## Abstract

The Third Biennial Conference on Science and Technology (BICOST-III) was held from 16 to 19 September 2004 at the Bandaranaike Memorial International Conference Hall-Colombo. The National Science and Technology Commission (NASTEC) organized the Conference in association with the Ministry of Science and Technology.

BICOST provides a forum for Scientists, Technologists, Policy makers and Administrators, the Private Sector and Civil Society Organizations to meet together, discuss, share views and exchange ideas to generate policy initiatives, formulate action plans and review the current and future Science and Technology directions for Sri Lanka.

The first BICOST held in the year 2000 was centered on the theme "The Role of Science and Technology in National Development". The second BICOST held in the year 2002 had as its theme "The Role of Science and Technology in Infrastructure Development"

The Third Biennial Conference on Science and Technology was particularly designed to formulate a Strategy and an Action Plan for Science and Technology to contribute to National Development as a significant driving force.

This Report documents the proceedings of BICOST-III and the Strategy Planning Workshop that followed.

# 1.0 INTRODUCTION

The third Biennial Conference on Science and Technology (BICOST-III) was held from 16 to 19 September 2004 at the Bandaranaike International Conference Hall Colombo. It was organized by the Nationalo Science and Technology Commission (NASTEC) and the Ministry of Science and Technology. Eminent national and international scientists and technologists, policy and decision-makers, end-users of science, technology, research and development and civil society members participated at this Workshop. Previously, BICOST-I was held in August 2000 at Kalutara and BICOST-II in September 2002 at Beruwala.

## 1.1 The Role of NASTEC

The National Science and Technology Commission (NASTEC) was established in August 1998 with the passage of the Science and Technology Act of 1994 in Parliament. The **Vision** of NASTEC *is* ***"to enhance the well being and prosperity of Sri Lanka through the potential of Science and Technology***". The **Mission** of NASTEC *is* ***"to furnish the Government with policies, plans and mechanisms for building a national capability in Science and Technology, and utilizing scientific personnel and institutions to promote national economic development with respect and regard for humanity and environment".***

The principal functions of NASTEC are described as: -

1. To advise the Government of Sri Lanka on: -
   - Policies and plans for the development of Science and Technology (S&T) with regard to application of S &T to stimulate economic growth;
   - Impact of S&T on the efficiency and competitiveness of industry, agriculture, services and the economy;
   - Impact on health, nutrition and poverty alleviation and development of human resources for S&T;
   - Development and management of natural resources
   - Identification and prioritization of S&T areas that are of national importance;
   - Creation of an appropriate climate to attract, build up and retain S&T expertise;
   - Allocation of funds for Research and Development (R&D) in S&T institutions.

2. To submit a report annually to the Government reviewing the S&T activities in Sri Lanka in the preceding year in relation to objects set out in the Act.

3. To review the progress of S&T institutions in relation to objects set out in the Act, and

4. To convene biennially, the Sri Lanka Conference on Science and Technology (BICOST).

The Third Biennial Conference on Science and Technology (BICOST-III) held from 16 to 19 September, 2004 emerged out of the mandate given to NASTEC by the Science and Technology Act of 1994. As mandated, Biennial Conference on Science and Technology (BICOST) provides a forum for the discussion of science and technology in Sri Lanka in relation to the objects set out in the Act, bringing together the main actors within the multi-faceted scenarios of Science and Technology, and its stakeholders and end-users, to draw a common agenda to direct the progress of S&T in the country, with the prime objective of national development.

## 1.2 BICOST-I and BICOST-II

***BICOST-I*** the theme of which was ***"The Role of Science and Technology in National Development"*** was held from 24 to 27 August 2000, focused on seven themes considered as critical initiatives necessary to sustain, enhance and strengthen the scientific and technological capability of the country to meet the new global economic challenges. They were Agriculture, Health, Education, Industry, Environment, Information and Finance.

***Issues*** identified in BICOST-I are broadly classified as follows: -

- The need for a National S&T Policy.
- The need for an Apex Body and related institutional infrastructure to coordinate/implement S&T interventions related to national development.
- The need to develop institutional mechanisms to establish public-private partnerships, stakeholder participation and foreign collaboration
- The need for infrastructure facilities for application and implementation of S&T at field level.
- The need for a proper knowledge management system- database, expertise, resource management etc.
- Science-awareness for public consumption- developing a science culture.
- Quality control and standardization in S&T activities.
- The need to enhance Human Resource capabilities in S&T.
- The need to protect and preserve natural resources and indigenous knowledge.
- The need for R&D specific areas like biotechnology, urban solid waste management, climate change, energy crisis, health and management of hazardous waste.

***BICOST-II*** held from 5 to 8 September 2002 attempted to identify priority areas for R&D and thrust areas for R&D Policy initiatives required to stimulate national development processes. The theme of BICOST-II was appropriately stated as " The Role of Science and Technology in Infrastructure Development". BICOST-II identified Health, Food and Agriculture, Environment, Trade and Industry as Sector-specific areas, and Water, Alternative Energy, Transport, Communication and Waste management as Functional areas.

***BICOST-II*** prioritized major thrust areas for research within the scope of S&T inputs for infrastructure development. The major thrust areas are classified as follows: -

- Improved systems to minimize losses – Water management, over-exploitation of resources, post-harvest losses, waste water recycling, energy conservation, coast conservation & degradation of habitat.
- Improvement of productivity and environment in Industry: - Control of air pollution, quality control of products, standardization of drugs, technical and market information
- Optimizing resource utilization: - Resource mapping, enhancement of agricultural productivity, water resources, reclamation of marshy lands, development of alternative energy sources, R&D in salinity resistant crop varieties, restoration of urban lakes, rivers, rain water recharge and aquifers.
- Enhancement of the quality of life of the people: - Reduction of air pollution, improvement of waste disposal techniques, minimizing noise pollution,

minimizing transport costs, improved water quality, reduction of accidents, improvement of health information systems.

As required under NASTEC procedures, the recommendations made and decisions arrived at the previous Biennial Conferences were referred to the institutions responsible for each activity area for implementation. However due to various reasons, the progress of implementation of previous BICOST recommendations was below expectations. Some of the reasons that contributed to the failure of the concerned institutions to follow-up and take appropriate action within the framework of their institutions were identified as follows: -

- Lack of a National Policy on Science and Technology.
- Insufficient multi-sectoral approaches and cross-sectional actions.
- Lack of institutional capacity to implement decisions.
- Lack of a critical mass of qualified human resources.
- Inadequacy of a basic database on natural resources to forecast research and make decision.
- Insufficient public awareness on the role of Science and Technology in relation to national development.
- Lack of recognition of modern sciences and technology and their application in research.
- Lack of sufficient financial resources at the disposal of the institutions to implement the decisions, and
- Non-availability of a National Body responsible to steer the implementation of BICOST decisions.

In the overall analysis, it was revealed that, the "Science and Technology Agenda for National Development", elaborated during BICOST-I in 2000, and the decisions on "The Role of Science and Technology in Infrastructure Development, arrived at BICOST-II in 2002, did not move with commitment and vigor as anticipated, towards making a significant contribution towards national development.

### 1.3 BICOST-III- Objectives

BICOST-III was expected to provide a forum of interaction between leading scientists and technologists of the country and policy makers, administrators and end-users, the outcome of which would form the basis to develop a Science and Technology Strategy for National Development within a viable Science and Technology Policy for Sri Lanka***. The focus of BICOST-III was to determine the strategy required to move Science and Technology forward as a significant driving force / engine of growth in national development and to generate the commitment of the various players in the process.***

In this context, it was considered pertinent to analyze factors that are inimical towards moving S&T forward and identify feasible strategies to strengthen the process of Research and Development in the field of Science and Technology. It was also considered necessary to reflect upon the factors that contributed to the failure of Research and Development Institutions to participate effectively in the process of achieving a common goal as anticipated in the two previous conferences.

Determination of the framework within which the strategies necessary to establish the inter-linkages to accelerate S&T activities leading to feasible commercial adaptation which ultimately will enhance national development efforts, was Therefore, seen as the vital key to

operationalize BICOST decisions. The principal Output expected of BICOST-III Therefore, was the formulation of a Strategic Plan to operationalize the outcomes of BICOST-I and BICOST-II.

Within this background, BICOST-III organized by NASTEC and the Ministry of Science and Technology consisted of three parts as follows: -

**Part I** - Ceremonial Session and Inauguration of BICOST-III.

**Part II** - Conference Session- Sharing of International and National Experiences in Science and Technology.

**Part III** - Workshop sessions to formulate a National Strategy for Science and Technology Research and Development.

(Please find the detailed programme in Annex 01)

### 1.4 Participants

A total of 279 participants registered themselves for the Conference sessions of BICOST-III. While more than 1400 Scientists, Technologists, Policy makers and Administrators, members of Civil society organizations, members of the Diplomatic Corps and special invitees had been invited only 380 participated at the Ceremonial Inauguration of BICOST-III.

