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**THE ROLE OF THE KING ABDULAZIZ CITY FOR SCIENCE
AND TECHNOLOGY REGARDING THE PRESENT STATUS
OF AND FUTURE PROSPECTS FOR RESEARCH
AND DEVELOPMENT IN SAUDI ARABIA**

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The Role of King Abdulaziz City for Science and Technology in the Present Status and Future Prospects of Research and Development in Saudi Arabia

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1. Introduction

In a world of increasing global competition, every nation pursues improved national economic performance through sustained growth in productivity. Technological innovation has been a major source of such growth, and governments have played important roles in many ways for accelerating it. One of these ways is to carry out a national research and development (R&D) program providing funds to technological innovation in public and private sectors.

Although the Kingdom's development plans have different foci and frameworks for achieving their goals, all plans, however, have the two general objectives of:

- a. Improving the welfare of the society by the application and incorporation of science and technology, while preserving cultural values.
- b. Developing the Kingdom's natural and human resources so as to reduce the extreme dependence upon the depletable hydrocarbon reserves by converting financial resources into domestically available physical assets.

The inception and implementation of viable science and technology policies are, therefore, basic prerequisites for the success of the national development plans. To achieve this, the government of Saudi Arabia has made a conscious effort to establish a solid infrastructure for scientific R&D.

Financial supports for scientific research in Saudi Arabia are organized primarily on three levels. On one level funding is by King Abdulaziz City for Science and Technology (KACST). On a second level, universities fund their own projects out of their research budgets to conduct scientific activities not funded by KACST. These projects involve finding solutions to localized problems, and conducting research in a specific field. On a third level, funding for research projects can come from the private sector. Many companies within Saudi Arabia maintain laboratory facilities, and conduct research specific to their individual needs. Private corporations may also fund scientific studies at research institutes or universities for the same reason, or may collaborate with the universities, with each paying a portion of the expenses.

This paper will review KACST's role in research and development activities in the Kingdom of Saudi Arabia.

- h. Directorate of Administrative Development: Assists the administration in developing manpower and in organizing administrative matters.

In addition to the technical directorates, the organizational structure of KACST includes the following research institutes, which conduct research related to their respective fields.

- Energy Research Institute: is concerned with the adoption and development of energy technologies that are appropriate for the social and environmental conditions of the kingdom. The main objectives of this institute is to survey the renewable energy resources available, identify the difficulties faced in using the renewable energy and research their appropriate solutions, and promote rational use of energy resources.
- Natural Resources and Environment Research Institute: is concerned with the research and studies related to various environmental problems and their relevant solution, to develop and conserve natural resources, and to enhance the level of the country contribution to global environmental issues.
- Astronomy and Geophysics Research Institute: The main goal of this institute is to undertake applied research in astronomy and geophysics, monitor and study earthquakes and mitigate their effects, and collaborate with universities and research centers in the area of common interest.
- Space Research Institute: is concerned mainly with the transfer, development, and application of aerospace technology such as aerospace systems, numerical design and simulation, laser application, remote sensing, GIS, and last but not least satellite imageries.
- Atomic Energy Research Institute: is concerned with the adoption and utilization of the nuclear sciences and technologies. The main objectives of this institute is to draft and implement a national atomic energy plan, conduct research in the field of nuclear technologies, identify manpower requirements and train them in the area of atomic energy research.
- Computers and Electronics Research Institute: The goal of this institute is to conduct research and studies in the fields of electrical engineering, bio-electrical engineering, systems engineering, computer engineering and computer sciences.
- Petroleum and Petrochemical Research Institute: is concerned with the adoption and utilization of the petroleum and petrochemical technologies.

2.3 Responsibilities

To achieve their R&D objectives, the various ministries and government agencies concerned with science and technology administer their respective programs. However KACST carries out the following programs:

a. Long-term Plan for R&D

This program concerns the formation of a long-term master plan for research and development in the Kingdom, focusing on the coordination of multi-sectoral activities, the long-term needs of Saudi society and the future directions of R&D.

Another program managed by this directorate and used as a tool for the advancement of science and technology is the National Research Projects Program. Under this program, KACST sponsors selected research projects that are designed to benefit various government agencies, either by directly helping to solve some of their problems, or by improving their work processes and procedures. This type of research project is managed by working groups of specialists selected from the staff of KACST, Saudi universities and other research centers. Within this grant program category, KACST has sponsored many research projects in areas such as medicine, engineering, agriculture, education, water, and traffic safety.

Two other programs designed to enhance research capabilities at universities and research centers, are the Limited Grant Program, and the Graduate Students Grant Program for supporting graduate students' research.

