.
May 1988.

- 155 Mansfield, E,
B,F "Technological change and market structure: an empirical study," American Economic Review, May 1983.
- 156 Mcpherson, J
D,G "How to approach methods for stimulating innovation," Industrial Management, Aug. 1984.
- 157 Mandell S & Ennis D.M.
D,E "Looking at Innovation strategies", Research Management, June 1985.
- 158 Merkhofer, M.W
E,G "A process for technology assessment based on decision analysis", TEchnological Forecasting & Social Change, 1982.
- 159 Merrett, R.L, and Merritt A.J.
E,G Innovation in the public sector, Sage Pub., Beverly Hills, 1985.
- 160 Merrifield, D.B.
C,D "Technology and the management of rapid change (R&D)" Research Management, May-June 1983.
- 161 Meyerson P and, Hamilton R.D
E,I "Matching corporate culture and technology," Advanced Management Journal Winter 1986.
- 162 Mody Ashoka
F,L "Policy for electronics industry: the options", Economic and Political Weekly, Mar. 23, 1985.
- 163 More, R.A
C,J "Generating profit from new technology: an agenda for a management research program (Canada)", Business Quarterly, Summer 1987.
- 164 Morita A
E,F "Technological management will be key to the success", Research Management, 1987.
- 165 Morone, Joseph
E,F "Strategic use of technology," California Management Review, Summer 1989.
- 166 Mortan, M.R
E,F "Technology and strategy : creating a successful partnership," Business Review, Jan-Feb. 1983.
- 167 Norodhaus, W.D.
A,L "Resources, technology, and development: Will the table be bar when poor countries get there", Indian Economic Review, Jul-Dec. 1986.

- 168 Norman, Clark,
A,L The Political economy of science and technology, Basil
Blackwell, New York, 1985.
- 169 Norris, W.C.
B,D "How customer needs are shaping the factory of the future",
Journal of Business Strategy, Winter 1986.
- 170 Norris, W.C,
B,D "Developing corporate policies for innovation: a program
of action," Long Range Planning, Aug. 1981.
- 171 OECD
B,F New technologies in the 1990s - a socio-economic
strategy, Organisation for Economic Co-operation and
Development, Paris, 1989.
- 172 Parthasarathi A,
B,D "Acquisition and Development of technology, "Economic &
Political Weekly, Nov.28, 1987.
- 173 Patel, S.J,
A,D "Technological transformation of the North Lessons: for
the South," Economic & Political Weekly, Nov.1-Dec.20,
1986.
- 174 Petroni, G
D,I "Who should plan technological innovation", Long Range
Planning, Oct. 1985.
- 175 Piganiol, P.,
A,L "The interface of science and technology with society,"
Science and Public Policy, Oct. 1986.
- 176 Preece D.
A,B Managing the adoption of new technology, Routledge,
1989.
- 177 Quinn, J.B.
D,E "Managing innovation: controlled chops", Harvard
Business Review, May-June 1985.
- 178 Quershi, M.A.,
B,D "Commercialisation of Indigenous Technology: Role of
financial Institutions," Indian Management, Nov. 1988.
- 179 Randolph, R.H. & Koppel B
A,G "Technology assessment in Asia: Status and Prospects",
Technological Forecasting & Social Change, 1982.
- 180 Randolph, W.A.,
E,I "Matching technology and the design of organization
units," California Management Review, Summer 1981.
- 181 Rao, H.S. (Dr.)

- C,D "Management of Technology Transfer from laboratory to industry, Indian Management, Nov. 1988.
- 182 Robert U Ayres
C,G "The future of technological forecasting", Technological Forecasting & Social Change, 1989.
- 183 Roberts, Edward, (ed)
D,E Generating Technological innovation, Oxford University Press, New York, 1987.
- 184 Rodrigues, C.A,
D,E "A proces for innovators in developing countries to implement new technology," Columbia Journal of World Business, Fall 1985.
- 185 Ross, I.M.,
B,F "The global contest in industrial competitiveness has just begun, Research Management, May-June 1985.
- 186 Roy, Rothwell,
B,F Reindustrialization and technology, Essex Laymen, Harlow, 1985.
- 187 Rushwing F.W & Brown C.G. (ed.)
F,K National Policies for developing high technology industries: international comparisons, Westview Press, London, 1986.
- 188 Ryan C.G,
B,F The marketing of technology, Peter Peregrium, London, 1984.
- 189 Sahal D
A,F "Technology, Productivity and Industrial Structure," Technological Forecasting & Social Change, 1983.
- 190 Saren M.A.
D,G "Classification and review of models of the intra-firm innovation process", R&D Management, Jan. 1984.
- 191 Saviotti P.P, and Metcaffe, J.S.
D,G "A Theoretical approach to the construction of technological output indicators," Research Policy, June 1984.
- 192 Sethi, Narendra K & Others
E,I "Technology strategies for business planning", Productivity Oct. - Dec. 1986.
- 193 Sharif M.N. (ed)
F,L "Technology Policy formulation and planning - a reference manual, Asian Pacific Center for Transfer of Technology, Bangalore, 1986.