The number of participants registered for the Conference sessions of BICOST-III is classified as follows: -

| | |
|---|---|
| Universities | - 58 |
| Research Organizations | - 40 |
| Policy makers Administrators | - 75 |
| Private Sector/ Industrialists | - 23 |
| Non-Governmental Organizations | -13 |

The number of participants who actually turned up for the Conference sessions is classified as follows: -

| | |
|---|---|
| Day 1 | - 177 |
| Day 2 | - 113 |
| Day 3 | - 87 |

## 2.0 INAUGURAL SESSIONS - 16 SEPTEMBER 2004 - MAIN AUDITORIUM, BANDARANAIKE MEMORIAL INTERNATIONAL CONFERENCE HALL

***The Third Biennial Conference*** on Science and Technology was ceremonially inaugurated in the presence of the Hon. Minister of Science and Technology, Prof. Tissa Vitarana, eminent scientists from Sri Lanka, internationally reputed scientists from abroad, senior administrators, members of the Diplomatic Corps and a large gathering of special invitees. President of the Democratic Socialist Republic of Sri Lanka Her Excellency Chandrika Bandaranaike Kumaratunga, who was invited as the Chief Guest was unable to attend the occasion due to unavoidable circumstances, but sent her felicitations and best wishes for the success of the Conference. Hon. Mahinda Rajapaksa, the Prime Minister graced the occasion as the Guest of Honour. Among the Special Invitees for the occasion were Prof. Attar-Ur-Rahman, Minister of Education, Former Minister of Science and Technology, Pakistan, Dr. Fawzi Abdel Kader Elrefaie, Chairman, Centre for Science and Technology of Non-Aligned and other Developing Countries, Prof. V.S Ramamurthy, Secretary, Department of Science and Technology, Government of India and Vice Chairman, Centre for Science and Technology of Non-Aligned and other Developing Countries, Prof. Arun Kulshreshtha, Director, Non Aligned Movement Science and Technology Center, Dr. Jorge Luis Fernandez Chamero, Director, Science, Technology and Environment Department, Cuba. Ir. Sri Woro B. Harijono, Deputy Minister of Science and Technology, Republic of Indonesia.

***The Conference was formally inaugurated*** with the lighting of the traditional ceremonial oil lamp by the Hon Prime Minister, Hon Minister of Science and Technology, Special International Invitees, Dr. R.O.B.Wijesekera and Members of the Board and Director/ Chief Executive Officer of NASTEC, amidst beating of traditional drums.

**2.1 Dr. M.C.N.Jayasuriya, Director/Chief Executive Officer, NASTEC** delivered the **Welcome Address**. He warmly welcomed the Hon. Prime Minister, Hon. Minister of Science and Technology, Dr. Fawzi Abdel Kader Elrefaie, Chairman, Centre for Science and Technology of Non-Aligned and other Developing Countries, other internationally reputed Scientists, Members of the Diplomatic Corps, Members of the Commission, special invitees and guests. Dr. Jayasuriya said that BICOST-III is a landmark event in the annals of Science and Technology in Sri Lanka, firstly since this is the first time that the Hon. Prime Minister has graced the inauguration of the Conference and secondly because BICOST-III coincides with five years of existence of NASTEC. It is also the first time that BICOST will have the benefit of sharing the experience of several eminent international scientists. During the past five years NASTEC has grown to be the premier Science and Technology Policy formulation and Advisory Institution in Sri Lanka. The decisions made and recommendations formulated at the previous BICOSTs bear ample testimony to this. BICOST-I dealt with the "Role of Science and Technology in National Development", while BICOST-II focused on "The Role of Science and Technology in Infrastructure Development". BICOST-III has been purposively designed different to the previous conferences in that the two previous conferences dealt with issues and priorities of science and technology in Sri Lanka; BICOST-III will specifically focus on developing a Science and Technology Strategy for national development and a Way-forward Action plan. It will not be an overstatement to say that NASTEC is unhappy with the outcome of the previous BICOSTs, since all the decisions and recommendations were referred to the organizations and institutions responsible for their implementation, the progress has been less than

adequate. Therefore, BICOST-III will particularly attempt to formulate a Science and Technology Strategy for Sri Lanka in the context of National Development and an Action Plan, which each player will be responsible for in the forthcoming years. Dr. Jayasuriya stated that several eminent scientists were invited to BICOST-III to associate themselves with the Sri Lankan scientists and the conference will greatly benefit from their knowledge and experience. He hoped that BICOST-III would be able to produce some concrete outputs making space for science and technology to contribute effectively to national development.

**2.2 The Hon. Minister of Science and Technology, Prof. Tissa Vitarana, MP,** delivering his address welcomed all present on the occasion of the inauguration of the Third Biennial Conference of Science and Technology both on behalf of the National Science and Technology Commission (NASTEC) and the Ministry of Science and Technology.

The Government has a strong commitment to National Development and Science and Technology has a major role to play in the national development efforts of the Government, the Hon. Minister said. He added that many who are present at this inauguration were also present at BICOST-I when "The Role of Science and Technology in National Development was extensively discussed and precise recommendations were made to the Government. At BICOST-II the discussion focused on "The Role of Science and Technology in Infrastructure Development". He was sorry to say that the implementation of the recommendations left much to be desired. He said that however he has much greater hope in BICOST-III for two reasons. One is that there is a Government with a different policy orientation and the other is that the theme of the Conference is focused on developing a "Science and Technology Strategy for National Development", which is the main objective of the present government. In designing our national development strategy, we need to take into consideration the problem of poverty in the country in which 50% of the population lives below the $2 poverty line and the fact that 28.5% of our children are malnourished. This is not a situation that we can be happy about let alone live with.

Under the open economy, the prime effort was to obtain high-cost high-level technology from abroad through foreign direct investment. The only sector that benefited was the garment industry. The conflict situation that plagued the county has not totally disappeared, and in that situation, investors will not come to invest in the country bringing high-level technology with them. The time has come to make an evaluation of this. We have to have the type of technology that would benefit not only the rich 10%, but also the other 90% who are poor as well. We have scientists in the country who have the capacity to do this. Unfortunately we have not had a correct Science and Technology Policy in the country so far.

The Hon. Minister said that everybody is talking about the private sector as the engine of growth. But neither the Private sector nor the Public sector can provide jobs without the Science and Technology sector. Sri Lanka has hitherto failed to recognize that Science and Technology provides the ***"engine of growth".*** The contribution to science and technology in terms of GDP in Sri Lanka is less than 0.13% whereas developed countries allocate 2% of GDP. Not surprisingly the research and development required is lacking and the country is forced to import highly expensive capital-intensive technology through foreign direct investment. Wrong policies have been adopted by Governments to cut down government expenditure and to recover costs. These policies have been thrust on the Science and Technology sectors too. For instance the ITI has been asked to recover 40% of its costs. One must realize that Research and Development is risky and cost recovery is a disincentive

to conducting research and development. With the result, R&D has lagged behind while routine tests have increased. The rising cost of testing has led to small and medium entrepreneurs being unable to afford both the test and the research they need. Though lip service is paid to the importance of small and medium industry policy this has had an adverse effect on their development.

The Hon. Minister said that it was unfortunate that none of the R&D institutions in Sri Lanka have Revolving Funds of their own. He stated that Her Excellency the President tried to correct the shortcomings by setting up the National Research Council. She also recognized the need to reward good scientific research by a system of Presidential Awards. But in the context of the overall unfavorable climate, research and development did not take off.

***BICOST-III*** is designed to provide a formula to change this situation. The specific focus of BICOST-III is to formulate a Science and Technology Strategy for National Development which would have the outcome of an interaction between the leading scientists, and technologists with policy makers, administrators and end-users of S&T. With the participation of eminent scientists and policy makers from Pakistan, India, Egypt, Cuba, and Indonesia and the linkages with the S&T community of the Non-Aligned Movement at this Conference, the strengthening of the international links could be further developed.

Although Sri Lanka has a large number of eminent scientists, most of them are frustrated due to various bureaucratic impediments. The Ministry of Science and Technology has already started work on improving the national S&T capability. Among the steps that are being taken are the increase of funding with the assistance of the Hon. Minister of Finance, the elimination of the pressure for cost recovery, the setting up of a revolving fund in each institution and measures to obtain more funds to improve the living and working conditions of scientists. The Hon. Minister of Finance has agreed to provide a higher rate of GDP for science and technology. It is necessary to have critical mass of good quality scientists in all the relevant fields of S&T. The brain drain must be prevented and Sri Lankan scientists of repute from abroad should be encouraged to return to the country.

Effective technology transfer is required to ensure that technologies that are developed by the scientists benefit the micro, small and medium entrepreneurs. This technology must not be confined to the city but must also flow to the village. There must be an exchange of ideas between the village and the S&T community. To achieve this, the Ministry is already implementing the "Vidatha" program. Computer linked resource centers are being established in every Divisional Secretariat area and S&T societies are being established in every village. There is also a need to have a government-established mechanism to upscale bench level research through pilot projects up to the commercial level.

The Hon. Minister added that popularization of science and technology especially among children should be expanded with emphasis on promoting innovativeness. Teaching methods of S&T also need to be improved. Maximum use should be made of computer facilities and the improvements in Information and Communication Technology, using both Sinhala and Tamil languages in addition to English.

The Hon Minister thanked also those present at the inauguration of BICOST-III, which he considered as a great encouragement to ensure that science and technology will be given its due place in Sri Lanka as the ***"engine of growth"***.

**2.3 Dr. Fawzi Abdel Kader Elrefaie of Egypt, Chairman, Centre for Science and Technology of Non-Aligned and other Developing Countries** delivered an address of felicitation to BICOST-III. He emphasized the importance of formulating plans through which scientists can commit themselves for research and development, and also to institute mechanisms to implement the plans through allocation of funds. He said that adequate financial support is critical to furtherance of science and technology.

**2.4 Ir. Sri Woro B. Harijono, Deputy Minister of Science and Technology, Republic of Indonesia** felicitated BICOST-III on behalf of the Republic of Indonesia. She added that Indonesia has attached particular importance to the promotion of science and technology towards national development. Special incentive programs have been formulated to link science and technology and research and development with enterprise development. Indonesia has gone to the extent of the government absorbing the cost of research projects up to the point where they become commercially adaptable propositions.