Aiming at studying the problems pertinent to economical growth, educational, and social welfare, the Humanities Grant Program was formulated. The recommendations of the funded research projects will be helpful in making decisions in the respective areas.

The Production Sectors Grants Program addresses the problems encountered in the production fields, and aims at rendering technical solutions to problems that hinder production. This program emphasizes the co-ordination between the production and the research sectors with the ultimate objective of drawing more involvement of the private sector in the R&D activities.

4. Links with Industry

Like most of the countries seriously involved in development, the Kingdom puts a strong emphasis on industrialization. Two decades ago, plans were enacted to diversify the economic base that heavily relied on the petroleum industry. Due to the experience that the country went through during this period and the projected plans for development in a competitive world, after being committed to joining the World Trade Organization, a sound conviction was proliferated that only aggressive policies in industrialization are required. This is apt to create demand for R&D activities, together with other related technical services as quality control and standard operational procedures (1).

The need for research to support development was perceived from the outset of the development plans. However, the role of industry and other private sector parties in the field of research support is not significant, but is promising, though moving at a slow rate (1). R&D units in industry are available in large enterprises like The Saudi Arabian Oil Company (SAUDI ARAMCO) and the Saudi Arabian Basic Industries Company (SABIC). Also, some limited activities take place between industry and universities such as King Fahad University for Petroleum and Minerals and King Saud University.

Efforts are being made to bridge the gap, between KACST, some universities, as well as the industry. Liaison offices exist in KACST and King Fahad University for Petroleum and Minerals, and are proposed at King Saud University (2). Also, a new research program is being studied by KACST, that would look only at sponsoring projects to help enhance the industry relationships with the research community. Chambers of commerce and industry, on the other hand, are actively engaged in seminars and workshops to discuss the problem and arrive at satisfactory solutions.

of the infrastructure, alternative building materials, insulation of building, utilization of solar energy, corrosion of reinforcing bars, and corrosion of drinking water network were considered necessary in the field of development. The national project for the study of rutting in asphalt pavements in the Kingdom is a good example, as it attempts to find a solution for this problem that is causing significant damage to the Kingdom's 37,000 kms road network, and incurring heavy maintenance cost beside the safety hazards.

Environmental studies also have a significant portion of KACST activities. Beside the efforts of the Institute of Natural Resources and Environmental Research, there are projects funded by the GDRGP. These projects are concerned with source, and effect of pollutants on human, animals, plants, and marine life. Project (AR-15-26), entitled "Study of Air Pollutants and Their Effects on the Environment and Public Health in the Yanbu Industrial City" and project (AR-11-50) entitled "Study of Contaminants in Some Selected Foods and Their Effect On Public Health" are cited as examples.

Developing of education curriculum is a threshold to a strong base in R&D. KACST has recognized the importance of developing science and mathematics curricula for forming the solid base for learning and adoption of technology. National projects on mathematics and science education at elementary and intermediate schools were sponsored by KACST. The projects aimed at studying the curricula of mathematics and science education, in addition to laying down conceptions for those curricula in the light of the individual and social needs. Another important project funded by KACST was on "Talent Scouting". The project aimed at scouting talented kids and directing more efforts and attention towards raising their talents. Future scientists are expected to come out of this group.

6. Principal Steps and Activities Aimed at Setting-up R&D System

The need for strategic planning as a tool for improving the R&D integration cannot be over-emphasized. In establishing any strategic planning certain basic guidelines must be considered. Among these are: the environment within which the R&D will be developed, provision of appropriate staff, evaluation and allocation of resources, and formulation of a review and feedback system. However, allocation of resource and provision of appropriate staff are the corner stone of the system.

Besides KACST, which represents the primary body for scientific research in Saudi Arabia, and the universities that are involved in scientific research, other organizations are active in conducting studies for the development of science and technology. This involvement takes place through the evaluation of science policies and administration of centers, and R&D programs.

R&D Resources

These resources include: human resource, technological resource, financial resource and information resources. Financial and information resources are inputs constituting the basic requirements enabling the R&D execution and management. The human and technological resources are considered R&D tools, which can be used, in the disciplined interpretation and translation of the requirement into operational target. Fig 1 indicates the components of the national Saudi R&D system.

cities, entering into partnership agreements with foreign industries recognized for their utilization of advanced industrial technology in certain industrial fields, and offering incentives to the private sector to engage in the industrialization of Saudi Arabia.

Building a viable industrial base has been the cornerstone of the economic development strategy in Saudi Arabia. To achieve this, there is considerable impetus to encourage R&D activities, which import and adapt advanced technologies. It is therefore Saudi policy to welcome foreign capital and encourage participation in economic development projects in cooperation with Saudi businesses.

