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INSTITUTIONAL MACHINERY AND OTHER MECHANISMS FOR PROMOTING NATIONAL POLICY DIALOGUES IN SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

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1. INTRODUCTION

A national science and technology policy should incorporate a number of interrelated elements: for instance, the determination of general direction and basic principles of scientific and technological advance and the establishment of priorities in tackling specific tasks at various stages of development; the planning of research and the technological modernization of the economy; the setting up of a Research and Development (R&D) network; the training of scientific manpower; and the introduction of economic incentives to help promote scientific and technological progress. Such a policy has to be both explicit and implicit and should contain various legal and executive measures that the country or state intends to carry out, to organize and develop the national S&T potential, to promote technological innovation, and to use such innovations in the best interest of the country's development. Such a policy must be taken as an important political decision by the Government and as an integral part of the overall development policy of the country. In the above context, if S&T policy-making organs are to make a significant and effective contribution to the overall development of a given country, they should, among others: establish and maintain the strongest link possible with the highest planning authority for national development as well as with those who are affected by S&T policy (stakeholders).

For the past thirty (30) years or so, the United Nations and some of its relevant specialized Agencies, notably UNESCO, have been engaged in the elaboration of practical measures required to integrate S&T in the process of development. Such S&T blueprints for, or applicable in, the African region include:

- UN Conference on the Application of Science & Technology to the Development of Less-Developed Countries, Geneva, Switzerland, 1963;

- Symposium on Science Policy Research Administration in Africa, 10-21 July 1967, Yaounde, Cameroon;

- The Conference of Ministers of African Member States Responsible for the Application of Science and Technology to Development (CASTAFRICA I), 21-30 January 1974, Dakar, Senegal;

- The UN Conference on Science and Technology for Development (UNCSTD), 20-31 August 1979, Vienna, Austria;

- The Second Conference of African Member States Responsible for the Application of Science and Technology to Development (CASTAFRICA II), 6-15 July 1987, Arusha, Tanzania.

While CASTAFRICA I could generally be regarded as an Awareness-Creating (increase of Africa's awareness of the primordial role of S&T in development process of a society) Conference, CASTAFRICA II could be termed as action-oriented.

Probably, as a result of the above Conferences and events, a number of African countries have established in the last 25 years, institutional machineries and mechanisms (Councils, Commissions, Ministries, etc.) for S&T policy making, coordination, execution and promotion of S&T activities. It is however widely acknowledged that, generally the established machineries and mechanisms have not been very successful in making science and technology play its rightful role in socio-economic development.

A study commissioned by ECA on performance review of S&T policy institutions in four African countries revealed that national institutions for S&T policy set for themselves well-defined goals and functions, but because of international economic pressures and internal structural weakness, those goals and functions have so far not been adequately realized. Explicit S&T policies have not been integrated into broader socio-economic policies. Nor have S&T plans and programmes been integrated into national socio-economic development plans and programmes in the countries studied.

One of the most important lessons that has been learnt is that Science and Technology in Africa continues to be treated as an isolated and "elitist" process in the dynamics of development and not as an integrated part, inseparable from the total social economic development process. Decisions regarding science and technology development are often taken in isolation without contributions or inputs from the majority of the stakeholders. More specifically, the linkages between the policy making and the research communities have been generally, fragile and unsustainable in several African countries, whose private sectors are also hardly consulted on S&T issues. Effective institutional machineries and mechanisms are required to promote national policy dialogue in S&T for development -- a process of decision making whereby stakeholders in the development process enter into partnership and participate in the consensus building on matters regarding S&T for development.

2. THE CONCEPT OF SCIENCE AND TECHNOLOGY POLICY

It is important to set out clearly the wide-ranging area of activities covered by S&T Policy as this phrase is now understood and used in this paper; it encompasses many activities that would not be covered by the concept of "Research Policy".

A policy may be defined as an order primarily aimed at influencing the actions of individuals or groups in pre-determined directions. Briefly put, S&T Policy is concerned with the generation, acquisition and application of knowledge from all of the sciences (social as well as natural) by countries in pursuit of their own economic, social and cultural development. It encompasses all aspects of the support of research. Equally importantly, it deals with educational processes which produce the participants in scientific and technological activities. S&T Policy is vitally concerned with the links which must exist between research and those institutions - public and private - which make use of the knowledge and technologies emerging from the global S&T system.

Those institutions, in turn, play their respective roles in the national economy and in the national effort to achieve social and cultural development. S&T Policy also involves the various activities of public and private bodies to design and stimulate technical change and innovation, not all of which are directly linked to research.

While a technology policy sets the national technology goals and objectives and induces the formulation of relevant policy instruments (salary structure and incentives, tax reduction for Research and Development expenses,, Intellectual Property Licensing Agreements, etc.) a technology plan embodies anticipatory decisions on specific investment programmes in various sectors. Specific commitments translate the technology policy and plan into action.

In virtually all cases, a country should possess an array of institutions, in both the public and private sectors, which are capable of fulfilling a number of policy and regulatory functions.

A viable national S&T policy generally needs to embrace:

- Policies and programmes for the training of people at all levels (managers, researchers, engineers, technologists, technicians);

- Policies regarding the organization and funding of research and development systems and institutions and networks (with networks assuming an increasing importance, world-wide);

- Policies to stimulate technical change, both radical and incremental, within enterprises;

- Policies and programmes seeking to establish a vigorous role for the research community and the community at large, in the formulation of options for public policies;

- Policies to establish appropriate forms of governance and accountability for institutions within the S&T system;

- Policies and programmes seeking to create healthy links between the research system and the productive sector, whether public or private, while at the same time acting to protect the public interest;

- Policies and programmes to promote unimpeded flows of scientific, technical, economic and social information both within the national system and internationally and regionally;

- Processes for the effective integration of a government's S&T Policies with other economic and social policies of that government;

- The establishment of structures, which are transparent in their activities, for the management of overall policy and strategy for S&T over the long term - such structures being designed to accommodate the different, appropriate roles of ministers, and of officials in the policy and resource allocation processes.

2.1 The Need for a National S&T Policy

S&T policies generally relate to the development and application of science and technology to fulfil a pre-determined socio-economic and other social goals of a community. The concern of S&T policy, therefore, includes the organization of the means required for the production and use of S&T knowledge and the allocation of resources (UNESCO, 1979). This definition brings out clearly the basic objective of technology policy i.e. to use S&T to solve socio-economic problems. It follows that the objective of a country's S&T policy must be derived from its socio-economic policies.

More specifically, S&T policy of a government consists of principles and methods, together with the legislative and executive provisions required to stimulate, mobilize and organize the country's scientific and technological potential, so as to implement the national development plan. Thus it is extremely important that S&T policies be integrated into the national socio-economic plans or, at least must be designed to support the national socio-economic goals.

The components of S&T policy are:

- The socio-economic goals or objectives;
- The S&T policy objectives;
- The sectoral policies and policy measures or strategies, and;
- The priority sectors.