**2.5 Dr. Jorge Luis Fernandez Chamero, Director, Science, Technology and Environment Department, Cuba** felicitated BICOST-III on behalf of the Government and people of Cuba. He said that Cuban advancements in the field of science and technology are the outcomes of the Cuban Revolution and that science and technology and research and development in Cuba are inspired by socialist thinking. Research and development activities are prioritized according to national priorities in self-sufficiency and development of export competitiveness. He wished BICOST-III all success.

**2.6 Prof V.S.Ramamurthy, Secretary, Department of Science and Technology, Government of India and Vice Chairman, Governing Council of the Centre for Science and Technology of Non-Aligned and other Developing Countries** making his Guest Presentation stated that he was happy to be associated with this important science and Technology event. India has advanced from a food deficiency situation to food sufficiency situation and science and technology has contributed vastly towards this achievement. Our strategies for science and technology have to be redefined. He added that trained manpower is the ultimate resource in a developing economy. We need to develop the science and technology infrastructure for the scientists to work in their own countries. Protection of intellectual rights is an important aspect to promote science and technology. Technology once developed and tested must be transferred to industrially realizable levels. Economic development of developing countries largely depends on their technical ability to process raw materials as value-added products. Biodiversity, indigenous resources and knowledge should be harnessed for development.

Dr Ramamurthy added that mitigation and management of natural disasters can benefit from science and technology. Lack of proper awareness among people on the applicability of science and technology often results in wrong decisions being made. It is extremely important that the "technology divide" be eliminated so that the benefits of research and development and science and technology will reach those who cannot access them. Dr. Ramamurthy said that scientists have to play a pro-active role to make science and technology available to all. In other words science and technology should produce "Development for all, with a human face".

**2.7 Prof. Dr. Atta-ur-Rahman, UNESCO Science Laureate, Minister of Education and Chairman, Higher Education Commission, Pakistan** delivering his Guest Presentation said that correct political leadership is imperative to the promotion and

development of Science and Technology for national development. It is the determination of the highest political authority that can make the change. The question of technology divide between the technology producers and technology users has to be addressed from the top. Upgrading the human resource base is the most important aspect.

Pakistan has taken several meaningful steps towards promoting science and technology. Government allocation for science and technology has been increased by 6000%. Allocation for higher Education has been raised by 1200%. It has also been possible to reverse the brain drain by offering good jobs and research grants to Pakistani scientists. Pakistan has taken several other steps as well to create a suitable environment for scientists to work. They are, faculty development; technology assisted learning, focused support in key areas, free access to literature, free access to sophisticated instruments, linkage to the economy and quality assurance.

The salary structure for scientists has been changed substantially increasing the salaries of scientists. A research productivity allowance scheme has been designed to further incentivize scientists. Pakistan has considered that creating the right atmosphere for scientists to live and work and contribute to national development is an important priority.

**2.8 Hon. Mahinda Rajapaksa MP, Prime Minister of the Democratic Socialist Republic of Sri Lanka** addressed the Conference and said that he was particularly happy to be present at the inauguration of the Third Biennial Conference on Science and Technology. Science and Technology can contribute a great deal to national development. The present government has attached a significant emphasis on national development. It is Therefore, opportune that Scientists, Technologists, Policy makers and Administrators and the Private sector who are the end-users of research and development outputs meet together to decide on a common strategy towards national development.

Science and Technology should contribute to alleviation of poverty in Sri Lanka, which is one of the main problems the Government is trying to tackle. Through the application of Science and Technology, we should attempt to create more enterprises and more job opportunities particularly in the rural sector. Therefore, it is essential that Science and Technology innovations should reach the masses in the same manner that it reaches the small percentage of the population who can afford to access technology. Therefore, a major emphasis should be made towards the need to transfer Science and Technology outputs to benefit the small and medium enterprises. We should learn lessons from our friendly neighbours like India and Pakistan. How did they deal with the issues concerning development and link Science and Technology to create jobs and to accelerate development? We know that these countries concentrated on simple, practical and down to earth technologies that the people could easily adopt. It is time that Sri Lanka too adopts similar strategies so that the people of the country will benefit from local technological advancements. He added that the Government is firmly committed to providing all assistance to our Scientists and Technologists to carry out their tasks without hindrance so that they would be able to contribute to the upliftment of the living conditions of our people. The Hon Prime Minister wished that BICOST-III would be able to consider these issues and come up with an implementable strategy for Science and Technology to contribute effectively to National Development. He wished the Conference all success.

Ms. Amali Disanayaka, Scientific Programme Manager, NASTEC delivered the Vote of Thanks.

# 3. CONFERENCE SESSIONS - SHARING OF INTERNATIONAL AND NATIONAL EXPERIENCES IN SCIENCE AND TECHNOLOGY

## 3.1 Presentations by International Consultants

International Consultants at the Conference Sessions made the following presentations: -

- Prof. Dr. Atta-ur-Rahman, UNESCO Science Laureate, Minister of Education and Chairman, Higher Education Commission, Pakistan.
- Prof V.S.Ramamurthy, Secretary, Department of Science and Technology, Government of India and Vice Chairman, Governing Council Non Aligned Movement Science and Technology Center.
- Dr. Jorge Luis Fernandez Chamero, Director, Science, Technology and Environment Department, Cuba.
- Ir. Sri Woro B. Harijono, Deputy Minister of Science and Technology, Republic of Indonesia.

Highlights of the presentations made by the International Consultants are given below:

*3.1.1. Science and Technology - an Imperative for Socio-Economic Development- Prof. Dr. Atta-ur-Rahman, UNESCO Science Laureate, Chairman, Higher Education Commission (Federal Minister) Government of Pakistan*

- The central role for higher education in Pakistan has been recognized as technological development for economic and social well being of the Pakistani people. Pakistan has a clear Vision about Science and Technology and a strong political will to move S&T forward prevails.
- Strong linkages have been established between Applied Research and Industrial Development through Government Facilitating Programs. Government budgetary allocation to Science and Technology as a percentage of GDP is 2%.
- For purposes of servicing the economy through Science and Technology Research and Development, the economy has been divided into 20 sectors like Agriculture, Industry, and Services etc. Fusing mechanisms have been established to join the Academia with the Private Sector in order to generate funds required for research.
- Pakistan follows a simultaneous Bi Modal Approach in development- Bottom-up, in respect of services like Basic health, Primary education, Water etc.; and Top-down for areas like Higher Education and Technology Development and Industrial linkages.
- A high emphasis has been given for Knowledge-based Education, Faculty development, Technology-assisted learning. The 4 most important requirements in Education in Pakistan are (i) higher quality of basic education, (ii) higher quality of higher education (iii) mechanisms to transfer technology to industrial processes, and (iv) high level of political will and clear Vision.
- Irresistible incentives have been given to the Private sector as well as to the scientific community to create an enabling environment for S&T to contribute effectively to national development.
- The question of "Technology Divide", the divide between the Technology-Producers and the Technology-Users, has to be addressed from the top.

- Upgrading the Human Resource is fundamental in Science and Technology development. It is the determination of the highest political authorities that can bring about the change in the fundamentals.
- Pakistan has taken several steps to create a suitable environment for scientists to work. They are (i) Faculty development (ii) Technology assisted learning (iii) Focused support in key areas (iv) Free access to literature (v) Free access to sophisticated instruments (vi) Linkage to the economy, and (vii) Quality assurance.
- Increased investment in Human Resource Development is Pakistan's most important priority. Government allocation to S&T has been increased by 6000% and to Higher Education, by 1200%.
- Enhancement of salaries of people who work in scientific jobs was considered critical and the results has created a lot of excitement in Pakistan. Other incentives given to encourage scientists are, research productivity allowances, incentives to contribute to scientific journals, and a Rating System for scientists.
- The option available for developing countries is to recognize that our children are our greatest asset and to build a strong and challenging educational system for them. We must then retain them by providing a stimulating working environment and an internationally competitive salary structure.
- In order to kick-start the process of Science and Technology development, and development of Higher Education, Pakistan has established the Higher Education Commission. The development budget of Universities has been raised from Rs. 0.8 billion (2 yrs ago) to Rs. 9.1 billion. Recurring and development budgets of Universities are being enhanced by 50% annually until they reach 1% of GDP in 4-5 years.
- Pakistan has recognized that the keys to success are (i) developing the brightest manpower (ii) time targeted programs (iii) convincing the government to invest massively in human resource development (iv) using the latest technologies (v) delegating tasks to competent persons and (vi) thinking big.
- Focused support in key areas include areas of industrial relevance, agriculture, engineering, IT, basic sciences, social sciences, economics, humanities and nursing and strengthening of Centers of Excellence. Linkages to the Economy have been established through development of a Culture of Innovation and the setting up of a Steering Committee for University-Industry linkages.
- Faculty Development Mechanism includes (i) Research Grant Programs (ii) Technological Infrastructure enhancement (iii) Improvement of Laboratories (iv) Access to information (v) Support for Research Activities (vi) grant of Post-Doctoral Fellowships (vii) Qualification improvement programs (viii) Teacher training and (ix) establishment of linkages with the industry.
- Pakistan endeavors to develop a strong base of Ph.D. level highly qualified faculty by an Indigenous Scholarship program, hiring of Foreign Faculty, faculty training, launching a Foreign Ph.D.Scholarship program and a Tenure Track system for appointment.
- With regard to quality assurance, several measures have been taken including the setting up of HEC-Provinces Steering Committees, establishment of International Linkages, Accreditation, Curriculum Review and University Ranking system.
- The Higher Education Infrastructure has been substantially improved through the University Computerization Initiative, Centralized Instrumentation Facilities, Pakistan Education and Research Network and Digital Library Program.