This policy is expected to be further enhanced by the implementation of the General Agreement on Tariffs and Trade. Universities and governmental agencies are expected to benefit from financial resources from industry, exposure to more applications-oriented research and obtaining better insights for curriculum development. It is, furthermore, postulated that important scientific achievements result from some technical problems faced by the industry; something that calls for close interaction between industry and the research community (3).

The idea of KACST-universities-industry linkage was faced, however, from the outset with difficulties due to the deep-rooted differences between the industrial and university atmospheres. In industry, as an example, secrecy is of vital importance for the obvious reason of competition, whereas researchers need to publicise their work to gain recognition. Also, the factor of time has a higher value in industry than in research. Industry wants its products to dominate the market by early release, while researchers seek assurance through diligence, repeatability and peer acceptance. In general, one major difference may be that profit comes as a prime goal for industry. Hence, a great discovery has little value for the industry if it does not have a high economic return.

Universities also have their own concerns that relate mostly to the relative freedom and impartiality that may be enjoyed by the research community. Many researchers voiced their strong concerns about compromising their value systems through increased exposure to commercial practices (4), or compromising their institutions' priorities in overall research and training (5). Other obstacles sometimes mentioned are (6);

- mutual distrust,
- financing for research,
- incentives for researchers,
- competitive position of the industry.

7. Obstacles that Hinder R&D

Saudi Arabia, like all developing countries, faces difficulties and has many problems in its quest for transfer of technology despite the significant progress made toward industrialization. Saudi Arabia had access to transfer of technology only in the last couple of decades, which means that insignificant accumulation of technology has been realized in such a short period of time. Some of these difficulties and obstacles, which face R&D, include:

1. The shortage of information and data: The unavailability of required quantitative and qualitative information and data is considered the most important impediment in

8. Future Perspectives

A major challenge facing the developing nations today is the identification and adaptation of strategies to leverage their positions to gain greater control over their own economies. This can be accomplished through a number of techniques, most notably through the transfer of technology and also through R&D. However, the “leap frog” phenomenon saves the extensive costs of both time and money to deviancy and technology domestically. On the other hand, the R&D process is slow and critical.

In general, there are certain factors that must be considered before technology can be satisfactorily introduced into the recipient country. Motivation on the part of the recipient to acquire the technology is one consideration. The suitability of the technology in question, the institutional, the environmental, and societal set-up or the others.

There are a number of methods for introducing technology to a developing country, and it has been the goal of Saudi Arabia to get the maximum returns of these methods. One of the most important strategies involves the flow of information into the Kingdom via books, journals, and other published scientific research achievements. Another strategy is to send students to study abroad in highly developed countries (Europe & USA) and upon they return home, they apply their acquired technological know-how. This strategy, in addition to an aggressive domestic educational campaign, is designed to train sufficient numbers of Saudi technicians, thereby reducing the dependency on foreign human resources.

Strengthening the Kingdom's own research and development capabilities is an essential condition for enhancing the level of science and technology in use. Because the competitiveness of private sector establishments depends to a large extent upon the productivity improvements induced by R&D activities, greater emphasis on the development of R&D capabilities in private companies is required. Regardless of whether it is performed in the public or the private sectors, R&D in the field of science and technology requires a long lead time and vast resources before its results are obtained and put into practical use. Thus, because of the extent of the task ahead, the effective mobilization of resources for R&D activities on a national scale is necessary, combined with close co-operation between the public and private sectors.

In response to these important issues, the following policy measures should be considered in formulating national strategies.

1. The establishment of a long-term national plan for the development of science and technology.
2. The development of measures to ensure maximum coordination between the relevant government agencies and effective cooperation with the private sector.
3. The adoption of a concerted action to expand and improve educational courses and curricula related to science and technology at all levels.
4. The mobilization of all available means to promote deeper public awareness of the importance of science and technology, such as the mass media, symposia, and exhibitions.

Phase-I: Studying the current status of science and technology, and the extent of the linkage between the science and technology base and the demands for development plans.

Phase-II: Conducting (18) studies of future directions of science and technology development in the world and their horizons in Saudi Arabia.

Phase-III: Has focused on the preparation of the basic components of the Policy and strategy which included goals, priorities, strategies and their alternatives, setting preliminary programs to attain the stated strategies, as well as the methodologies to be followed.

Phase-IV: Has aimed at the preparation of the five years plans, the details of the programs, priorities of the different objectives, phasing out of projects as prepared by the agencies in the concerned sectors. All these efforts are directed towards determining the priorities and strategies to utilize human, financial and natural resources for the social welfare and the realization of development goals.