Unlike educational or investment policies, the need for an S&T policy is not always obvious to many policy makers. The following summary outlines the need for S&T policies:

(i) The private sector in Africa is generally unable or not willing to allocate any funds to the development of S&T capability;

(ii) The development of science and technology does not appear to be an objective of Capital Markets. There is, therefore, the need for explicit and planned policies;

(iii) Resources are scarce hence there is the need to order national priorities to ensure effective use of human and material resources;

(iv) The determination of national priorities and the allocation of resources are functions which must necessarily be performed by the national government in collaboration with stakeholders;

(v) To increase and mobilize the S&T potential of a country in the service of the objectives which its government pursues;

(vi) To allow for the lengthy periods of time required to train specialist staff to fully develop the capabilities within institutions to manage, assimilate and produce knowledge;

(vii) To ensure that the infant S&T activities generate efficient capabilities to work toward selected goals;

(viii) To correct market imperfections in the technology generation and trade.

A 1991 science and technology study of seven countries in Southern Africa found that virtually all production technologies were imported, many of them highly inappropriate to the needs they purported to address. Although all the countries had a variety of sectoral science and technology policies, these were fragmented and inadequate. A study conducted in Botswana recognized the inadequacy and costliness of the country's fragmented approach to science and technology, but saw the weakness in other countries' attempts to create formal research or policy institutions (Botswana Technology Centre, 1990). The study acknowledged that Botswana did not yet have the capacity to effectively identify, acquire, adapt, develop, service and use science and technology, and that a policy was required which could guide national action for technological transformation, and in particular to reduce the country's state of technological dependency.

The study saw needs in several areas: human resource development, economy and production, the need for consistent and appropriate standards and legislation, research and development, information and public awareness, and institutional development.

It also recognized that there were greater or lesser degrees of expertise in some or all of these areas, and proposed a short-, medium-and long-range plan. Rather than create yet more institutions, the plan would bring key officials from government, the private and non-governmental sectors, and the educational community together in a variety of co-ordinated fora for the development, coordination and control of a thoughtful genuinely national policy on science and technology.

Without such a policy, a country is left with a loose set of funding programmes, *ad hoc* co-operation between universities, industry, government, and a lot of windy rhetoric. The development of a technological capacity and of technologies appropriate to the needs of any country is dependent upon the institutional, economic and social environment in which they grow. For technology to advance, a government needs good information on the scientific and technological aspects of its economy and infrastructure. Policy makers, administrators and the private sector must be able to recognize and act upon the technological aspects of their work. This requires training, co-ordination, and the sharing of information. It means that when opportunities and problems arise, genuine alternatives are considered and weighed openly. It means that there must be good interaction between engineers, economic planners, entrepreneurs and social anthropologists. Such factors are the hallmarks of any society in which technology is effectively harnessed as a tool for development.

Moreover, the existence of a leader with a vision and a critical mass with adequate appreciation of science facilitates effective national policy dialogue in S&T for development.

3. SCIENCE AND TECHNOLOGY AND SOCIETY: THE SITUATION IN AFRICA AND THE NEED FOR A S&T POLICY DIALOGUE

The creation of a dynamic atmosphere that nurtures S&T for development is often obviated by certain systemic shortcomings: lack of understanding of the role of S&T, absence of a technology culture, absence of social carriers of technology and manpower, insufficiently or inappropriately trained manpower; inability to change due to unprepared tradition-bound population, lack of information and other constraints.

The structure and functioning of government plays an important role in fuelling the development and application of science and technology in the socio-economic transformation of the society. The depth of commitment by the government remains an essential locomotive in engineering the growth of science and technology in the region.

Political institutions and processes vary greatly in Africa. Likewise, the system of government in African countries is as heterogeneous as its ethnic composition and as diverse as its geophysical structure. This ranges from the British-styled parliamentary system to the American Congressional/Presidential and the French Presidential systems, from the military-ruled system to dynastic structures. In the midst of all these systems, S&T as the great instrument of social change is bogged down partly because many of the political leaders seem to lack orientation toward long-term needs, and very often tend to attend only to short-run wants.

Generally, the structure and functioning of African governments creates a situation where their scientific policies at best, are ineffectual, and at worst, destructive. Evidence of this can be derived from the failures to implement the recommendations of CASTAFRICA I and the Lagos Plan of Action; to cite only two of the many conclusions reached at various conferences for the scientific and technological development of the continent.

The structure and functioning of the government determines the effective machinery of planning and coordination of development activities as well as setting the pace for more effective ways of linking scientific research and technological advancement to economic growth and development. Science policy cannot be separated from an overall government policy. Being apathetic about science and technology or being greedily malevolent about the appropriate utilization of S&T only subjects Africa to exploitation, dependency and a weak bargaining position within the international community of nations.

In Africa, the irony in science and government and people's relationship is that government policy is always treated as a personal issue. The populace are not allowed to actively participate and openly contribute to the functioning of government. They are excluded from the decision-making process. Public accountability of government output functions is non-existent.

In a democracy, public opinion is a major influence in the decision-making process. It is therefore vital that the people, as well as the decision-makers recognize and understand the scientific aspects of public issues and interact so as to make S&T an important tool for social change.

Science and technology should therefore be given major considerations in public policy. Furthermore, better understanding of science by government, the higher ranks of the civil service and the top echelon of the political parties of the country should lead to a better policy for science. Both the political parties and administrative machineries in the society need to appreciate, 'the interconnections between basic, strategic and applied research, the relative timescales and uncertainties of these three phases, and special factors such as increasing instrumental sophistication that affect the cost of research, and the dynamics of the system for financing research in the higher education sector'.

Even though many African countries are handicapped because of widespread illiteracy, government should rather intensify its efforts to educate the public to understand the scientific and technological aspects of social development and to learn to accept the scope and limitations of scientific method in the process of development.

The role of the intellectual community will be instrumental in the process of change. So far, the intellectual community has not been active enough; giving room for power brokers to steer the nations in any direction. The passivity of the scientific community in most African countries has greatly contributed to the many ills of the continent. Where individual members of the scientific community have participated actively in the political process, it has been in several cases for personal goals. Such participation has left the scientific community weak and disunited rather than enforcing its collective role within the policy and decision making mechanisms of the country.

This passivity has also rendered the role of science and technology insignificant in the process of nation-building. There has to be a change particularly on the part of the scientific community to strive towards a concerted input attitude in the political process before science and technology can play its rightful role in the development process.

3.1 The Technology Demand-Supply Mismatch

Important as it is to ascertain the technological requirements of general socio-economic goals, this is only one side of the effort necessary to guide technological change in support of development. This attention to what might be termed the "demand side" of technology must be matched by attention to the "supply side" that is to the provision of the technologies called for.

This supply side is marked by activities covering the broad areas of generation, importation, and absorption of technology. Specifically, these include scientific research, technological research, engineering design, and a wide range of support activities such as information, quality control and trouble-shooting services, training and other measures for developing human resources.

In most part of Africa, S&T policies, where they exist, continue to emphasize the supply side of S&T. The demand side (linkages with the economy and society) has been more or less neglected.