- The initiative for Technology Assisted Learning includes the establishment of an internal network of 56 Universities, Internet connectivity at Karachi, Lahore and Islamabad, University Computerization and Networking Initiative including the creation of the Virtual University, and the Digital Library System. The Digital Library has 11,600 full-text journals with nation–wide access and abstracts of 20,000 journals.
- The knowledge through the Internet makes MIT open course lecture materials available to Pakistani students and access to free Video lectures by World Authorities aired by the University of California. Also the Distance Learning Initiatives of Stanford University, Illinois University and Open University (UK) are made accessible.

*3.1.2. Science and Technology in India - Prof. V.S.Ramamurthy, Secretary, Department of Science and Technology, Government of India. Vice Chairman, Governing Council, NAM S&T Center.*

- The 21st Century is dominated by knowledge. Access to knowledge is the key to development. If we cannot access knowledge, then we will be left behind.
- Science is the foundation on which all technologies are built. Technology is the driving force for economic development and national security. Both are interlinked.
- In India, technology has touched the hearts of the people very much. India has succeeded in transforming from food deficiency to food surplus due to the advancements made in the fields of science and technology.
- Developing countries should refine their strategies in the context of the needs of the countries. Within "Global Marketization", new opportunities keep emerging each day and countries should be quick to seize the opportunities. Trained manpower is the ultimate resource in a developing economy. The strength lies in our ability to convert the opportunity to economic advantage.
- It is important that for countries that desire to utilize science and technology for the benefit of the economy and the people, proper infrastructure facilities within the Academic and R&D institutions have to be developed for scientists to work in their own countries. New Science and Technology policies need to be formulated taking national priorities into consideration
- Lack of public awareness on the capacity for science and technology to make crucial change is a key deficiency. Decisions are often made on misinformation. There is also the need to reduce the "Technology Divide", which is the gap between the people who can access technology and those who cannot. Countries should develop pro-active methods to carry science and technology within reach of the masses. S&T interventions in society need to be geared at "reaching the unreached"
- Generation of Intellectual Property Rights Laws to protect and safe guard the property rights of scientists is of prime importance.
- Scientists in developing countries should devote time and energy to develop technology to convert raw materials into value-added products. It is also important to transfer adaptable technology to industrially realizable levels and to harness traditional knowledge. Technology transfer must be a continuous process.
- Inadequate infrastructure is the major bottleneck that constrains transfer of technology to the end users.
- Science and technology can contribute largely towards preservation of biodiversity and mitigation of the effects of natural disasters.

- There is a need to establish a close linkage between the " Technology producers" and the "Technology users". The linkage should take the form of a continuous partnership.

*3.1.3. Sustainable Innovation of Strategic S&T Policy, Indonesian Case - Ir. Sri Woro b. Harijono, Deputy Minister of Research and Technology Republic of Indonesia.*

- The Ministry of Research and Technology is one of 12 Ministries functioning under the President of the Republic of Indonesia, responsible to the Parliament. The National Research Council established by the Government provides advise to the President, Parliament as well as to the Ministry of Research and Technology.
- The Ministry of Research and Technology is responsible for Science and Technology Policy, Science and Technology Programs, and Science and Technology promotion and diffusion.
- The Ministry maintains direct coordination and linkage with the 7 National Research Institutions - (i) Indonesian Institute of Science, (ii) Assessment and Application of Technology Agency, (iii) National Institute of Aeronautics and Space, (iv) National Coordinating Agency of Surveys and Mapping, (V) National Standardization Agency, (vi) National Nuclear Energy Agency and (vii) Nuclear Energy Control Board.
- The Ministry also inter-links indirectly with R&D institutions and Centers under the different Ministries, Universities, Regional R&D institutions and Government and Small and Medium Enterprises.
- The Major Law passed in 1945 makes it the duty of the Government to "develop and improve national science and technology capability to ensure national prosperity and create national prestige". Law No. 25 of 2001 on the National Development Program, considered issues arising out of globalization focused on strengthening of Science and Technology capability to join the ranks of advanced countries through utilization of S&T for economic and social development.
- The Science and Technology National System Law enacted in 2002 provides for S&T networking arrangements among the Government Institutions, Academia and the Industry, allocation of resources for S&T activities and for institutional mechanisms necessary for a national S&T innovation system.
- The Presidential Instruction No. 4 of 2003 has made the Ministry of Research and Technology as the coordinator of S&T policy formulation and implementation.
- Incentive schemes offered by the Ministry of Research and Technology include direct support and indirect support for technology supply and business development. The scopes of the incentive programs include assistance provided from the Idea-generation stage, through start-up, grow-up and fortification. Funds are generated from government sources, private funding, and sponsorship, Banks or through IPOs at the appropriate stages.
- One of the most notable features of the incentive scheme is that from the idea stage up to the point where the idea is developed as a commercially feasible project, support and facilitation is provided to conduct research, develop prototype, patent, pilot scale-up trial, production, market analysis etc. From the stage where the project becomes a commercially feasible business, funds are generated from private sources, Banks, Venture Capital etc.

*3.1.4. Priorities for Scientific Research and Technological Development and National Programs for the 2005-06 period, Cuba - Dr. Jorge Luis Fernandez Chamero, Director, Science, Technology and Environment Department, Cuba.*

- Scientific and Technological development is one of the unquestionable achievements of the Cuban Revolution. The efforts undertaken in Cuba in the field of S&T during the last 40 years, the infrastructure created and the great mass of patriotic and loyal scientists represent a notable achievement of the revolutionary process.
- The results of Cuban scientific research have made a significant impact on the economic recovery of the nation, environmental protection, development of the socialist society and the welfare of the Cuban people.
- Reflecting upon the sentiments expressed by the Commander-in Chief of Cuba, the scientific community has embarked on an initiative to identify the priorities for scientific research and technological development in Cuba during the forthcoming years, in the light of the country's general economic strategy, advances and trends in science and technology in the World and the potential of the domestic scientific and technological infrastructure.
- The strategy developed by the Cuban scientific community has identified 7 areas considered to be of strategic importance. They are, (i) Food production (ii) Sustainable energy development (iii) Health (iv) Environment (v) Social sciences and Humanities (vi) New Information Technology, and (vii) Basic Sciences.
- The key areas have been identified taking into consideration the following pre-conditions (i) to decisively contribute to the economic recovery and sustainable development of the country as an essential part of the defense of the ideas of socialism, and (ii) to integrate the scientific and technological development attained by the country with the new trends in the World to have short term and medium term impact on the Cuban society and the economy.
- National Scientific and Technological Programs have been developed in relation to the subject areas identified. Some have been implemented while others are continued in the appropriate manner.
- Food Production: Increased attention is focused on research and development on sugar and by-products, beans, cattle farming and fishing. Attention is also directed to the furtherance of areas where results have already been achieved like citrus and vegetable production and pig farming. Actions are set out to (i) intensify the technological innovation to intensify food and feed production, improve biotechnology, sugar-agro industry, and plant improvement and phytogenetic resources (ii) continue the implementation of national programs on the latter 3 above, (iii) develop programs not associated with national priorities and (iv) develop the utilization of vegetable protein, vegetables, roots and fruits.
- Sustainable Energy Development: Research and development activities on this priority area are directed towards (i) increasing self sufficiency in fuel (ii) utilization of bio mass as an energy source (iii) exploitation of other renewable energy sources (solar, hydro and eolic energy) and (iv) development of electrification of transportation. Aspects such as increase of power efficiency in buildings, industry and services, power management, automation computing and application of biotechnology in the fuel industry are given emphasis.
- Health: Health research will continue to have high priority in the forthcoming years. A new industry producing vaccines and drugs has been developed in Cuba, supported by basic research in the fields of Molecular and Cellular Biology, Genetic

Engineering, Immunology, Biochemistry, Physiology, Pharmacology etc. The principal objectives of research and development in the health sector are to develop and produce vaccines, new pharmacological products, products and services in Neurosciences and medical equipments.

- Environment: Major emphasis is being made to collect and collate information on the natural resources of Cuba, its degree of conservation and rational use, evaluation of the results of the program for Rehabilitation and conservation of water basins, management of solid waste, and alternative sources of energy. Two national programs have been implemented on "Global changes and evolution of Cuban Environment" and " Sustainable development in the Mountains".
- Social Sciences and Humanities: The Cuban society needs the economic efficiency, satisfaction of the needs of the people, and the preservation and development of the achievements of the Revolution. In this regard, several programs are under way to increase the knowledge and appreciation of the ideology of the Cuban Revolution, Education in the context of Cuban reality etc.
- New Information Technologies: The strategy envisages emphasis on soft ware development for national use and export, accelerate incorporation of information technology into Cuban industry, boost R&D capacity to assimilate upcoming technologies related to internet, computing, robotics etc.
- Basic Sciences: The objectives of the program are to develop research project targeted at new scientific knowledge in strategic advanced subjects of Mathematics, Physics, Chemistry and Computing Sciences, and to keep the country updated in key areas of contemporary sciences.
- A program has been launched to develop new materials that can be applied in the fabrication of products, appliances and high tech equipments associated to health, biotechnology, tourism, environment, agriculture and construction sectors, and to utilize natural resources and raw materials that provide greater value-addition.