- 194 Simpson et al
F,G Challenge of new technology, Westview Press, Colorado, 1987.
- 195 Skinner, W,
E,F Operations technology: blind spot in strategic management," Interfaces, Jan. - Feb. 1984.
- 196 Smilor, R.W
D,F "Commercialising technology through new business incubators", Research Management, Sept. - Oct. 1987.
- 197 Stahelk W.R
C,L "R&D in a sustainable society", Science and Public Policy, 1986.
- 198 Subramanian, S.K
A,L "Planning Science and Technology for national development: the Indian: experience", Technological Forecasting and Social Change, 1987.
- 199 Szakonyi G (eds.)
C,F "Don't concentrate on traditional R&D Management", Research Management, Sept. - Oct. 1986.
- 200 Tallman, W.H.
C,K "CIM must be part of overall corporate strategy", Management Review, Sept. 1986.
- 201 Teece, D.J.
B,L "Profiting from technological innovation - implications for integration, collaboration, licensing and public policy", Research Policy, Dec. 1986.
- 202 Tisdell, Clean, Maithra, P.
A,F Technological change, development and the environment: socio economic perspective, London, 1988.
- 203 Verschuur, JJ
B,J Technologies and markets, Peter Peregrinus Ltd. London, 1984.
- 204 White, B.D.
D,E "Technical innovation : Is it part of your strategic planning process?" Management Planning, May - June 1984.
- 205 Wilkinson, B. & Smith, Steven.
D,F "Management strategies for technical change," Science Policy, April 1983.

- 206 Williams J.R.
D,E "Technological evolution and competitive resources",
Strategic Management Journal, Jan. - Mar. 1983.
- 206 Wilson I,
E,F "The Strategic management of technology: corporate fad
or strategic necessity," Long Range Planning, Apr. 1986.

Annex 3

R E S O U R C E M A T E R I A L
Collected by Zoltán Szabó

CORE MODULES

1. Technology and Development

Basics:

- Joaquín Cordua: Development and Management of Technology, Advanced Course on Management of Technology in the Enterprise, National Institute of Advanced Studies, IDEA, Organization of American States, OAS, and Interuniversity Center for Development, CINDA, Caracas, Venezuela, may 1983 (Spanish).
- Zoltán Szabó: Concept and Problems of the Management of Technology in Latin America, Interamerican Science, Vol. 19, No. 2, OAS, Washington, D.C., 1978 (Spanish).
- Gabriel Poveda Ramos: Management of Technology Tasks in the Enterprise, First Latin American Course on the Management of Technology in the Enterprise, OAS, National Fund for Studies and Projects of Brazil, FINEP, and Science and Technology Management Program of the University of Sao Paulo, PACTo, Sao Paulo, Brazil, October 1980 (Spanish).
- Zoltán Szabó: Technology Development for Small and Medium Industries, OAS, SUBIN, FINEP, and PACTo. Latin American Course on Management of R & D projects, Sao Paulo, Brazil, November 1985 (Spanish).

Also recommended:

- Michael L. Tushman and William L. Moore, Editors: Readings in the Management of Innovations, pp. 213 to 249, 401 to 444, 469 to 486, 519 to 532, and 718 to 759. Ballinger Publishing Company, Cambridge, Massachusetts, 1988.
- OAS: The Management of Technology in Latin America. Final Report, Experts Group on Management of Technology. Washington, D.C., may 1978 (Spanish).
- Rafael Vargas Rangel: Problems of Management of Technology in Small Industries and the Industrial Extension Service. Interamerican Science, Vol. 19, No. 2, OAS, Washington, D.C., 1978 (Spanish).
- Gabriel Poveda Ramos: Support Resources for the Management of Technology in the Enterprise, Interamerican Science, Vol. 19, No. 2, OAS, Washington, D.C., 1978 (Spanish).