The concerns of a country's decision-makers for this supply side are twofold. First is the need to develop a local technological capability that can select and master the knowledge imported from foreign sources. And second is the need to establish links between the country's demand side and supply side--to place demand for technology in contact with the country's own sources of supply. In several African countries, the institutions that undertake scientific and technological research have remained isolated from the local users of technology. What links they have formed are limited primarily to the large industrial and agricultural enterprises which, in fact, already possess the technical capability to meet their own internal needs. Meanwhile, these local scientific and technological institutions, often created and maintained at high cost to a country's small national budget, ignore the vast numbers of small farmers, entrepreneurs and artisans, and the people who are living under subsistence economies, thus depriving them of even the most elementary advice and assistance in technological matters. The professionals and technicians of these institutions--technological institutes, research laboratories, scientific councils, technology registers, and technical information services--do not even know how to establish contact with these small farmers and entrepreneurs. The gap separating them is simply too wide, both geographically and psychologically.

In addressing these fundamental supply and demand issues, decision-makers must resort to a wide range of policy actions. Thus, in addition to setting priorities and allocating resources, they must take measures that will achieve the following:

- Create and strengthen research laboratories, technological institutes, and information, quality-control, and trouble-shooting services;

- Develop local groups that can provide pre-investment and project implementation services;

- Awaken financial institutions to the importance of technological choice in investment projects and to the need to finance the risks associated with research and innovation;

- Organize educational opportunities and on-the-job training schemes that will turn out the required amounts and levels of skills;

- Strengthen market mechanisms through better income distribution, compulsory licensing, restrictions on monopolistic practices, and modification of legal and cultural patterns that prevent grassroots participation in the markets;

- Underwrite scientific research that leads to publicity of available knowledge, not subject to appropriation, in fields that are pertinent to the needs of the poor (nutrition, sanitation, housing, etc.);

- Experiment with new types of intermediary organizations for providing technical and financial assistance at the lowest levels of an economy. Such organizations should work within a community, training talented young people to go out among their own and awaken them to the causes of poverty and show what opportunities exist to improve the situation, especially through self-help rather than with government help. Such community leadership should also be taught how to guide small entrepreneurs and others to choose and implement technology that is appropriate to the development of the community;

- Seek to overcome the inadequacy in the understanding of decision-makers and planners by providing training for these individuals to help them know how to deal with the interactions between science, technology, the society, the economy, the legal framework, the environment, and the cultural patterns of the country. This training should ask decision-makers to examine the scientific and technological dimension of development which includes among others:

  . The links between the scientific and technological infrastructure of a country and its production enterprises and social groups;

  . The management of technology as a distinct variable factor of production which can be fitted to each investment project and sector strategy.

With special reference to effective linkages between R&D bodies and industry, it is, not sufficient to simply assign the functions of the total innovation chain to S&T promotion agents (public and private). Lessons learnt in Asia and Latin America demonstrate that specific modalities and mechanisms should be adopted. The following are viable modalities and mechanisms for linking R&D to users or industry (Han-Chol, K. 1986):

a) Modalities

- Contract research (fully or partially funded by government);

- Joint research in large scale priority R&D projects;

- Tripartite research, designed to bring research efforts of universities, industry and government together;

- Assistance for project feasibility studies, engineering consultancy and design services;

b) Mechanisms

- Representation of industry on boards of R&D institutions (to encourage consultative approach to priority setting and commitment);

- Secondment of R&D personnel to industry (to improve capacity to generate and diffuse technology);

- Project selection and implementation (of both government and donor funded projects) to include the role of R&D;

- Liaison units within R&D institutions to facilitate linkages in general.

With special reference to promoting effective working relationship between R&D institutions and the private sector, the establishment of Venture Capital Corporations should be considered. Such corporations could offer technical and financial support for venture businesses for the development of technologies, investigations, surveys, consultancies. More specifically, the main functions of venture capital corporations will be to:

- Link research organizations with businesses and entrepreneurs by translating research and development into practical applications;

- Foster and strengthen technology-intensive small and medium industries through equity investment and/or equity-type investment; and

- Invest in R&D and provide loans for R&D costs incurred either internally or through contracts with external research institutes, for the initial commercialization of new technology and/or investments and arrangements related thereto.

Systematic and mutual cooperation between government, universities, industry and research institutes should be recognized as "a must". The Figure below shows schematically, the relations among the four sectors.

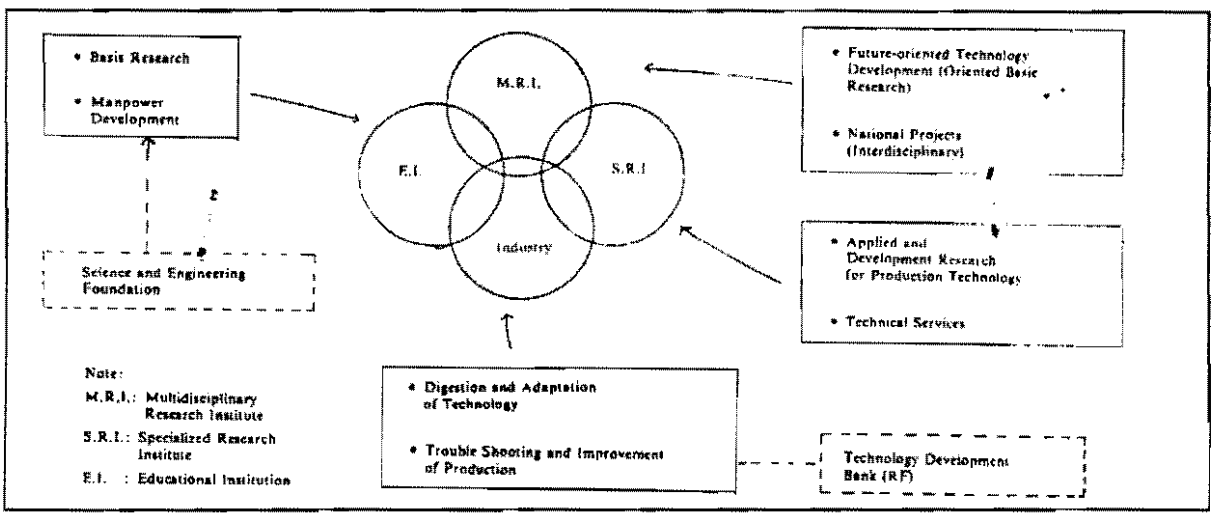

Figure..... Schematic Diagram of Academia and Industry Relation (Adapted from APCTT, 1986: Country Study Series (Voca).

4. NATIONAL SCIENCE AND TECHNOLOGY POLICY DIALOGUES: ISSUES, PROMOTIONAL MACHINERIES AND MECHANISMS

Science and technology have had an enormous impact on reducing the burden of physical work and improving social welfare. These contributions have only been made possible by the enormous methodological power of scientific reasoning which extends human ability to imagine and develop alternatives. This being said, however, the development of science and technology is much more than the application of objective logic. It is built on social consensus about goals and values. Science and technology exist only through human beings in action in certain contexts, and as such cannot be entirely value-free and neutral.