### 3.2 Presentations by Sri Lankan Consultants

Sri Lankan Consultants at the Conference Sessions made the following presentations: -

- Dr. R.O.B.Wijesekera- Research and Development: A Retrospect and Prospect.
- Dr. A.M.Mubarak- Development and Transfer of Technologies: Review of Status and Alternatives for the Future.
- Dr. Jaanaki. Gooneratne- BICOST-I&II Situation Analysis- A Critical Review.
- Mr. Chandra. Embuldeniya- The way forward for Technology-Industry Linkage.

Highlights of presentations made by the Sri Lankan Consultants are given below. The full presentations will appear in the Proceedings of BICOST-III.

*3.2.1 Presentations by Sri Lankan Scientists - Research in Sri Lanka-Retrospect and Prospect, Dr. R.O.B.Wijesekera*

- The national Research and Development has remained at a standstill for a considerable length of time. Over a period of three decades, there has been no improvement or strengthening of the national capability for research.
- National capability for research is defined in broad terms as the nation's capability to carry out good, endogenous research in a range of subject areas relevant to its needs.

- National capability for research depend on several factors such as, (i) the quality and quantity of researchers (ii) the institutional infrastructure available to them (iii) access to information on leading edge research (iv) the quantum of funding and flexibility for its use (v) perquisites afforded to scientists to continually attract good material (vi) smooth interaction with global and regional science, and (vii) a vibrant interactive local atmosphere where research is recognized.
- The major contributor to research expenditure throughout has been the government. However the government expenditure on research and development in relation to GDP has been below 0.2% for over two decades, when the level recommended by agencies like the UNESCO for developing countries is a minimum of 1%.
- The total number of scientists available in Sri Lanka, including the post-graduate students is 2537, which works out to 1 per 10,000 population. Of the R&D personnel, 25% are post-doctoral, and 40% are over 40 years of age. The ideal number of scientific and research personnel required for a country the size and population of Sri Lanka would be more than double the present strength.
- Countries neighboring Sri Lanka, and East Asian countries have overtaken us in terms of national scientific capability.
- Scientific and technological research brings economic rewards to society. The approach to accelerate our research capacity should be incentive-driven rather than following a command and control approach. The approach should create space for each scientist to feel that he or she is a part of a collective effort and a goal oriented strategy.
- Research, whether sponsored by government, corporate sector, donor-funded or financed by private enterprise, should be directed towards well-marked goals. The Goals identified, in this presentation have been inspired by the Millennium Development Goals identified at the Earth Summit in 2000.
- Broadly, the Goals identified as research priorities in the context of national development are as follows: -

- Goal 1: Security in Food and Nutrition
- Goal 2: Security in Water and Energy.
- Goal 3: Security in Health and Shelter
- Goal 4: Competitiveness in Trade and Industry.

- While there is hope that all national research will be directed towards the achievement of the above goals, the major thrust to build a research capability should have the following guiding objectives. (i) increase the number of active researchers (ii) direct all research to be responsive to the major goals (iii) enhance national investments on R&D with Government and Corporate sector in partnership (iv) identify gaps in the present range of research and commission research in these areas (v) judiciously utilize external resources (vi) utilize the expatriate assistance, and (vii) build an international level capability for science and technology within the country.
- Funding is crucial to move R&D forward. Even when funds are available, access to funds has not been smooth due to administrative and political impediments. The presentation recommended a two-component funding system as follows: -
    - Institutional Subsistence Component- normal budgeted funds for each institution, with progressive increases to undertake additional commitments.
    - Research Program Component- funds to facilitate research itself, based on the estimated cost of the research project falling in line with

the 4 goals mentioned above, to be derived from a special fund termed the National Science and Technology Research Fund.

- Research is needed to develop new technology, adapt transferred technology and to understand and interpret global developments in technology. Research is also needed for Sri Lanka to safeguard against risk factors in global technological developments, to propel industry to new heights and for national security.
- Research indeed is the chassis on which the modern development process moves.

*3.2.2 BICOST-I and II- Situation Analysis - A Critical Review, Dr. Jaanaki Gooneratne*

- The Biennial Conference on Science and Technology (BICOST) is a mandated task of NASTEC, bringing together the main actors of Science and Technology functions, stakeholders and end-users of S&T outcomes, to draw a common agenda to direct the progress of S&T in the country with the prime objective of national development.
- BICOST-I held in 2000 focused on initiatives necessary to sustain, enhance and strengthen the scientific and technological capacity in the country in order to utilize S&T to productively address the challenges brought about by the new global economic and trade patterns. The conference dealt with Agriculture, Health, Education, Industry, Environment Information and Finance as sub-themes.
- BICOST-II held in 2002, focused on identification of S&T inputs needed to develop infrastructure to facilitate the process of national development. Health, Food and Agriculture, Environment and Trade and Industry were identified as "Sector-specifics", while Water, Energy, Transport, Communication and Waste management were dealt with as "Functionals"
- The outcomes of the two Conferences have been documented in the conference reports titled "S&T for National Development" and "S&T for Infrastructure Development", respectively.

Part I of the presentation dealt with the progress made by the individual institutions, independently or as a catalytic effect, on recommendations and conclusions of BICOST-II. The presentation highlighted the achievements made in the following areas: -

- Waste Management – actions initiated by the Ministry of Forestry and Environment, Central Environmental Authority and BOI, with regard to urban waste and hazardous waste; Ministry of Health with regard to hospital waste; NBRO regarding liquid waste and effluent discharge.
- Water Quality – actions taken by NBRO to conduct research on control of surface water pollution; ITI, to monitor the quality of water in industrial and urban areas and to carry out research on recycling waste water and treatment of sea water.
- Water Management – actions intended to be taken by the Water Resources Secretariat to develop an integrated water resource management system for all water bodies; water quality management system being developed by NBRO; and research being undertaken to breed drought and salinity resistant crop varieties.
- Air Quality and noise/vibration pollution – actions taken by NBRO regarding the Continuous Air Quality Monitoring and Management Program with World Bank assistance; studies being carried out by the University of Colombo on the effects of air pollution on childhood wheezy epics; work undertaken by ITI to monitor and provide consultancy to industries to reduce noise/vibration/pollution; and Noise related legislation which is under preparation by CEA jointly with ITI.
- Energy (Alternate)- lack on any discernible progress.

- Transport Issues- A National Transport Plan is being implemented; the Ministry of Transport has developed a Road Safety Strategy; a Strategic Plan to develop the Railways is being formulated.
- Quality Assurance- The establishment of a National Accreditation Board has been approved; draft legislation on quality assurance of Ayurvedic drugs has been prepared.
- Information and Communication- The Department of Meteorology has used GIS to quantify the soil moisture content in the country. However a number of other proposed actions have not been implemented yet.
- Biodiversity- a project on Wildlife Conservation and Protected Area Management was initiated in 2001 for habitat mapping in seven selected protected areas. The Forest Resource Management Project started in 1999 is continuing to survey and demarcate the current and proposed forest reserves; A National Red List on threatened/extinct organisms is under preparation; The Biodiversity Secretariat has established a taxonomic initiative program and a national list of invasive fauna and flora has been prepared.

Part II of the presentation dealt with the progress to be achieved regarding BICOST-II&I. and are highlighted as follows: -

- Issues arising out of BICOST-II that have not been pursued yet: -
  - General issues – Establishment of an Apex Body and S&T Councils; Formulation of an S&T Policy; establishment of a Central Fund.
  - Scientific personnel and expertise - Preparation of a database of local expertise; improvement of remuneration and working conditions of scientists; continuous professional development of scientists.
  - Institutional infrastructure - Instituting a central mechanism to requisition servicing and repair of equipment; provision of Internet access at low cost; institution of policy and mechanisms to develop public-private partnerships, foreign collaborations etc.
  - Enhancement of quality of life of general public - a series of actions targeted at improvement of the quality of life of the people through science and technology interventions decided at BICOST-II are yet to be implemented.
  - Quality control and standardization - Actions yet to commence in upgrading the quality of scientific journals, establishment of independent regulatory bodies, etc.
  - Protection and preservation of natural resources - Actions yet to commence on implementation of a policy in respect of soil conservation, land degradation, water resources, coast and marine resources, solid waste management etc.

- Impediments to the implementation of the recommendations of BICOST-I&II
  - Lack of Policy initiatives.
  - Lack of a National Policy on S&T.
  - Inadequate finances.
  - Lack of a critical mass of S&T personnel
  - Inadequate institutional capacity.
  - Poor access to knowledge.

- Post BICOST activities of NASTEC
  - A report on inimical factors affecting the Science and Technology development in the country.
  - A report on the working environment in scientific institutions.

- Capability assessment and development of S&T Institutions.
- A study on performance of S&T Institutions.
- Proposal to establish a Central Library Service.
- Prioritization of research proposals that are cross-disciplinary and trans-institutional
- Facilitations for research management (documents, web site etc)

- Conceptual framework for an S&T Strategy for National Development.
  - The key strategic initiatives are Knowledge, Resources and Research and Technology.
  - Knowledge management is the base on which research and technology is generated from.
  - Research Management extends from basic research to commercialization, while Technology Management begins after the completion of research and ends prior to commercialization.
  - Knowledge management is a key concept. It is a discipline that promotes an integrated approach to identifying, managing and sharing all institutional information assets.
  - Explicit knowledge is formal and systemic, while Tacit knowledge is personal and hard to formalize and therefore, more difficult to communicate.
  - Resources and Research Management revolves around generating new ideas, recognizing opportunities, fostering creative conflicts within groups, creating an innovation-friendly culture and moving innovation for commercialization.
  - Technology Management encompasses technology forecasting, assessment and transfer with the broad objective of promoting technology for social and economic gain.