Both Phase-I and II of the comprehensive plan have already been accomplished and the work on Phase-III is in progress. It is expected that successful implementation of this plan will have tremendous impact on R&D in the Kingdom of Saudi Arabia.

9. Conclusions

The organizational structure of KACST, which is composed of nine organizational units and seven specialized research institutes, was discussed. KACST's responsibilities to achieve the R&D objectives through co-ordination of multi-sector activities were described. Besides KACST, which represents the primary body for scientific research in Saudi Arabia, the involvement of other organizations in conducting studies for the R&D was discussed.

The R&D resources in Saudi Arabia and the obstacles hindering R&D were examined. The shortage of well trained scientific and technical manpower, insufficient investment in R&D, difficulties, facing the relationship between industry and research, and lack of capabilities in universities to help transfer of technology are the main obstacles facing R&D. Institution-wise, the Saudi system for R&D is satisfactory. However, the overview strategy for R&D should strengthen and consolidate KACST's role on R&D.

Some policy measures should be considered in formulating national strategies. These include development of measures to ensure maximum coordination between the relevant government agencies and effective co-operation with the private sectors, improvement of educational courses and curricula related to science and technology at all levels, and strengthening the governments role in improving the overall infrastructure support for science and technology.

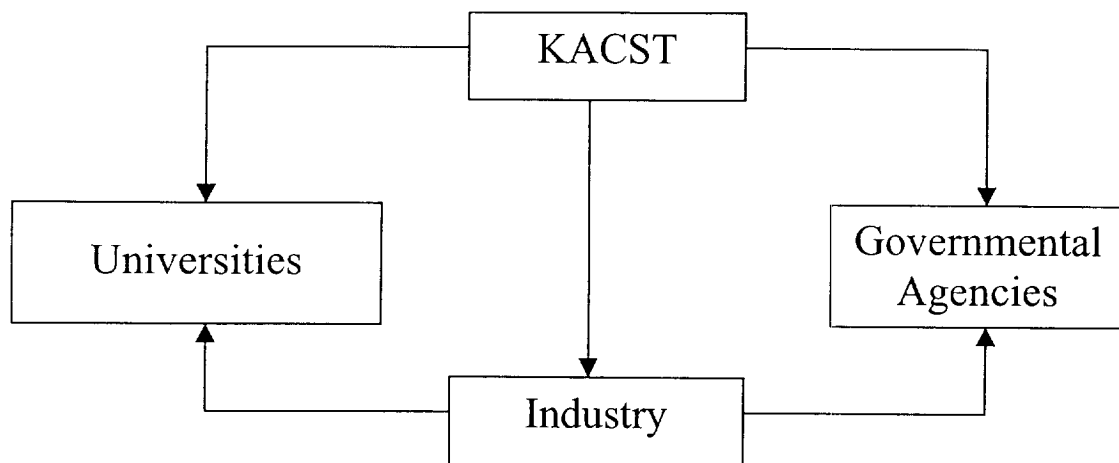
The experience of Saudi Arabia with R&D programs is relatively new. Nevertheless, KACST's experience can be useful to developing countries.

Table 1. General Annual Program:
Number of Projects and Funds from 1979 to 1999

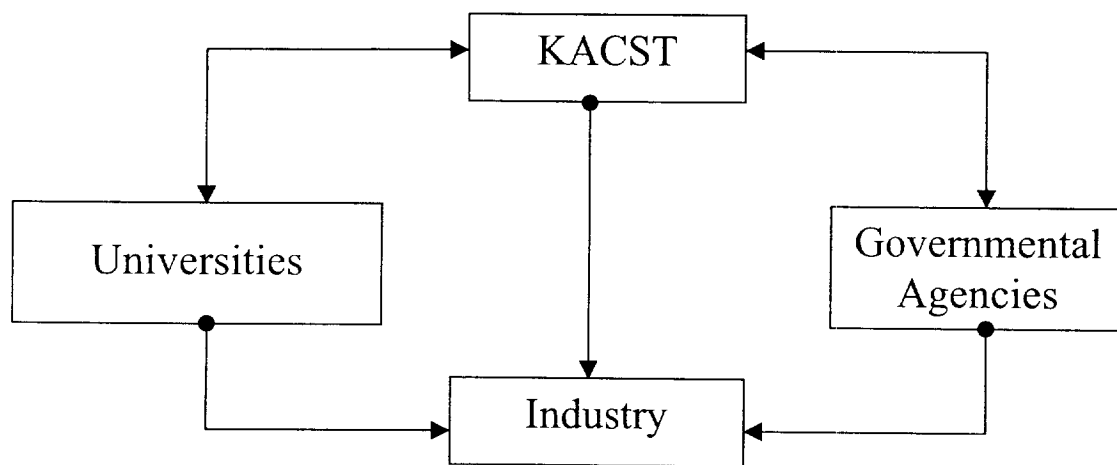
Fields	Number of Projects	Fund (SR)
Medicine	99	110,706,328
Engineering	150	99,462,987
Agriculture	86	80,302,285
Basic Sciences	32	22,874,242
Petrochemicals	23	15,694,556
Pollution	21	14,225,700
Water Resources	14	12,245,726
Natural Resources	13	12,008,536
Total	438	367,520,360