Technological change and innovation cannot have their socially beneficial effects if the cultural and political contexts are not prepared to develop, absorb and incorporate them in national development plans so as to achieve the desired structural transformations. The diffusion of an awareness of science and technology is a fundamental condition for their successful social integration. An indication of this degree of awareness can be gauged by the extent to which members of the general public have been trained in science and technology.

This background and the preceding chapters illustrate the more the need for national exchange of ideas on S&T development issues. S&T will not be able to contribute fully to endogenous and sustained development - until key major social obstacles to development are identified and addressed through domestic participation of the stakeholders.

Science and technology dialogues at the national level can indeed help in facilitating the formulation of viable policies and lay a framework for identification of national priorities and their implementation. These dialogues build up a consensus among the public, private and academic sectors on issues of national relevance.

In particular, the building up of endogenous capacity in any country must be preceded by intensive consultations by the stakeholders. The people around which S&T development revolves must analyze national problems and identify methods for solving them. The modes and methods of solutions eventually lead to strengthening of Scientific and Technological base.

4.1 The Role of the Social Sciences and their Relevant Institutions

For a truly national dialogue of S&T policy to ensue, there must be dynamic initiatives from many quarters: government, trade unions, academia, women groups, NGOs, informal sector, etc., etc. More especially, the role of the social sciences and the institutions supporting them is important in the promotion of any meaningful S&T policy dialogue. The social sciences have important roles to play:

- In informing and improving the processes of developing public policies by all levels of government;

- In working with the natural and engineering sciences to help articulate the needs of the population, providing guidance to those who would stimulate technological change as a means of attaining social and economic goals; and

- In providing informed and carefully argued critiques of societal trends and the public policies which shape or interact with these trends; such contributions can be significant in establishing traditions of free political discourse in a democratic society.

Some of these roles can be performed within state institutions, others are more comfortably carried out within a university or other non-governmental environment. However, government needs to support a carefully designed system to allocate resources to all of these activities, no matter where they are located institutionally. Further to the above, the social sciences can assist in determining priorities for strategic research.

Since no country can afford to be the world leader in all branches of science, choices have been made. In recent years, countries and organizations have developed sophisticated techniques to help them determine research priorities. These techniques usually involve some combination of knowledge about the most promising research areas in scientific disciplines, together with an identification of societal needs.

These techniques, termed research foresight techniques, have been used to identify national priorities for long-term (15 years) strategic research. They have helped identify those areas of basic scientific research most likely to benefit society within the specified time frame. Other studies have helped determine the most promising areas in which to concentrate resources, within specific sectors or scientific disciplines. Martin & Irvine have summarized the research foresight approaches followed in a number of industrialized countries and corporations. Their book Research Foresight: Priority Setting in Science provides a handbook of approaches which could be adapted to African conditions.

The Japanese have done most to develop these methodologies, and they have had considerable success in "breeding" new technologies through the process of identifying priorities. Indeed, it is the process itself which has proved to be most significant. The Japanese government has articulated a process of involving many scientists, industrialists and policy makers from government, industry and academia in a variety of delphi-type exercises. Such a process of participation helps unite all parts of the scientific and technological communities to work together to achieve the objectives within the agreed priority areas.

Africa might embark on a similar participatory exercise, involving not only the scientific community, but all parts of society, in an exercise which joins an identification of scientific opportunities with an identification of societal needs. A truly national exercise to identify priorities for strategic research could be a powerful tool in forging a democratic Africa. Furthermore, to improve National Science and Technology Policy Dialogue, Governments should give highest priority to two policy actions. One is to shift from a control mode of government-stakeholder relations to a regulatory mode.

The second is to enhance the authority and capacities of business associations such as chambers of commerce, sectoral and industrial as well as professional associations and consultative bodies that encourage regular (S&T policy business-government) discussions.

Science and Technology are the raw materials for development today and it will probably remain so in the future. If Africa's continuing marginalization is to be arrested, its S&T policy decisions must be taken at the highest possible level of government to ensure that the importance of scientific knowledge and technological activities receives due attention and is filtered through the appropriate channels. It further involves a profound dedication to ensure that scientific and technical achievements are directed towards overcoming human misery and national underdevelopment. That extraordinary conception of mission has yet to be cultivated and hence to generate the moral responsibility and compelling ideology needed for the generation and utilization of endogenous science and technology.

The Asian experience shows that political commitment is the single most important determinant of technology development, creating social consciousness on the S&T community, giving considerable autonomy to S&T organizations, awakening technology consciousness among administrators and bureaucrats, providing moral support to S&T people, creating a scientific temper and assuming active personal leadership of S&T organizations.

Science and Technology for development needs a multi-participatory decision-making system wherein the importance of S&T in national development is understood by all parties involved.

4.2 Science and Technology Policy Stakeholders: Who are they and what are their Roles?

Three phases may be discerned in the development of an S&T policy:

(i) The preparatory phase;

(ii) The formulation phase; and

(iii) The implementation and review phase.

The preparatory phase deals with the collection and analysis of data and information on the present economic and technological conditions to determine needs and areas of technological relevance. The specific supporting research activities are Economic Mapping, Technology Mapping and Analysis of implications of development objectives.

The formulation phase involves the identification and prioritization of areas for policy intervention, S&T programmes, projects and the specification and design of appropriate policy instruments. The implementation and review phase concerns itself with the implementation and monitoring of the policies and, if necessary their modification as a result of feedback.

Stakeholders are defined in this paper as:

- Those whose behaviour can be expected to be significantly affected by a policy;

- Those who have information, knowledge, resources, or positions which are important in relation to the policy issues; and

- Those who control instrumental mechanisms for intervening.

They need to understand the rationale behind the policy and, more importantly, what behaviour is expected of them. It is, therefore, important to involve stakeholders in the formulation, implementation, monitoring and continuing evaluation of S&T policies through tailor-made special workshops, lectures, seminars, retreats, etc. By bringing together industrialists, other economic operators, scientists and policy makers to discuss the correlation between S&T and development, workshops and seminars are often effective means to promote policy dialogues in S&T, to analyze sectoral case studies, and to assess levels of S&T awareness and technical capacity. Trade Fairs also offer an important opportunity for stimulating dialogue among stakeholders.

The stakeholders in S&T policy making process must include a wider group of operators and target groups since the aim of involving them is to generate discussion and debate among them; to elicit their active participation in the preparation and implementation of the policy.

To make explicit to managers and administrators the interdependence of the science and technology system and socio-economic decision-making. More specifically, the stakeholders include:

(i) Policy makers, analysts and managers (Economic Planners, Finance Ministry officials, project managers, etc.);

(ii) Implementors of S&T policies (officials of the appropriate technology promotion agents, development banks, etc.);

(iii) The target groups most likely to be affected by the particular policy (public and private enterprises, officials of technology promotion agents, etc.);

(iv) Other groups (professional associations, industry groups, trade unions, academic institutions, community leaders, non-governmental organizations, etc.).