2. Technology Markets

Basics:

- Claudio Huepe: Technology Marketing and Real Costs of Imported Technology. Advanced Course on Management of Technology in the Enterprise. IDEA, OAS, and CINDA, Caracas, Venezuela, May 1983 (Spanish).
- UNIDO: Manual on Technology Transfer Negotiations. Industrial Technology Promotion Division, Vienna, Austria.
- Alberto Araújo: Consulting and Engineering Activities and Their Role in Technology and Investment. First Latin American Course on Management of Technology, OAS, FINEP and PACTO, Sao Paulo, Brazil, September 1980 (Spanish).
- Michael Gadbow and Timothy Richards: Intellectual Property Rights: Global Consensus, Global Conflict? Westview Press, 1988, USA.

Also recommended:

- Office of Technology Assessment: Intellectual Property Rights in an Age of Electronics and Information. GPO, 1986, Washington, D.C., USA.
- José Adeodato de Souza Neto/Hilda Maria Salomé Pereira: Intellectual Propriety and Technology Transfer. PACTO. Journal of Administration, Vol. 24 (2) April/June 1989 (Portuguese).
- Raúl Barnett, Julio de la Roche, Henry Echeverri and Gustavo Flórez: Unpacking Projects. Colciencias, Bogota, Colombia, November 1979 (Spanish).
- CINDA/PNUD/Executive Secretariat of the Andrés Bello Agreement, SECAB: Contracting Technology. R & D Manual Series No. 9, Santiago, Chile, 1989 (Spanish).

3. Management of Research and Development

Basics:

- Esteban L. Bertha: R & D Activities, IDEA, OAS and CINDA, Advanced Course on Management of Technology in the Enterprise, Caracas, Venezuela, may 1983 (Spanish).
- Jacques Marcovitch: The Enterprise as a System: The Management of Technology Subsystem, IDEA, OAS and CINDA, Advanced Course on Management of Technology, Caracas, Venezuela, may 1983 (Spanish).
- Miguel de Santiago: Interinstitutional Linkages in Technology Development, Latin American Seminar on Institutional and Financial Promotion of Technology Management in Projects, OAS, National Science and Technology Council, CONACYT, and National Fund for Studies and Projects, FONEP, Mexico, November 1983 (Spanish).
- Fernando M. Machado: Project Portfolio, in "Administration of Research Programmes and Projects" pp. 89 a 108, IDB(Inter American Development Bank)-SECAB-CINDA, Science and Technology Series No. 25, Santiago, Chile, 1990 (Spanish).

Also recommended:

- Michael L. Tushman & William L. Moore, Editors: Readings in the Management of Innovation, Second Edition, p. 214 to 218 and 293 to 309, Ballinger Publishing Company, Cambridge, Massachusetts, 1988.
- Alan L. Frohman: Critical Functions for an Innovative R & D Organization, The Business Quarterly, Winter 1974.
- Marcos Cortez Campomar: Marketing Activities in National R & D Technology Institutes, Journal of Administration, PACTo, University of Sao Paulo, Brazil, 1985 (Portuguese).
- Miguel de Santiago: Technology Transfer from R & D Projects to Production, OAS, SUBIN, FINEP and PACTo, Latin American Course on Management of R & D Projects. Sao Paulo, Brazil, November 1985 (Spanish).

5. Technology and Corporate Strategy

Basics:

- Nicolás Majluf: Strategic Management of Technology, article in "Management of Technology in the Enterprise" pp. 3 to 73. CINDA, PNUD, and SECAB, R & D Manuals Series No. 2, Santiago, Chile, 1989 (Spanish).
- Carlos O. Bartero: Management of Technology: Issues of Organization and Administration. Journal of Business Administration, Fundacao Getulio Vargas, Rio de Janeiro, Vol. 17, No. 6 Nov/Dec. 1977 (Portuguese).
- Jacques Marcovitch: Technology and Competitiveness, an article of "General Concepts of the Management of Technology" IDB, SECAB and CINDA, Science and Technology Collection No. 26, Santiago, Chile, 1990 (Spanish).
- Pere Escorsa Castells and Enrique de la Puerta González Quevedo: Formulating the Technological Strategy of the Enterprise: A Methodology, IV. Latin American Seminar on the Management of Technology, Latin American Association of Management of Technology, ALTFC, Caracas, Venezuela, September 1991.