Table 2. The Limited Grants Program:
Number of Projects and Funds from 1996 to 1999

Fields	Number of Projects	Fund (SR)
Medicine	84	6,480,658
Engineering	35	2,879,045
Agriculture	30	2,405,260
Basic Sciences	40	3,462,473
Natural Resources	1	75,400
Water Resources	4	310,935
Total	194	15,613,771



a) Research Funding Flow



b) Information Flow

Fig.1: Present Major Components of the National Saudi R & D System.

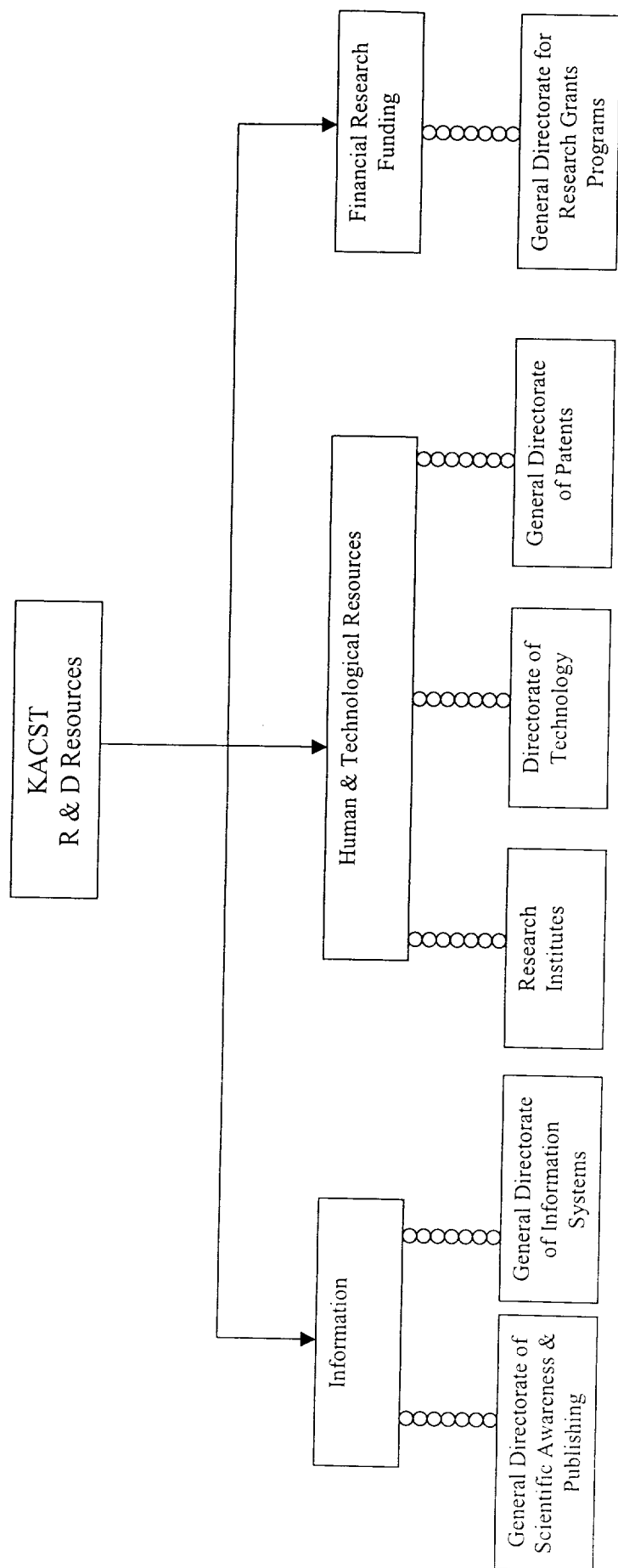


Fig.2: KACST R & D Resources

Table 3. The Post-graduate Students Grant Program:
Number of Projects and Funds from 1991 to 1999

Fields	Number of Projects	Fund (SR)
Medicine	59	1,678,101
Engineering	28	808,120
Agriculture	68	1,924,279
Basic Sciences	64	1,995,949
Natural Resources	2	65,555
Water Resources	4	94,185
Total	229	6,674,699

Table 4. The National Program:
Number of Projects and Funds from 1979 to 1999

Fields	Number of Projects	Fund (SR)
Medicine	6	35,320,561
Engineering	7	36,678,670
Agriculture	1	9,750,907
Basic Sciences	1	1.255.000
Education	1	4,806,487
Traffic Safety	1	11,590,780
Total	17	99,402,405

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5. The strengthening of the government's role in improving the overall infrastructure support for science and technology, through improved information services, a patent protection scheme, and the establishment of an appropriate mechanism for sponsoring risk-sharing systems and the efficient transfer of technology.
6. The establishment and expansion of R&D activities in both the public and private sectors.