The stakeholders have a crucial role to play in:

(i) Determination of priorities;

(ii) Determination of the S&T needs and technological areas of relevance;

(iii) Commercialization of R&D results;

(iv) Monitoring and evaluation of S&T policies;

(v) Initiation of new or improved policies;

(vi) Selection and acquisition of technology.

The promotion of national policy dialogue in Science and Technology for development should necessarily involve the concerned stakeholders since such dialogues are meant, among others, to assist in assessing the various dimensions of the problems, needs and resources, and also in sensitizing the stakeholders on opportunities, challenges and constraints.

The issues in science and technology should be the subject of a national seminar or conference during which stakeholders or their representatives would have the opportunity to express their views, receive answers to their queries and thereby better appreciate the purposes and intent of the S&T policies or plan.

In fact, one of the most effective mechanisms for the promotion of national policy dialogue in S&T for development is the "Stakeholders Policy Dialogue" --- a process of decision making whereby stakeholders in the development process participate in the consensus building on matters regarding science and technology for development. Stakeholder dialogues are used as a principal means of building endogenous capacity.

4.3 The Leadership Factor in National Policy Dialogue in S&T for Development

Leadership, both political as well as scientific and technological, is a key and critical factor in any successful pursuit of national policy dialogue in S&T for development. The experience of some relatively successful developing countries reveals the important role of political leadership in endorsing and supporting various consultations, forums and public debates on Science and Technology for development.

These countries have transformed their economy and provided upward social mobility to their citizens, by properly identifying technology problems and issues with the help of an enlightened political leadership and forward-looking advisory committees. Enthusiastic political support given by such leaders, as Nehru in India, and Park in Korea, in establishing autonomous scientific and technological research establishments almost from scratch in such areas as nuclear science and technology in the case of India and industrial technology as regards Korea, testifies to the importance of political support to indigenous scientific and technological development.

It is important therefore that the head of any government is an active supporter of national S&T activities. This is more important than the design of any particular organizational system. In France, for example, the organizational structure has not undergone significant change for many years, but S&T prospered under two Presidents who were committed to ensuring that France's capacities in S&T were harnessed to the national good. The same system went into relative decline under Presidents who showed little interest (Pompidou and Mitterand).

According to Levin[3] (1996), the French paid only sporadic to their own technological history or to the field of technology in general until after World War II and not really until the advent of the Fifth Republic, when they began to develop a modern technological capacity. From 1958 onwards, the French under the leadership of General De Gaulle, with the view to responding to the demands of the nation and the will to bridge the "technology gap" between Europe and the United States of America, opted for a policy of close coordination between the State, research workers and industrialists.

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3 Levin, Mariam R. (1996) - What the French have to say about the history of technology : In "Technology and Culture" ; Volume 37, Number 1. Jan 1996, the University of Chicago Press, USA.

The policy was marked by the development of the "MAJOR PROGRAMMES" approach and by the doctrine which is its **de facto** corollary : that of the State as purchaser" (Lemoine, P. ; 1984) 'Major programmes" were launched : military, then civilian, nuclear power ; space research, with the establishment of the National Centre for Space Studies (CNES) in 1962 and the development of launchers and satellites ; the civil aviation programme, which gave birth to Concorde and then to Airbus ; computer science, with the Calculus plan ; and later, public telecommunications, with the national telephone equipment plan. These major programmes were not only scientific research operations but also industrial operations leading to the production of goods intended for sale, such as the Ariane rocket. By **engaging** top-level engineers in the public sector and **instituting** a **structrued organization** of public procurement, France gained a remarkably strong position in most of the fields concerned ; nuclear power, aviation and space.

Further to the above, it is worthy of note that the year 1956 saw the introduction by the Government of "development aid" which, as it name suggests, was designed to promote the development of prototypes or pilot installations. In the 1960s industrial research and development (R&D), otherwise known as applied research, were given special encouragement by a variety of means ; subsidies, tax advantages, technology transfer agencies, implementation of technology plants (the Calculus Plan, the Components Plan, etc.).

Two major steps were taken to stimulate technological innovations :

- The establishment of ANVAR (National Agency for Valorization of Research) in 1067. This new government agency was given the task of ensuring that the results of public research were put to good use, and of acting as an interface between the producers of R&D and industrialists ;

- The introduction of pre-development aid i n1969. This mechanism was designed in particular to take advantage of the achievements of collective research. Like 'aid to technical research" or "development aid", "pre-development aid" was still based on a linear view of the innovation process in which different phases followed one another almost automatically : fundamental research, then applied research and development, then industrialization, and finally marketing.

In any country, scientific and technological leaders must be given a chance to develop. Providing such opportunities involves risks, but there are lessons to be drawn from specific experience in both developed and developing countries on ways to find and cultivate leadership. The Max Planck Gesellschaft in Germany (dating back to the Kaiser Wilhelm Society), for instance, has adopted a policy of establishing its institutes solely according to the availability of directors.

When a director leaves an institute, either upon retirement or death, the raison d'etre of the institute is reassessed in the light of the potential alternative directors and their prospective achievements. The importance of appropriate leadership in scientific and technological activities is also exemplified by careers of Dr. Forge Sabato of the Argentine Atomic Energy Commission, Dr. Hyung-Sup Choi of the Korea Institute of Science and Technology, and Dr. M. J. Bhabha of the Tata Institute of Fundamental Research and the India Atomic Energy Establishment.

4.4 Citizens' Enlightenment on Science and Technology

An inclusive S&T policy needs institutional representation at cabinet level. A distinct S&T ministry is desirable. There is also the need for a national S&T Advisory Council to coordinate the portfolios of those departments with clear S&T interests, like Agriculture, Education, Economic Planning, Energy, and Trade and Industry.

Just as the S&T community ought to be democratically responsible, citizens should be enlightened about S&T. This is a basic requirement for collaborating and cooperative efforts and for socially relevant S&T activity. The great risk for S&T activity to become insular and cultic, in the absence of sustained public appreciation and responsiveness, should be avoided. To this effect, apart from the urgent need for the development of human resources, there is equally the pressing need to popularize science.

All three modes of learning should be fully employed: formal, non-formal, and informal. Informal learning tends to be spontaneous, and depends for its efficacy on the combination of the other two. The Ministries of Arts and Culture, and Science and Technology can play a valuable role in promoting non-formal learning by rallying S&T-intensive ministries to hold routine mass campaigns on science awareness.

It is perhaps in this way that collaboration with the Ministry of Arts and Culture may prove beneficial, as the promulgation of science on such a scale could become part of a national culture programme. Citizens may thus hopefully come to appreciate science and technology with an intensity similar to the passion for football, concerts, local festivals and the cinema. Promotional means would include the mass media, museums, and science fairs or exhibitions. The drive should not be confined to the urban areas, since the rural population is as much in need of information as impoverished urban population.