*3.2.3 Development and Transfer of Technologies - Review of Status and Alternatives for the Future, Dr. A.M.Mubarak*

- Technology transfer is defined as "the formal transfer of new discoveries and innovations resulting from scientific research conducted at Universities and Research and Development Institutions to the commercial sector for public benefit".
- The overriding goal of any technology transfer is its successful adoption by a large majority of consumers who can use technology. The schematic view presented in the paper depicts technology transfer, which involves taking intellectual property that derives from state funded R&D institutions, developing products and then commercializing them.
- The process of technology transfer typically involves those who create the technology and prove the concept, those who embed the technology in a useful product or process and those who embrace it, further develop, commercialize and ultimately use it.
- In Sri Lanka, more than 90% of the technologies used by industries are imported, the transfer of which take place via direct foreign investment, joint ventures, licensing or acquisition of machinery and equipment.
- When formulating a national strategy for R&D transfer, transfers that take place through the above ways should also be given due consideration to ensure that such

technology transfers are aimed at improving the economic progress and social benefits to the nation.

- Science and technology activities in Sri Lanka are conducted by a variety of organizations coming under 10 Ministries. The Ministry of Science and Technology is the principal Ministry responsible for policy formulation, coordination and development of S&T.
- The organizational framework for S&T in Sri Lanka consists of (i) University system and the Institute of Fundamental Studies. (ii) Institutions that promote and provide guidance to Govt. on S&T policy issues (iii) Professional S&T bodies, and (iv) Institutions established for R&D and technical services.
- The Industrial Technology Institute (ITI) and the National Engineering Research and Development Center (NERDC) were established for the purpose of promoting industrial development through research and development and transfer of technology.
- ITI is a Statutory Board, functioning under the Ministry of Science and Technology, the Mission of which is "to provide demand driven scientific industrial R&D and internationally competitive technical services to catalyze rapid industrialization for the benefit of the people of Sri Lanka". Its major functions are (i) testing, consultancy, and contract research (ii) Technology transfer (iii) adaptation of technologies and development of new technologies (iv) collection, processing and dissemination of useful technical information (v) training of technical persons and (vi) monitoring and mitigation of environmental pollution.
- Research currently being conducted at ITI are focused on four broad thrust area- (i) Food (ii) Herbal (iii) Materials, and (iv) Environment. All technical services including testing are pooled into four groups- (i) Chemical and Microbiological, (ii) Materials (iii) Industrial Metrology, and (iv) Electro technology.
- The NERD Center has as its functions, promotion and development of indigenous technology, ensure the adoption and adaptation of appropriate technology, offering of technology transfer services and, monitoring and sourcing technological information. Its research activities are centered on low cost housing, biogas generation, gasification, alternative energy etc.
- Arthur C Clarke Institute for Modern Technology (ACCIMT) aims to accelerate the process of introduction and development of modern technologies. The major thrust area of the Center is Microelectronics. A Space Application Center has been setup to cover satellite communications, remote sensing and astronomy
- The Industrial Development Board (IDB) the original mandate of which was to assist industry by providing industrial information, market advice, investment analysis, engineering and technical assistance and entrepreneur development and training, is now concerned with the development of products and processes based on appropriate technology and dissemination to rural level.
- The presentation covered in detail the current situation of the principal R&D institutions with regard to manpower, facilities and funding, all of which were explained as inadequate to contribute effectively towards the national development demands.
- Some of the major impediments are (i) a majority of recruits having little experience in research (ii) lack of a conducive environment (iii) stagnation of knowledge (iv) pressure on income generation (v) ill equipped laboratory facilities (vi) high operational costs (vii) poor maintenance (viii) shortage of trained technicians (ix) low government investment on R&D.

- Almost all technologies developed at the R&D institutions are "evolutionary". There has not been any revolutionary technology developed. The innovative activities of institutions cater mostly to the immediate demands of the SME sector and not the medium term and long term needs of the nation.
- A major impediment in the technology transfer process is the wide gap between the research community and the private sector. Lack of incentives, lack of protection of intellectual property rights, costs involved in R&D and lack of awareness too act as inimical factors.
- Because of the high cost of obtaining international patents, most technologies remain unpatented. There is no clear policy on ownership of research funded by the government.
- An effective transfer of technologies would require mechanisms such as (i) identification of technologies (ii) acquisition (ii) assessment (iv) identification of potential users (v) adaptation at minimum cost (vi) financing the process of adaptation (vii) maintaining contact with users for follow-up and trouble shooting.

### *3.2.4 Industry-Technology Linkage for National Development -Mr. Chandra Embuldeniya*

- The level of technology in Sri Lanka is relatively poor. There is very little research done on innovative new products. The Innovation Capacity is the potential a country carries to produce a stream of commercially relevant innovations.
- The innovation capacity depends on 3 broad elements (i) common innovation infrastructure (ii) cluster-specific conditions, and (iii) quality of linkages. These must be addressed urgently.
- Quality of linkages is one of the most important issues. The corporate sector in Sri Lanka does not have adequate linkages with the formal S&T institutions and Universities.
- Industrialized countries spend 2/3rd of total funds allocated to S&T on R&D. The S&T expenditure as a percentage of GDP in Sri Lanka is 0.17%, as compared with 0.2%- 0.7% in India and Malaysia. While in developed countries the private sector contributes 50-80% of the national R&D expenditure, the Sri Lankan private sector contribution is less than 10%.
- Although Sri Lanka is rich in natural resources, they have not been adequately tapped as a basis for R&D to innovate new products. Instead our industry is used to exporting raw agricultural and mineral resources with very little value addition.
- Sri Lanka has over 42 research organizations. Half of these are agricultural research institutions. Among the main constraints facing R&D institutions are limited availability of scientists, difficulty in retaining them, lack of funds, poor industry linkages, irrelevant research outputs in relation to industry needs, poor dissemination, and lack of demand driven approach.
- The local industrial community has suggested several measures to improve the contributions of R&D institutions. Among them are, the need to improve work ethics and attitudes, improve funding, enhance industry-institute relationships, undertake more industry focused research and improve physical facilities in the institutions.
- Higher value addition to the economy takes place at higher technology levels where higher skills are needed. Sri Lanka is currently trapped into a state of low-equilibrium driven by low-income, labor intensive, low-value added mass productions.

- Innovation can be classified into 4 broad processes –(i) identification of opportunities for products and services, (ii) management of the R& D portfolio, (iii) design and development of new products and services, and iv) bringing the new products and services to the market.
- For an organization, the direct benefit from innovation is revenue growth and enhanced margins from new products and services. The economic benefits to a country arise from the aggregate innovation adding value to the economy.
- Innovations need science and technology expertise. Experts have to work in a multi disciplinary team and the ability to absorb and infuse the knowledge into the new product is very important.
- In developing a National Strategy for Science and Technology major emphasis has to be placed in the need for competitiveness in international markets.
- The presentation offered a series of suggestions to enhance the quality and quantity of S&T contributions to industry and trade, which include policy changes, institutional changes and changes to operational mechanisms.

# 4.0 REPORT OF THE PROCEEDINGS AND OUTCOMES OF THE WORKSHOP SESSIONS OF BICOST-III

The rest of this report contains the proceedings and outcome of the Workshop facilitated by the Institute for Participatory Interaction in Development ( IPID ) to formulate a National Strategy for Science and Technology Research and Development, as part of BICOST-III organized by the National Science and Technology Commission in collaboration with the Ministry of Science and Technology.

## 4.1 Objectives of the Workshop Sessions

The principal objectives of the Workshop were as follows: -

- To identify the inimical factors and gaps that are currently standing in the way of Science and Technology contributions in the context of national development.
- To identify the causes and feasible suggestions to overcome the inimical factors and impediments as perceived by the different players.
- Based on the above reflection and the experiences and the highlights of the national and international presentations made at BICOST-III, develop an outline for a National Strategy to utilize Science and Technology Research and Development as a significant driving force in the context of national development, and
- To develop a Way-Forward Action Plan to follow-up on the strategy developed at BICOST-III.

## 4.2 Programme of the Workshop Sessions ( BICOST-III )

The summary of the Workshop programme appears below:

1. Plenary Session- Introduction to the Logical Framework Approach
2. Group Work Session 1. - Step I. - Inimical Factors/Gaps impeding progress as anticipated by BICOST-I&II- Perceptions of different players.
3. Group Work Session 1. - Step II – Causal factors and feasible suggestions to overcome the identified constraints/ obstacles as perceived by the different players.
4. Presentation of Group Work results at Plenary.
5. Plenary Session- Reflect and agree on Goal, Purpose and Key Objectives/Outputs for a National Strategy focusing on Science and Technology as a driving force in National Development.
6. Group Work Session 2. - Mixed Groups – Identification of Key Indicators and Main Activities as per Objectives/Outputs.
7. Presentation of Group Work results at Plenary.
8. Plenary Session- Way-Forward Action Planning-Post-BICOST-III Action Plan.

Details of the programme appear in **Annex 01**

## 4.3 Methodology of the Workshop

*4.3.1 Concept presentation of Logical Framework Approach methodology as a tool for formulating strategic directions*

The Chief Moderator Ms. Mallika R. Samaranayake explained the concept of the Logical Framework Approach (LFA), which would be adapted during the process of the Workshop for achieving the objectives as follows.

The Logical Framework Approach is an analytical tool for objectives oriented project planning and management. The Approach is **Objectives oriented**, **Target group oriented** and **Participatory.** Using the Logical Frame Approach helps to clarify the purpose expected, identify the information required, define the key elements, analyze the setting, as it is, facilitate communication between the different players and identify how the outcomes could be measured.