KACST in collaboration with the concerned public and private sectors, and the Ministry of Planning have embarked on preparing a long term comprehensive national plan for science and technology in the Kingdom for the period (1420-1440 H /2000-2020.). This plan focuses on setting objectives and priorities, commensurate with the available resources, to provide for the critical demands of the development plan, and to set a solid national base for science and technology.

The National Plan for Science and Technology has to be comprehensive. It will integrate the different perceptions of science and technology needs in the country. It will also consider both short and long term requirements. The Plan will accommodate the diversity of scientific and technological fields and must recognize the complex relationships among these fields and with the economic sectors. It must foster a balance of internal development and importation in accordance with reasonable expectations for adaptation and absorption of new capabilities.

The Plan will be flexible to reflect the progress of social and economic development programs, and to meet the needs to change that may arise from innovation, reorientation of goals or priorities, or from decisions to alter the scope or schedule of programs. The Plan also will be practical, and should present reasonable expectations for progress and realistic schedules for implementation.

The Comprehensive Plan for Science and Technology will encompass broad missions such as the increase of public awareness of science and technology roles, manpower development, expansion of research and development capabilities, and the acquisition and adaptation of technology. The basic components of the comprehensive plan are: goals, objectives, strategies, programs and projects. The long term goals, objectives and priorities of the plan will be a part of the national goals, objectives, and priorities. Therefore, the organizations and processes involved in preparing the Plan will response to the requirements of the National Development Plan.

The Comprehensive Plan for Science and Technology has two main parts:

Part 1: A Policy and Strategy present long-term goals, objectives, and strategies for the period of 1420-1440/ 2000-2020 AD

Part II: Four executive 5 year – plans describe programs, project, and priorities in detail. Each Five Year Plan will be associated with a counterpart of the national development plan (7th, 8th, 9th, and 10th).

The comprehensive plan has been implemented in four consecutive and inter-related phases:

selection and determination of science and technology priorities in the countries of the region. Planning for the future cannot be separated from the evaluation of the past and the present. These evaluations include knowing its positive response in order to build on that, or determine its shortcoming in order to avoid repeating them. Thus, provision of information on existing situation and its accomplishments, direction of its development, and identifying strong and weak points of the science and technology system, become a base for the selection and determination of priorities, and their evaluation and development, in such a way as to coincide with actual national needs. The unavailability of sufficient information is attributed to the recent establishment of data and information centers, and to the shortage of executed studies in this direction. Moreover, there is a weak coordination among related institutes. This prevents planners and decision-makers from getting information easily, and in time (7).

2. The shortage of well trained scientific and technical manpower: Institute concerned with determining or executing science and technology priorities face many difficulties by not having enough numbers of national cadres experienced in selection and determination of priorities. This happened because the field is considered partly new, and was not cared for by the academic media until recently. The task of these institutes becomes more difficult as this field requires accustomed experiences acquainted with national situations and conditions. This makes seeking aid of foreign experiences insufficient to the rising needs (7). Therefore, educational programs should be directed towards strengthening the technical education and more emphasis should be put on practical training of university students. Vocational training should be pursued at the intermediate and secondary level.
3. Ways and means for determining priorities: Though there is a great interest in developing countries and several international organizations, to develop ways and means for determining science and technology priorities, however, there are no ideal methods that could demonstrate scientific priority expectations, selection, and determination. This makes choosing an ideal way for countries of the region not easy. Eventually, this demanded making intensive efforts, and use of several ways, to insure adequate choice in determining science and technology priorities (7).
4. Investment in science and technology: The investment in science and technology and specifically in R&D is very insufficient. The main investment in R&D is governmental. More contribution by the industry is called for. Recently the government has started to advocate more industry involvement in R&D.
5. Private sector: Difficulties facing the relationship between industry and research centers due to the lack of vision on the industry's part to understand the mission of research centers particular when it comes to funding. On the part of the universities and research centers, the lack of adequate information about problems facing the industry and the extent of their influence production were not fully realized.