The effort could boost formal teaching in the long run. Secondary school students would be exposed to the rudiments of science and have their interest reinforced through many non-formal sources outside the school. An osmosis of sorts would thus take place between the home and the school, which would in turn accelerate informal learning. There could be no clearer evidence for the existence of scientific culture than for a student to return home to share a newly learnt piece of scientific knowledge with an attentively responsive adult family member who may have heard or read of it himself.

Scientific awakening occurs most frequently and powerfully in youth. However, it is also at this developmental stage that the enthusiasm can either blossom or wither. For this reason, the relevant Ministry should continually conduct nationwide surveys of youth attitudes to, or interest in, science and technology. The data obtained could then be used to plan and organize annual national youth science forums to attract and reward the best and brightest from all groups.

In recent years, a number of developing countries, with China the most notable example, have singled out public understanding as a key factor in the further development of their scientific and technological capacity. An effective effort to promote a broad-based public understanding of and knowledge about science and technology, especially about its potential benefits and limitations, can help a country to harness science and technology and to broaden the human resource base for science and technology. Certain types of science and technology institutions, such as science and technology centers, and popular science and technology journalism, have found immense constituencies in many countries.

If properly mobilized, these constituencies may form a strong basis for science and technology development.

If science and technology are to become a true part of the development effort, a receptive audience should be created in various societal groups-government, entrepreneurs, students, intellectuals, general public, etc. Furthermore, close communication between researchers and policy makers and the involvement of research in policy formulation can improve the practicality of policy formulation and implementation. The interlocking communication and information among concerned organizations (networks, etc.) has therefore to be established for the effective implementation of S&T policy (demystification and popularization of science).

Diffusion campaigns (radio, TV, Video films, theater, ...) and science education are principal and effective instruments for the popularization and demystification of S&T . In addition, the subjects of S&T policy and technology management should be introduced in scientific and technical undergraduate courses, particularly in engineering, business management, and government administration.

4.5. Creation of a climate for S&T: Science and Technology Movement

The promotion of national S&T dialogue cannot effectively take place without first or at the same time creating a climate for science and technology. A major policy goal for laying a solid foundation for science and technology should be the creation of a climate favourable to carrying out such activities. The government, with the cooperation of the academic and industrial communities and the mass media, should launch a nationwide science movement whose main objective is to create an environment in which the general public can apply scientific principles to daily living with a spirit of rationality, efficiency and creativeness. This movement can provide a strong foundation for national development.

In its efforts to realize the ideas and goals of the movement, the following activities can be effected:

- Operation of science exhibition halls and National Science Museums;
- Operation of science film libraries;
- Publication of science and technology booklets;
- Lectures on science for housewives and students;
- Conduct of Innovation and Invention Contests;
- Publication of Technical guidance for farmers and fisherfolk;
- Activation of mass media;
- Conduct of National personal computer contest; and
- Development of specific projects on:

- Community science and technology network;

- A Media Resource Service to assist journalist gain access to scientists and technologists with special expertise on current issues.

Thus, the exploratory spirit of youth in science will be encouraged in order to expand the foundation for future science manpower development while enhancing the ability to adapt to a modern industrialized society. A national science museum should be devoted to collecting, preserving, studying and exhibiting materials in the fields of science, technology, industry and natural history. The main functions of the museum will be to diffuse scientific way of living for the general public.

Furthermore, other possible institutional mechanisms to facilitate national policy dialogue in S&T include:

- National Information Centres. In parallel with international and region-wide information Centres, the creation of national S&T referral services can promote dialogue in S&T as well as facilitate linkages between technology producers, traders and users. National information systems should be decentralized and linked to sub-regional, regional and international information Centres through regional and international clearing houses.

  It is usually desirable to establish information Centres not under government auspices but with a private sector umbrella organization, closer to the end-user and the general public. The Centres are expected to play a coordinating, match-making and catalytic role in policy dialogue by providing S&T information and advice, stimulating demonstration of "S&T products". Clear advertising and distribution strategies need also be devised by the institutions charged with S&T information dissemination. This would help to avoid ineffectiveness and overlapping in existing institutional structures. Local NGOs and business associations have a significant role in this field, because they often function as important intermediaries for information flows among private enterprises.

  Various forms of partnerships agreements and institutional twinning --- such as government and private enterprise partnerships, inter-agency partnership or partnerships between industry and research Centres --- have proven effective in both facilitating, among national actors, the flow of information on S&T issues and the promotion of S&T policy dialogue. Science and Technology consultants and specialized intermediaries can also help to generate linkages and facilitate communication and information flows among principal parties.

4.6. Administrative Structure for Integrating S&T Issues into Development Policy, and Decision-making Machinery and Technology Policy

The comprehensive incorporation of science and technology issues into decision-making on a continuous as opposed to an intermittent, ad-hoc basis requires not only the availability of the S&T policy instruments, but also the setting up of permanent mechanisms and procedures for building into the policy-making process routine awareness of, and treatment of these issues.

In addition to the above, professional associations should be established to serve S&T personnel of different specializations. If feasible, such associations should be set up also in North America and Europe. Such "outside" associations could serve as a medium through which Governments can attract high-calibre S&T experts working in America and Europe to return to Africa either on a temporary or permanent basis to assist in the national S&T programme.

In the attempt of incorporating S&T policies in the overall development policy, one should be aware of the conflicts that almost always exist among the different factions or planners or stakeholders. Particularly difficult to overcome are basic problems in the political economy of a society in which there are strong links between the technological structure and the financial and power structure. Many of the problems which hinder the introduction and conduct of S&T policies are capable of solution, and an important part of the solution lies in the creation of an appropriate administrative structure, within which those responsible for formulating S&T policies operate. If S&T policies are to be successfully implemented, the mechanism must exist for translating them from statements on paper into action - which in turn requires that the S&T policy formulators are appropriately placed in the government administrative machine.

The effective introduction of a well-designed technology dimension into policy determination requires that those responsible for technology matters either participate directly in high-level policy committees or have direct and routine access, in an advisory capacity, to those who do. It also requires that consideration of technology issues be widespread, and based on a two-way flow of information between the central S&T unit and the wide range of relevant ministries and other agencies (as indicated in Figure .....). This in turn suggests that appropriate, qualified personnel should be involved in all of specific activities in which an S&T input is particularly desirable --- education and manpower planning, foreign-aid negotiations, industrial promotion, fiscal and tariff policy formulation, and so on.

Furthermore, allocation of a separate budget to the S&T unit to permit financing of both policy-orientated research and a number of specific S&T activities (such as engagement in international know-how networks) will both ensure that at least a modicum of progress is made in promoting specific technology activities, and provide a means of sensitizing government to the nature and functions of science and technology policies.

It is often useful to have a senior minister in cabinet charged with ensuring the development and application of S&T policy. This need not imply a separate department or ministry; what is more important is that the person holding responsibility, be a member of the cabinet's key economic and social committees, to bring about policy integration.