Also recommended:

- Michael E. Porter: The Competitive Advantage of Nations. The Free Press, New York, 1990.
- Michael L. Dertouzos, Richard K. Lester and Robert M. Solow: Made in America, Regaining the Productive Edge. The MIT Commission on Industrial Productivity, Harper Collins Publishers, Cambridge, Massachusetts, MIT Press, 1989.
- Stephen S. Cohen, David Teece, Laura D. Tyson, and John Zysman: Competitiveness, Vol. III, Global Competition: The New Reality. Report of the President's Commission on Industrial Competitiveness, Washington, D.C.: GPA, 1985.
- F. R. David: How Companies Define their Mission. Long Rang Planning, 1989.

6. Technology and Strategic Planning

Basics:

- Jacques Marcovitch: The Enterprise as a System: The Subsystem of the Management of Technology, pp. 1 a 23, IDEA, OAS and CINDA, Advanced Course on Management of Technology in the Enterprise, Caracas, Venezuela, may 1983 (Spanish).
- Arturo García Torres: Strategic Planning and Technological Planning, an article of "The Management of Technology in the Enterprise" pp. 11 to 68, IDB-SECAB-CINDA, Science and Technology Collection, No. 27, Santiago, Chile, 1990 (Spanish).
- Héctor Ochoa: Influence of the Technology Factor on the Overall Operation of the Enterprise, CINDA, "International Course on the Management of Technology in the Enterprise", Santiago, Chile, September 1980 (Spanish).
- Jacques Marcovitch and Eduardo Vasconcellos: Techniques for Strategic Planning for R & D Institutes, pp. 39 a 53, an article of "Administration of the Technological Innovation Process", Atlas S/A, Sao Paulo, Brazil, 1980 (portuguese).

Also recommended:

- H. W. Gottinger: A Strategy Management Decision Support Tool for Technology Management, International Journal of Technology Management, 1989.
- Carmine Taralli: Strategic Planning and Technological Planning Related, Proceedings of the II. Latin American Seminar on Management of Technology, Latin American Association of Management of Technology, ALTEC, Mexico, September 1987 (portuguese).
- Eunice Lacava Kwasnicka: Technical Human Resource Planning in the Research Institution, an article of "Administration of the Technology Innovation Process", pp. 295 to 305, PACTO, Atlas Publishers, Sao Paulo, Brazil, 1980 (portuguese).
- L. A. Van Gunsteren: Planning for Technology as a Corporate Resource: a Strategic Classification, Long Range Planning, April 1987.

ELECTIVE MODULES

1. Technology Information and Analysis

Basics:

- Enrique Medina R.: Technology Information, IDEA, OAS and CINDA, Advanced Course on Management of Technology in the Enterprise, Caracas, Venezuela, May 1983 (Spanish).
- Alberto Araoz: Access to Information and Technology for Industrial Development, IV. Latin American Seminar on the Management of Technology, Latin American Association of Management of Technology, ALTEC, Caracas, Venezuela, September 1991.
- G. P. Sweeney: The Use of National Resources to Encourage The More Effective Use of Information by Industry, Technical Information Division, IIRS, Dublin, September 1976.
- Rafael E. Rodriguez Pérez: Technical Information, an article of "General Concepts of the Management of Technology", IDB, SECAB and CINDA, Science and Technology Collection No. 26, Santiago, Chile, 1990 (Spanish).

Also recommended:

- Wainer da Silveira e Silva: Forecasting: New Tool Available for Science and Technology Administration, IX. National Symposium of Research on Science and Technology Administration, University of Sao Paulo, PACTO, Sao Paulo, October, 1984 (Portuguese).
- Thomas J. Allen and Arnoud De Meyer: Technical Communication Among Scientists and Engineers in Four Organizations in Sweden: Results of a Pilot Study, Working Paper WP 1318-82, Alfred P. Sloan School of Management, MIT, Cambridge, Massachusetts, USA, May 1982.
- Jorge Beinstein: Forecasts on Technology and the Global Market, Latin American Course on Management of Technology for Export Promotion and Support, OAS and Direction of Technical Assistance and Technology Services, Santa Fé Province, Rosario, Argentina, October 1989 (Spanish).
- K. Nasch: Sources of Information for Technological Innovations, Technology Management Publication, 1, 1988.