As indicated in the diagram the Project / Programme Planning Matrix comprises of four levels, which are sequentially arranged and are critical to the attainment of the final objective.

- ***Goal/Vision:*** - The long term or higher-level objective, which the project or the initiative is expected to reach.
- ***Purpose/Mission:*** - The immediate or intermediate results the project or the initiative is expected to contribute to and the improvements or changes that the project or the initiative brings to contribute to the Goal/Vision.
- ***Outputs/Results:*** - The results that the project management or the prime movers of the initiative should be able to guarantee in order to achieve the Purpose/Mission.
- ***Activities:*** - The scheduled activities that will be undertaken by the project/programme to produce the outputs. The schedule of implementation prepared during the process of planning will help to monitor the implementation of the activities related to the achievement of programme outputs, with established responsibilities in the form of the ***Activity Plan,*** providing a tool for progress monitoring.

The ***horizontal logic*** flows from the summary of objectives stated above to the Objectively Verifiable Indicators and the Means of Verification. Through the LFA process, the planning team can identify qualitative, quantitative, location and target specific time bound Objectively Verifiable Indicators (OVIs) to measure the achievement of the Goal, Purpose and Outputs. The ***Means of Verification*** (MOVs) are the sources of information that exists or can be provided cost-effectively to verify whether the objectives are achieved at each level.

The Project/Programme Planning Matrix (PPM) also provides space to identify and appreciate ***Important Assumptions and Preconditions*** critical to the achievement of the objectives at each level. The achievement of the hierarchy of objectives is associated with the assumptions preceding each level as indicated in Diagram 01. It establishes the ***vertical logic.***
In the Logical Framework Approach a development activity is seen as a ***causally linked*** sequence of events. These are described at the levels mentioned above: inputs, activities, outputs, purpose and goal. The process is seen as a hypothesis that

- If the ***inputs*** are available, then the activities will take place.
- If the ***activities*** take place, then the outputs will be produced.
- If the ***outputs*** are produced, then the purpose will be achieved.
- In the long run, achievement of the ***purpose*** will contribute to the fulfillment of the goal
- The project ***goal*** will remain viable over time.

The uncertainties of the process are explained by ***Assumptions*** at each level. These are outside the direct control of the project, but have to be fulfilled for the development process

to succeed. The approach allows the planning team to reflect on ***important assumptions*** / external factors and risks that can influence the programme initiatives.
Therefore,, in order to ensure the successful achievement of the outcomes of BICOST-III and the Post BICOST-III Way Forward Action Plan, it would be prudent to follow the logical steps of Action Planning, to plan, implement and measure the outcomes knowledgeably and in a result oriented manner.

Logical Framework Approach is generally applied in two stages as outlined below.

*1. Situation Analysis.*

- Participation Analysis
- Problem Analysis
- Objectives Analysis
- Alternatives Analysis.

*2. Project Design - Development of the Project / Programme Planning Matrix (PPM)*

- Goal, Purpose, Output, Activities
- Objectively Verifiable Indicators ( OVIs ) and Means of Verification ( MOVs )
- Assumptions/External Factors/Risks
- Inputs (Human Resources, Financial Resources, Physical Resources and Time)

*4.3.2 Application of Logical Framework Approach to the Planning Process (BICOST III)*

The justification to employ the Logical Framework Approach as a tool to formulate the National Strategy for Science and Technology emerges from the fact that it is a management tool developed for participatory planning by teams consisting of diverse stakeholder groups. The method enables groups to achieve specifically structured tasks encouraging dynamic teamwork and productive working relationships providing for intensive sharing of knowledge and experience.

***An adapted version*** of the Logical Framework Approach was used at this Workshop to achieve the objectives stated at section 2.1. A series of plenary and group work sessions were organized for the purpose. Visualization techniques were used for active participation. Structured formats were developed for group work, the results of which were followed by presentations at plenary. The sequence of deliberations was arranged as follows: -

- Identification of key areas for consideration, harmonization and reaching consensus at plenary sessions.
- Group sessions to brainstorm and reach agreement among the various players.
- Presentation of group work findings and discussion at plenary with a view to arrive at consensus.

Using the adapted version of the Logical Framework Approach, the hierarchy of objectives were revisited and elaborated based on the current Science and Technology Research and Development environment in the country. Objectively Verifiable Indicators were identified in relation to the objectives appearing at the different levels of the hierarchy indicating the measurable results to be achieved.

**Diagram 01 - Project / Programme Planning Matrix**

| Summary of Objectives | Objectively Verification Indicators ( OVIs) | Means of Verification ( MOVs ) | Assumptions (External Factors) |
|---|---|---|---|
| **Long Term ( Vision / Goal )** | | | |
| **Intermediate Objective ( Mission / Purpose )** | | | **For Contribution to the Long Term Objective** |
| **Short Term Objective ( Outputs/ Results )** | | | **For Achievement of Intermediate Objective** |
| **Immediate Objective ( Activities )** | **Inputs** | | **For Achievement of Short Term Objective** |
| | | | **Pre – Conditions** |

The formulation of a National Strategy for Science and Technology, in which the key players and the stakeholders come from a variety of disciplines and areas of interests, having a rich diversity of specialization, the LFA as a planning tool offers a series of advantages. LFA ensures that fundamental questions are asked and deficiencies analyzed in order to obtain specifically relevant information. The approach provides for systematic and logical analysis of the inter-related elements that constitute a well-designed project/programme. LFA enriches planning by highlighting linkages between project elements and external factors and facilitates common understanding and better communication between professionals, decision-makers and other stakeholders.
*During the course of BICOST-III Workshop*, the situation analysis (Step 01) was ***adapted*** to take the form of following steps, combining participation analysis, problem analysis objective analysis and alternatives analysis:

1. *Situation Analysis* in the form of a format to reflect on
   - Inimical Factors, Gaps/ Impediments *(Problem Analysis)*
   - Causal Factors *(Problem Analysis)*
   - Suggestions to over come *(Objectives Analysis combined with alternatives)*
   - The above task was assigned to different stakeholder groups *(Participation Analysis)* to obtain views from their own perspective reflecting on the above in the context of considering Science and Technology as the engine of growth for economic and social development. The stakeholder groups consisted of policy makers / administrators, academics (Universities and Research Institutes), Private sector representatives / industrialists and representatives from Non Governmental organizations.

2. *The programme design (PPM)* was formulated on the basis of the situation analysis outlined above using the Log Frame comprising of the summary of objectives *(Goal, Purpose, Outputs and Activities), OVIs and MOVs* establishing the horizontal logic and linking with assumptions / external factors, establishing the vertical logic.

### *4.3.3 Workshop Facilitation*

The Workshop sessions plenary and group work were facilitated by a team consisting of the following members with the overall facilitation provided by Ms. Mallika Samaranayake of the Institute of Participatory Interaction in Development (IPID). The team members consisted of Prof. Kamal Karunanayake, Dr. Janaki Gooneratne, Mr. Chandra Embuldeniya, Mr. Wilfred Mediwaka, Mr. N. P. Karunadasa, assisted by Ms. Bhagya Wickrema, Ms. Nadeeja Jayamanne, Ms. Wasanthi Thenuwara, Ms Manjula Abeysinghe, Ms. Niranjala Priyadarshani and Mr. Thishan Lakmal.

# 5.0 IMPEDIMENTS TO PROGRESS OF SCIENCE AND TECHNOLOGY STAKEHOLDER PERCEPTIONS (SITUATION ANALYSIS)

Looking at the varied disciplines and interest areas to which the large number of participants belongs, the discussions were structured for all participants to express their views in an unrestrained environment. The workshop program was also arranged with a view to obtaining sector specific views in particular with regard to the concerns of each discipline/activity/interest area and to provide an opportunity for all sectors to interact with each other in arriving at a general consensus.

In preparation for the group work session to make a situation analysis of the outcomes of BICOST-I&II and the general situation of Science and Technology Research and Development in the context of national development, the Principal Facilitator of the Workshop, Ms. Mallika. R. Samaranayake, Chairperson, Institute for Participatory Interaction in Development made a brief introduction to the Log Frame Approach and the abridged version that would be followed due to the time limitation.

Ideally, any planning process utilizing the LFA would need intensively moderated discussions, spread over a five day period as a basic minimum. However, both due to the serious limitation in time (1 ½ days) and due to the fact presentations made by the International Consultants provided an important insight on Science and Technology options and priorities in general, and the Sri Lankan Consultants covered some of the areas that need to be concentrated in regard to the S&T situation specific to Sri Lanka, in the course of their presentations, it was considered that dispensing with some of the preliminaries leading to Stakeholder analysis, Problem analysis, Objectives analysis and Analysis of alternatives, all integral parts of Log Frame Approach, would not reduce the quality of the exercise of ***Situation Analysis***.

For the purpose of making an assessment of the Inimical Factors/Gaps impeding the progress as anticipated by BICOST-I&II, the participants were grouped according to the stakeholder groups they represented, as follows: -

**Group A - Public Sector / Decision makers.**

**Group B1 - Universities.**

**Group B2 - Research Institutions.**

**Group C - Private Sector.**

**Group D - Civil Society/ NGOs**

The results produced by group work sessions are given below.