Furthermore, it is stressed that the S&T Unit described above should be established at a high level, transcending departmental or functional divisions. In order for it to function effectively, an ability to keep up-to-date with technological developments and to predict and assess their economic and social impact is crucial. This involves governments establishing an effective capacity to undertake:

- **Technology forecasting**, necessarily approximate and at a broad perspective level, but an essential management tool for indicative planning purposes. It could be used, for example, to give early warning indicators of, say, future threats to exports from substitutes and long-term employment bottlenecks;

- **Technology evaluation,** an important stage in making major decisions regarding new technologies. It could involve conventional accounting and economic assessment supplemented by an evaluation of social and environmental effects and the wider `systems' implications; and

- **Technology monitoring,** to keep the effects of a new technology under review once it has been installed.

The machinery is not very important in itself -- some governments have elaborate structures for technology policy which do little. Rather what is needed is political acceptance that technology policy is a crucial task of government. Besides this, there is the need for a consultative process to promote continuously awareness of the need for integration of S&T and develop demand-led public and private sector perspectives. This process should be assisted by a mechanism called Integrational Action Group (IAG), which is a small, proactive and flexible mechanism drawing for its activities the resources of the various sectors of the economy. The Group is supposed to be a catalyst, facilitator and promoter of informed consultations amongst key actors of the economy for greater coherence in the decision-making process. For IAG to be effective in a given setting, it is important that information, experiences and expertise be shared by a collaborative and coordinated network. This national or sub-regional networking is a major and essential aspect of the mechanism.

4.7 The Presidential Advisory Committee

A Presidential or Prime Ministerial Advisory Committee would need to have:

- A group of people who, by dint of their expertise, experience and accomplishments, would command wide respect throughout the country;

- A clear set of terms of reference and an acceptable time frame within which to report;

- The power to hold public hearings, to invite submissions, and to conduct studies and research if necessary;

- The requirement to make public their findings, any testimony which they gathered, and the results of any research which they commissioned; (a well conducted commission could set new standards for transparency in its operations);

- A competent, professional secretariat; and

- An adequate budget.

Membership is often by appointment by the President or Prime Minister, so political judgement is involved. The Committee would recommend to the Head of State the most desirable S&T policies.

Advisory mechanisms on lowel levels than reporting directly to the head of government can make useful contribution; for example, the Japanese case of widely consultative mechanisms to advise on likely emerging technological trends. The value of the Japanese process is the way in which the consultations bring shareholders together.

4.8. The Presidential National Science and Technology Promotion Convention

As stated earlier, an indispensable factor in the development of S&T in a developing country is the commitment of the national political leader towards using S&T for national development. In order to practically demonstrate this determination, a Presidential National Science and Technology Promotion Convention should be instituted. Such a Convention should be presided over by the President of the Republic, and held twice in a year. The necessary arrangements should be made by the Ministry of Science and Technology or its equivalent.

The objectives of the Convention could be as follows:

- Plan technology development to reach government development goals;
- To ensure effective implementation of S&T development plans;
- Plan national technical manpower development;
- Plan measures to enhance productivity and quality control;
- Plan consumer protection through technology;
- Study successful cases of technology development and advanced technology trends.

The members of the National S&T Promotion Convention should include ministers of all ministries, heads of research institutes and representatives from industry and trade unions. Additionally, individuals, who by dint of their expertise, experience and accomplishments, could be invited to attend the Conventions. It is expected that such a Convention while promoting S&T policy dialogue as well as plan implementation will also enable the country to cope timely and efficiently with international technology competition through the combined efforts of Government, industry and academia.

4.9 The Ministerial Council for Science and Technology Promotion

The Council should compose of the various ministers and prominent members from the S&T community as well as the private sector. The Prime Minister should be the Chairman of this Council. The setting up of the Council is based on the rationale and on the appreciation of the fact that S&T policy dialogue promotion and S&T programmes are in general interrelated with the work of other ministries and the Ministry of Science and Technology cannot handle all aspects single-handedly. Thus, the Council should be seen as a medium by which confirmation of the policies and plans developed by the Ministry of S&T is sought from other ministries so that coordination at the national level can be carried out effectively.

The establishment of a broad-based Industry and Technology Co-ordinating Committee, with its membership drawn from other ministries, public and private institutions and the private sector, will provide an effective mechanism for co-ordinating and harmonizing, at the operational level, the programmes and activities of the Ministry with those of other bodies and for providing policy guidance to the Ministry responsible for S&T.

4.10 Institutionalized Task Force on National Science and Technology Policy

A Task Force on National Science and Technology policy should be put in place. Membership of such a Task Force will be drawn from trade unions, women's groups, private entrepreneurs and selected professional associations.

The Task Force will sensitize and promote understanding among relevant government and private institutions about their roles and responsibilities in enhancing the use and application of S&T for national development.

The Task Force will also be responsible for organizing once in every two years a national S&T Round Table Conference which should take the form of an EXPERT GROUP MEETING. It will among others review R&D findings and their utilization in the productive sectors; build national consensus on initiatives to be taken to strengthen S&T as an effective means to respond to private sector development needs and on the allocation of resources for implementing national programmes; map out national technology needs and portfolios of prioritized programmes and projects for external financing.

5. BROAD-BASED POLICY DIALOGUE PROJECT IDEA: A MULTI-PHASED INITIATIVE

The objective of this idea is to develop an approach which could be applicable in general in developing African countries to encourage them to build their endogenous capability in Science and Technology.

The approach which can also be called "Stakeholders Policy Dialogue" is a process of decision making whereby stakeholders in the development process participate, or become partners, in the consensus building on issues regarding Science and Technology for development. An important aspect of this idea is that it will be up to individual countries to determine, through this learning process (policy dialogue), their needs and priorities, based on which to optimize the utilization of their resources. Furthermore, an important output of this stakeholders policy dialogue is expected to be a portfolio of prioritized initiatives based on broad consensus. The project will seek to initiate an approach whereby consensus is effectively reached on S&T issues so that they receive societal support. It is expected to be implemented through a number of studies in support of a series of policy dialogues, on subjects starting from general to specific, gradually leading towards a set of concrete initiatives. The resulting appropriately formulated portfolio of prioritized initiatives will then be used as a platform for both internal and external donor financing aimed at strengthening science and technology structures.

In the first phase, an agreed number of diagnostic studies will be undertaken. These will have the objective of examining the broad issues affecting Science and Technology. The issues will necessarily include the impact of macro-economic policies and the legislative framework on technological innovation, industrial research and development, as well as the Science and Technology infrastructure and its utilization for the attainment of national, social and economic objectives.

Using the first set of studies as background documents, the first round of dialogue will focus on the identification of broad areas which affect national science and technology and which need critical examination to see how they promote or impede scientific and technological processes from being fully utilized to meet national, social and economic objectives.

During this second phase, a second set of studies which inter alia, will result from the first round of dialogue, will concentrate on suggested options and recommendations for future actions. These studies, after being scrutinized by the second round of stakeholders' policy dialogue and further revised, will serve as the basis for specific portfolio formulation.

The third phase will be essentially a portfolio formulation process. Initiatives on projects as referred to here could be policy adjustment programmes, training of human resources or institutional building. The third round of policy dialogues will therefore review the initiatives that will have been proposed, examine resources allocation and generate a portfolio of priority initiatives to be funded by both internal and external sources. Consensus building during this round will ensure the support of the various sectors and secure adequate resources for the implementation of the new initiatives.