King Abdulaziz City for Science and Technology

KACST occupies a unique place on both National and International scientific knowledge which can be efficiently utilized to support industrial and agricultural development. KACST cannot substitute for innovative capacities of the industry, which is the true producer of wealth, nor does it do the same job as the universities in basic and applied research or in education. However, it certainly can be a valuable supplier and an incremental developer of technology and key staging-post for engineers and applied scientists moving from universities into industries. Furthermore, it is not an intermediary organization moving the ideas generated in universities into the industrial application, but KACST has its own dynamics that maintain a continuous supply of technologies and technological related services which the industry needs. KACST's R&D resources are unfolded in Fig. 2.

Universities

The fundamental message of the Saudi Universities is teaching, research and community service. As with universities throughout the world, the academic staff is encouraged to conduct research in their respective fields, and to publish the results in scientific journals. The academic community in any society forms an integral part of R&D. Whereas industry is the eventual outlet for the flow of technology to the consuming public, an inherent relationship exists between the universities and the producing sector, as illustrated in Fig. 1.

The flow of technology from the university to industry follows two paths. First, the university graduates who take knowledge directly to the industry. Second, the university supplies industry with new technology indirectly by holding symposia, publishing articles, conducting research, solving technical problems, etc.

Technology is also advanced in the university by support from industry. One of the most common methods is direct funding of research projects. In Saudi Arabia, a considerable amount of research is conducted by universities under contract from private and state-run business. Of course, not all the research projects are funded externally, but there is a very definite and important field of mutual benefit between the two sectors. It is in this area that close cooperation exists.

Ministries and Governmental Agencies

Various government ministries, government-run research centers, government sponsored research projects, special commissions, and governmental corporations are heavily involved in R&D of the new technologies. This involvement takes place through the evaluation of science policies and the administration of centers, and R&D programs.

Industrial Sectors

There is a consensus among Saudi planners and policy makers that the nation's economic competitiveness grows out of the capacity of its industries to innovate and upgrade, fully exploiting the latest technologies. In light of this realization, the Saudi government has focused its effort on building the country's industrial base through various means. Of these R&D has become a prime mandate; the increase in diversification through innovation constitutes a basic pillar of Saudi national development plans.

Given this mandate, along with the knowledge that industrial development is enhanced greatly by technology transfer, several successful strategies have been developed and implemented to achieve industrial diversification. These strategies include building industrial

5. Relevance of R&D Activities to National Development Priorities

One of the main activities undertaken by KACST in R&D is funding and supervision of applied research that serves agencies involved in development. KACST represented by the GDRGP, contact ministries, other government agencies, research institutes and production centers to collect information about the problems that face these sectors and affect their development plans. Proposal for research priorities received from the different sources are screened by the GDRGP. The GDRGP has formed specialized working groups on the various disciplines eg: medicine, agriculture, natural resources, engineering and petrochemicals to examine the proposed topics and suggest priorities on the short and long terms. The GDRGP then formulates and announce the priorities.

Eighteen annual programs have already been funded, in which 438 projects were funded. Table (1) shows the number and funding of projects in each field. Besides the annual program 194 and 229 projects were funded in the Limited Grant Program and the Graduate Students Grant Program, respectively. Table (2) and Table (3) show the number and funding of projects for each program. These activities are being carried out through the GDRGP that also shoulders the responsibility of funding national projects that tackle issues of interest for development sectors in a more general manner than those projects of the annual programs. Seventeen national projects have been supported till now, with a total fund of about SR 100 million. Fields of research covered by those projects included basic sciences, medicine, agriculture, engineering, environmental studies, water resources, petroleum and petrochemicals as well as education and traffic safety. Table (4) shows the number of national projects and the amount of funds for each project.

Projects in the field of agriculture that have been funded address issues like conservation of irrigation water, utilization of salt-water in agriculture, breeding of drought resistant cultivars and husbandry of indigenous plants to be utilized in horticultural and ornamental purpose. Project (AR-16-112), entitled "Use of sub-surface drip irrigation technology for water conservation in the Kingdom of Saudi Arabia" may be taken as an example of conservation of water by means of estimating the actual need of plants for water and fulfilling that by computerized scheduling of irrigation.

The field of medical sciences is enriched through survey analyses of the health status and attempts to irradiate some of the diseases spread in certain parts of the Kingdom, like leishmaniasis, prevention of dental cavities through fluoridation of drinking water, guidelines for the development of health care facilities, and investigation of asthma and allergy in cities of Saudi Arabian were some of the topics which were pursued. Projects in the area of utilization of Saudi dates and their by-products in biosynthesis of antibiotics (AR-9-15), and chemical and pharmacological studies on local medicinal plants (AR-1-3) are examples of the badly needed R&D issues in Saudi Arabia.