2. Total Quality Management

Basics:

- J.M. Juran: Juran on Planning for Quality, Fourth Edition. The Free Press, USA, 1988.
- W. Edwards Deming: Quality, Productivity, and Competitive Position, Cambridge, Massachusetts, MIT Press, 1982.
- James L. Bossert, editor: Procurement Quality Control, Fourth Edition, American Society for Quality Control Customer-Supplier Technical Committee, 1988. American Society for Quality Control Quality Press, Milwaukee, WI, USA.
- ISO: ISO 9000 International Standards for Quality Management.

Also recommended:

- Armand V. Feigenbaum: Total Quality Control, Third Edition, 1991, American Society for Quality Control Quality Press, Milwaukee, WI, USA.
- Richard T. Lubben: Just-in-Time Manufacturing: An Aggressive Manufacturing Strategy, American Society for Quality Control Quality Press, Milwaukee, WI, USA.
- Thomas A. Rattliff Jr.: The Laboratory Quality Assurance System, American Society for Quality Control Quality Press, Milwaukee, WI, USA.
- Ranjit Roy: A Primer on the Taguchi Method, 1990, American Society for Quality Control Quality Press, Milwaukee, WI, USA.

3. Leadership and Human Resources

Basics:

- Humberto Serna: Human Resources, Second Latin American Course on Management of Technology in the Enterprise, OAS, CINDA, NAFINSA and FONEP, Mexico, september/october 1981.
- Jacques Marcovitch: Project Execution, an article of "Administration of Research Programmes and Projects", pp. 127 to 152, BID-SECAB-CINDA, Science and Technology Collection No. 25, Santiago, Chile, 1990.
- Jill P. Kern, John J. Riley, and Louis N. Jones, editors: Human Resources Management, 1987, American Society for Quality Control Quality Press, Milwaukee, WI, USA.
- Christopher Layton: Ten Innovations: an International Study on Technological Development and the Use of Qualified Scientists and Engineers in Ten Industries, Crane, Russak and Co. Inc., New York, 1972.

Also Recommended:

- Roger W. Berger, David L. Shores, and Mary Thompson: Quality Circles, 1986, American Society for Quality Control Quality Press, Milwaukee, WI, USA.
- Alberto Aráoz: Personnel Training for Technology Development Tasks in the Enterprise, First Latin American Course on Management of Technology in the Enterprise, OAS, FINEP and PACTo, Sao Paulo, Brazil, October 1980 (Spanish).
- Amantino Ramos de Freitas: Human Resources Development in the Institute of Technological Research of Sao Paulo State, Inc. and IPT, First Latin American Course on Management of Technology in the Enterprise, OAS, FINEP and PACTo, Sao Paulo, Brazil, October 1980 (Portuguese).
- Arnold D. Kerr and R. Byron Pipes: Why we Need Hands-On Engineering Education? Technology Review, October 1987, MIT, Cambridge, Massachusetts, USA.

4. Financing and Investment

Basics:

- OAS, FONEP and CONACYT MEXICO: Latin American Seminar on Institutional and Financial Promotion of Technology Management in Projects: A Synthesis, pp. 15 to 72, Mexico, November 1983 (Spanish).
- Alberto Aráoz: Financial Institutions and Technology Development, OAS, CONACYT and FONEP: Latin American Seminar on Institutional and Financial Promotion of Technology Management in Projects, Mexico, November 1983 (Spanish).
- José Adeodato de Souza Neto: Venture Capital for Technological Innovation in the Enterprise, an article of "Management of Technology in the Enterprise" pp. 188 to 208, IDB-SECAB-CINDA Collection Science and Technology No. 27, Santiago, Chile, 1990 (Spanish).
- Fernando Magalhaes Machado: Financing Innovations, OAS, CONACYT y FONEP: Latin American Seminar on Institutional and Financial Promotion of Technology Management in Projects, Mexico, November 1983 (Portuguese).