At the end of it all, there will be a round table on coalition of resources which will be a joint effort by the Government and other agencies to solicit funding and other resources from both bilateral and multilateral sources to finance the portfolio of prioritized initiatives, besides domestic financing.

Experience in practise indicates that at least the following stakeholders should be kept in mind in the above initiative:

* Government representatives of the different ministries and agencies;

* Industry representatives (users and suppliers of technology);

* Representatives of the technical infrastructure (universities, R&D-institutions, colleges, consultants);

* Representatives of the most important NGOs.

All these stakeholders have different tasks: initiator, executer, financier. In order to keep all stakeholders committed to the dialogue process, it is important that the process is:

* Open to all of the stakeholders (sharing of all information);

* Seeking a maximum of consensus (follow-up).

Organizational Framework

- Important aspects of the organizational framework are:

  * The establishment of an assessment team, steering group, sound-board, etc. Which parties are going to be integrated in what kind of way in the organizational framework;

  * The agreement on procedures for decisions and information. The way important decisions are made have to be agreed upon before starting the process;

  * The choice of the executer. Because of the different interests at stake an independent facilitator (organization e.g. a local institution or a board) can function as bridge for consensus between the different interests.

6. IN LIEU OF A CONCLUSION

One of the most important lessons that has been learnt over the years is that Science and Technology in most African countries have hitherto been treated as an isolated and elitist process in the dynamics of development and not as an integrated part, inseparable from the social, economic development process.

Furthermore, decisions regarding technologies have often been taken in isolation without due consideration of the total development picture, or of the needs and expectations of the stakeholders. The consequence is that the majority of the populations in the region do not feel that they are the owners of any given S&T policy, where they exist.

The current situations prevailing in most of the countries call for strong determination and purposeful reorientation in the decision making system. Many of the problems afflicting the technological development of the region are internal in nature which cannot be solved from outside. It is therefore the greatest challenge to the leadership in the countries of the region to face the situation squarely, and initiate concrete measures which should aim at promoting national policy dialogues in Science and Technology for development. For this to happen, effective machineries and mechanisms are required at the various levels of the society. These could include the setting up, or institutionalization, of:

- Science and Technology Movement;
- Permanent Administrative structure for integrating S&T issues into development policy;
- Presidential Advisory Committee;
- Ministerial Council for Science and Technology Promotion;
- National Task Force on Science and Technology Policy; and
- Stakeholders Policy Dialogues.

Furthermore, and perhaps more importantly, the issue of leadership both political and scientific and technological, is a key and critical factor in any successful pursuit of national policy dialogue in S&T for development. The experiences of both developed and newly industrializing countries copiously and clearly show that economies as well as upward social mobility of citizens can be transformed and provided, respectively, by properly identifying technology problems and issues with the help of an enlightened political leadership and forward-looking advisory committees/boards as well as effective stakeholders partnerships.

Stakeholders Consultations: A Mechanism for National Policy Dialogue Promotion

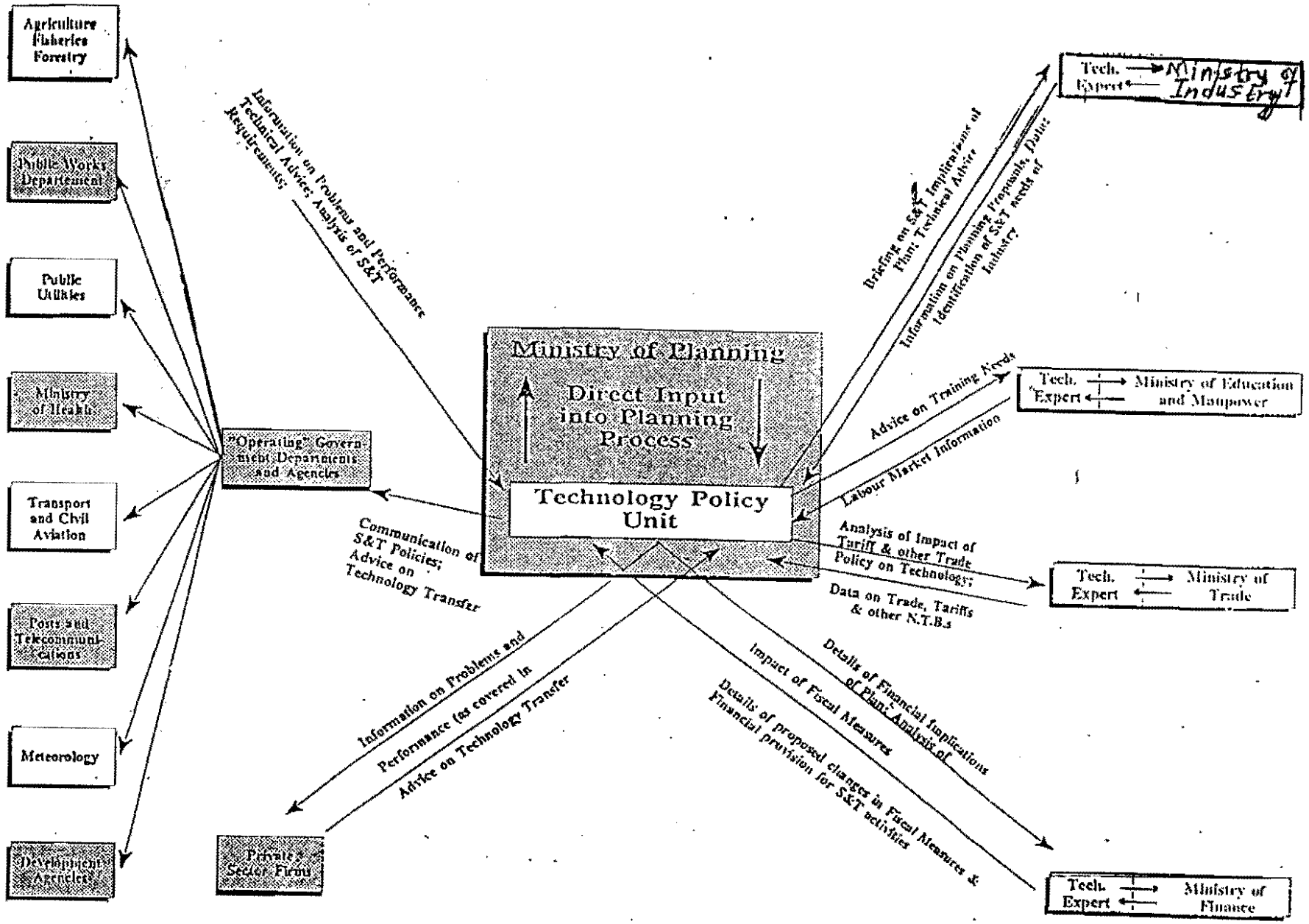

Figure Logistical and Functional Scheme for Science and Technology Unit
(Adapted from David J.C. Forsyth; 1989)

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