The engineering field is generally involved in a more direct way in the process of R&D. Of the most important aspects of this field is the overwhelming effort that is directed towards the issue of water in the Kingdom to develop alternative water resources like desalination and to find suitable ways of enrichment of aquifers. Evaluation and upgrading of water desalination plants was given top priority. Alternative chemical treatments were studied (AR-13-70). Other research projects in the various fields of engineering that dealt with problems

b. Applied Research Program

The goal of this program is to promote R&D activities congruous with stated national development objectives, taking into account the physical, environmental, and natural resources conditions of the Kingdom.

c. Supporting Services for Science and Technology

The aims of this program are to consolidate the R&D infrastructure by upgrading computerized information services, and to provide the necessary patent services and legal framework for the introduction of new technologies. Another important feature of this program is to establish a technology development and transfer system to facilitate the adoption of new technologies into the private sector, thereby enhancing the competitiveness of Saudi industries in the international marketplace.

d. Science and Technology Awareness Program

This program intends to arouse the public awareness and understanding of R&D through the mass media, symposia, exhibitions, and education at all levels.

e. International Cooperation

This program aims at the transfer of technology from other countries. This technology will then be further adapted and developed for efficient exploitation within the Kingdom. Joint Saudi-foreign R&D activities will be promoted via grants from KACST in conjunction with the Economic Offset Programs. International information services will be strengthened through linkages with computerized communications networks.

3. Links with Universities

Since its inception in 1977, KACST has been carrying out its mission in the promotion of science and technology in the Kingdom by coordinating and cooperating with various universities, agencies and institutions concerned with research and development, and encouraging Saudi experts to undertake research that will help promote the development and evolution of the society.

Research is either undertaken by KACST research institutes, or through contracts with universities and other research centres. Research institutes address projects that are traditionally handled by national laboratories in other countries. Areas covered by the seven institutes in the organization are solar energy, atomic energy, electronics and computers, petroleum and petrochemicals, natural resources and environment, and astronomy and geophysics. Another division within KACST shoulders contract research, the other major activity,, which is the General Directorate of Research Grants Programs (GDRGP). Most of the government-funded research is managed through this division. Anticipated beneficiaries of research results are mostly public agencies involved in development efforts, with the dominant type of research being applied. Research Grants are awarded annually to individuals and groups of researchers whose proposals have merit in addressing problems of the economic and industrial sectors. In most cases, the selected topics and fields complement the national development plan. Under this program, KACST sponsors numerous research projects in various areas of science and technology, including medicine, engineering, agriculture, and basic sciences, etc.

2. King Abdulaziz City for Science and Technology

KACST's mission is to organize and coordinate all scientific research in the Kingdom, and to ensure that the national development goals are served. Therefore, any funding for research projects that comes from KACST takes into consideration the benefit to Saudi Arabia. Research projects funded by KACST may be conducted either at KACST's own facilities in Riyadh, at one of the universities throughout the Kingdom, or at different research institutes or centers.

2.1 Historical Background

The development of science and technology in Saudi Arabia is due to a conscious effort by the government to efficiently utilize the country's resources in a way that will keep the Kingdom technologically in step with the rest of the world. To do this, there have been a number of deliberate measures taken to promote scientific and technological research. Perhaps the most important are those that led to the establishment of KACST.

The issuance of a Royal Decree in 1977 established a national organization responsible for science and technology, which was known at that time as the "Saudi Arabian National Center for Science and Technology" (SANCST). In 1986, the name was changed to KACST to better reflect the importance of its mission and the size of its tasks.

2.2 The Organizational Structure

KACST carries out its various activities through a well-structured organization that includes technical directorates and research institutes. The directorates within KACST concerned with research and technology include:

- a. General Directorate of Research Grants Programs: Supervises KACST research grants program and prepares related plans and studies.
- b. General Directorate of Information: Provides information to the various divisions of KACST and to other research centers and universities throughout the Kingdom. In addition, it coordinates information at the national level.
- c. General Directorate of Patents: Concerns the receipt, registration, and examination of patent applications, as well as the issuing of patents' certificates.
- d. General Directorate of Scientific Awareness and Publishing: Concerns the dissemination of scientific results among the people and promotes interest in R&D.
- e. Directorate of Planning and Follow-up: Assists the administration in preparing KACST plans and in following-up the implementation of these plans.
- f. Directorate of Technology Transfer: Regulates the transfer of technology by proposing necessary laws and regulations. Also provides related information and statistics.
- g. Directorate of International Cooperation: Concerns international cooperative activities in the field of science and technology. Also acts as a liaison between international scientific organizations and national committees to promote R&D and to disseminate information.