Also recommended

- Pierre Battini: Venture Capital and Technology Parks, International Seminar on Technology Parks, OAS, Ministry of Science and Technology, National Science and Technology Development Council (CNPq) and FINEP, Brazil, Rio de Janeiro, December 1987.
- Rubén Emilio Zeida: Financial Mechanisms for Technology Development Promotion in the Productive Sector, OAS, CONACYT and FONEP: Latin American Seminar on Institutional and Financial Promotion of Technology Management in Projects, Mexico, November 1983 (Spanish).
- Jaime Ayala Ramírez: Programmes' and Projects' Financing, an article of "Administration of Research Programmes and Projects" pp. 197 to 222, IDB-SECAB-CINDA, Collection Science and Technology, No. 25, Santiago, Chile, 1990 (Spanish).
- Jaime Silva Bautista: Financing Technology Development Projects in Latin America, OAS, SUBIN, FINEP, PACTO. Latin American Course in Management of R & D Projects, Sao Paulo, Brazil, November 1985.

5. Management of High Tech Industries

Basics:

- Carlota Pérez: Microelectronics, Long Waves and World Structural Change, Science Policy Research Unit (SPRU) University of Sussex, July 1984.
- National Academy of Engineering: Globalization of Technology, NAP, 1989.
- National Academy of Engineering: Cutting Edge Technologies, National Academy Press, Washington, D.C., 1984.
- Charles F. Sabel, Gary Herrigel, Richard Kazis, and Richard Deeg: How to Keep Mature Industries Innovative, Technology Review, Vol. 90, No. 3, April 1987, MIT, Cambridge, Massachusetts, USA.

Also recommended:

- Stephen S. Cohen: Global Restructuring, the Microelectronic Industry, and the Role of Skills in the New Trade Game, Berkeley Roundtable on the International Economy, University of California, Berkeley, June 1987.
- Marjory Blumenthal and Jim Dray: The Automated Factory: Vision and Reality, Technology Review, Vol. 88, No. 1, January 1985, MIT, Cambridge, Massachusetts. USA.
- Alberto Aráoz: Latin American Cooperation in Cutting Edge Technologies, Proceedings of the II. Latin American Seminar on Technology Management, Latin American Association of Technology Management, ALTEC, Mexico, September 1987 (Spanish).
- Silvio A. dos Santos: Advanced Technology Enterprise Creation: The European Experience and Brazilian Prospects, IX. National Symposium of Science and Technology Administration, Sao Paulo, Brazil, October 1984 (Portuguese).

6. Strategies for Government

Basics:

- The Carnegie Commission on Science, Technology and Government: Technology and Economic Performance: Organizing the Executive Branch for a Stronger National Technology Base. A report of the Carnegie Commission, Washington, D.C., September 1991.
- Clyde Prestowitz: Japanese vs. Western Economics, Technology Review, Vol 91 No. 4, May/June 1988, MIT, Cambridge, Massachusetts, USA.
- Ignacio Avalos Gutierrez: Government's Role in the Technology Innovation Process, an article of "General Concepts of Technology Management", IDB, SECAB and CINDA, Science and Technology Collection, No. 26, Santiago, Chile, 1990.
- Ken Geiser: The Greening of Industry, Making the Transition to a Sustainable Economy, Technology Review, Vol. 94, No. 6, August/September 1991, MIT, Cambridge, Massachusetts, USA.

Also recommended:

- Enrique Sabatté: Technology Management Characteristics in Latin American Public Sector Enterprises, OAS, CINDA, NAFINSA and FONEP, Second Latin American Course on Management of Technology in the Enterprise, Mexico, September/October 1981 (Spanish).
- Arnaldo Pinela: Technology Policy and Competitiveness. Information as the Axis of Negotiation, Espacios, Venezuelan Journal of Management of Technology, Vol. 13, Num. 1, Caracas, Venezuela, July 1992 (Spanish).
- Alberto Aráoz: Technology Development and Government's Purchasing Power, First Latin American Course on Management of Technology in the Enterprise, OAS, FINEP and PACTO, Sao Paulo, Brazil, October 1980 (Spanish).
- Edward J. Malecki: Hope or Hyperbole? High Tech and Economic Development, Technology Review, Vol. 90 No. 7, October 1987, MIT, Cambridge, Massachusetts, USA.