## 5.1 Situation Analysis by Group A (Policy makers/Administrators)

**Goal of National Policy:** To accept S & T as the engine of growth for economic and social development growth of the country

| Inimical Factors, Gaps/ Impediments | Causal Factors | Suggestions to Overcome |
|---|---|---|
| 1. Lack of appropriate policy support for S&T<br>E.g. Fiscal policy of the country is not geared to promote local industries | 1.1 Lack of awareness<br><br>1.2 Lack of updated policies | 1.1 Need to have a clear policy on S&T /R&D in the context of national development |
| 2. Lack of intra & inter Ministerial co-ordination | 2.1 Mechanisms are not properly operating | 2.1 Implement effective mechanism for inter agency co-ordination |
| 3. R&D/S&T to develop appropriate technologies was not in the agenda of the Ministries/Dept. /other institutions | | 3.1 Need to establish R&D cells in each implementing agency focusing on S&T needs<br>3.2 Establish special S&T unit in the Department of National Planning |
| 4. Differences of the priorities of Governmental decision makers | 4.1 Lack of adequate resources to address immediate priorities | 4.1 Establishment of revolving fund for each agency to promote S&T/R&D and for public sector agencies to buy services |
| 5. BICOST-I & II did not identify the monitoring & evaluation mechanism | | 5.1 Inter Ministerial committee to be chaired by Secretary to HE the President. NASTEC should provide technical advices to the committee |
| 6. Lack of advocacy and social marketing of the BICOST-I & II | 6.1 No mechanisms for advocacy and social marketing | 6.1 Develop a mechanism for advocacy and social marketing |
| 7. Approach of BICOST-I& II was top-down and did not address the need of end users | | |
| 8. BICOST-I & II did not identify appropriate technologies suitable for socio-economic development | | |
| 9. Lack of funding for R& D is the core issue (only 0.13% of GDP is set aside for S&T/RD Therefore, inadequate to set up the required infrastructure | | |
| 10. Recommendations of BICOST-I &II are not prioritized | | |
| 11. Some recommendations are unimplementable and ambiguous and as a result could not lead to the formulation of clear action plans by the implementing agencies. | | |
| 12. Suitable people are not utilized in the correct positions | | |
| 13. Scientists are not adequately motivated | | |
| 14. Inadequate recognition by the scientists of the need to work | | |

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| in partnership with industry. Complete pay back for R&D should not be expected from SMI | | |
| 15. No proper methodology and Apex Body to implement BICOST-I & II | | |
| 16. Not geared for research-oriented culture (e.g. for school level upwards) | | |
| 17. Establish research and survey culture from the school level | | |

### 5.2 Situation Analysis by Group B1 (Universities)

| Inimical Factors, Gaps/ Impediments | Causal Factors | Suggestions to Overcome |
|---|---|---|
| 1. BICOST-II suggestions were not conveyed to the scientific community properly | Adequate publicity is not given | Publicity should be given through media: interactive discussions through electronic media including Internet<br>Process should be more consultative. This should be a continuous process<br>Produce a booklet or give publicity to the BICOST-I and II suggestions and circulate among Academic staff |
| 2. Both BICOST-I and II had too many thrust areas, Therefore, little emphasis was devoted to each area | Although priority areas have been identified, mechanisms for funding and implementation were not clearly mentioned | Selected areas are not prioritized through a rating system<br>Inter-Ministerial and inter-institutional collaboration was weak. |
| 3. All priority areas were not identified at BICOST-I & II<br>No motivation and necessary budgetary allocation for the identified programmes<br>No coordination between University and other institutions to have a common goal<br>No time frame on a planned basis | | |
| 4. No participation of the end users in the identification of priorities and planning process | – Lack of commitment from relevant stakeholders<br>– Lack of incentives | Highest level forum similar to GUIRR in USA, should be established where relevant stakeholders (and Ministries of Education, Industry, Science and Tech) should be co-opted in when deciding priorities and the decisions should be binding<br>(GUIRR) Government, University, Industry, Research Round Table |
| 5. Lack of a National Science and Technology Policy | Lack of awareness among policy makers | Organize awareness programs for policy makers |
| 6. Funds not available for monitoring programmes for | Funding agencies funded only for research | Budgetary allocation for research and monitoring |

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| preparation of a base line for identification of problems | programmes but not for monitoring programmes | Funding organizers should allocate funds for monitoring or establish separate funding agencies |
| 7. Lack of funds for planned R & D activities.<br>When funds have been allocated, prohibitive, inefficient and outdated financial regulations makes it difficult to spend the allocated funds within the specified period | | |
| 8. Incapable persons were being appointed to higher posts in Science and Technology Institutions | Wrong decision makers<br>Political influence | Select suitable persons based on a properly constructed data base |
| 9. No proper reward scheme to reward scientists who carry out research relevant to local needs | Reward scheme not planned according to the local needs | Accreditation of local journals<br>Reward scheme for local publications |
| 10. Emphasis has not been given to research with an immediate impact | Basic research has been over stressed | Prioritize the problem based research and identify them for funding |
| 11. Lack of interest/ participation in research and development exercises by the industrialists. | Secrecy of research findings | Intellectual property rights should be maintained<br>Industry- Institute partnerships |
| 12. Higher education does not cater to national needs with respect to relevant degree programmes | Lack of regular curriculum revisions<br>Revisions not carried out with industrial participation | Revision of curriculum in consultation with the industry |
| 13. Difficulty in access to the relevant scientific literature. | Inadequate networking of information | Establish a National Scientific Library which has all the journals and access to all data bases |

### 5.3 Situation Analysis by Group B 2 (Research Institutions)

| **Inimical Factors, Gaps/ Impediments** | **Causal Factors** | **Suggestions to Overcome** |
|---|---|---|
| 1. Lack of political will & vision<br>2. Lack of firm a national policy<br>3. S & T not recognized as a tool for national development<br>4. BICOST recommendations were/ are not accepted as Sri Lanka 's national policy<br>5. S & T research policy formulation developed independently in several separate organizations | - Conflict of interest in providing advice to policy makers<br>- Lack of identified sectoral priorities<br>- No proper coordination among Ministries/ Institutions leading to separate policy documents<br>- Policy makers not convinced about the importance of S & T as it was not marketed professionally | - Awareness programs for politicians<br>- Good S & T policy in line with the National policy to be formulated<br>- NASTEC should be the APEX body under President or Prime Minister of Sri Lanka for effective implementation of S & T Policy<br>- give more autonomy to R & D Organizations |

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| 6. No critical mass for R & D | - Lack of national plan for knowledge development of scientific human resources<br>- poor remuneration<br>- no incentives<br>- no appreciation/ recognition<br>- no promotional prospects<br>- inadequate opportunities for skill development | - to ensure overseas exposure to scientists at all levels for: conference participation / sabbatical opportunities, split programs.<br>- institution to develop a hard plan with allocation of responsibility to CEO and accountability<br>- development of HR plan based on national S & T needs |
| | - inadequate opportunities to interact with scientists having similar interest in Sri Lanka<br>- knowledge base stagnant due to inadequate opportunities for training/ retraining<br>- pressure on income generation diverts R & D staff to technical services that are in demand<br>- majority has limited research experience | - implement proper performance evaluation system for motivate and reward for R & D personnel<br>develop a HRD plan with allocation of responsibility to CEO and accountability<br>- establish a HRD plan with capacity buildings targets (national requirements & number of. scientists per population)<br>- chain of incentives at different levels |
| 7. Inadequate facilities of R & D organizations | - lack of Research culture in many S & T institutions | enhance R & D facilities (equipment, IT, library facilities)<br>access to digital desk to electronic library facilities. (If Pakistan could, so can we!)<br>increase disbursement for research<br>enhance research facilities for R & D organizations |
| 8. No H R development to undertake R & D | | |
| 9. Lack of technology transfer mechanism | Negative attitudes for change in higher ranks in the policy planners | Conflicting interests & advice to policy makers |
| 10. Political & economical uncertainty | | |
| 11. No separate science budget | | |
| 12. Quantum of funding (inadequate) | | |
| 13. Lack of efficient monitoring system (schemes, programs) | | |
| 14. Lack of knowledge of the policy makers on the importance of the S & T in the context of development | | |
| 15. How powerful is the Apex body? | | |

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| 16. Inconsistent policy | | |
| 17. Quantum of allocation of funds not sufficient for R & D institutions to implement their programs | | |
| 18. Lack of continuity with change of the Government in both policy & strategic directions | | |
| 19. Lack of recognition for S & T | | |
| 20. NASTEC has not functioned as a APEX body | | |
| 21. S & T research policy formulation developed independently in several parallel organizations | | |
| 22. Frustration among implementers due to<br>- Bureaurocracy<br>- Poor remuneration<br>- Lack of facilities | | |
| 23. Lack of mechanisms to give due credit/ exposure to young researchers/ research managers in comparison with life span (impediment -old circulars & schemes for science) | | |
| 24. Wrong persons assuming roles in decision making. Right persons in wrong places. Planners not properly qualified trying to do professional planning | | |
| 25. Wrong people in key positions | | |
| 26. Poor research culture in country<br>- no team work etc. | | |
| 27. NASTEC has failed in coordination of S & T institutions in the country | | |
| 28. R & D progress should be made public otherwise reasons listed are consequences | | |
| 29. R & D institutions cannot attract best engineers & scientist due to poor remuneration & recognition | | |
| 30. Lack of proper scientist evaluation system | | |
| 31. Consensus based on random ideas & not scientifically based. | | |
| 32. Lack of demand for S & T from end users | | |
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| 33. Too many institutions for funding & for the same job | | |
| 34. Civil war | | |
| 35. Inability to retain qualified staff in R & T organization | | |
| 36. NASTEC's inability to coordinate R & D | | |
| 37. R & D cannot be carried out properly if researches have to earn part of their salaries | | |
| 38. No specific bodies were identified as actors to implement the recommendations of BICOST-I | | |
| 39. There is no political, economic or social stability over past two decades | | |
| 40. Recommendations itself are deficient | | |
| 41. NASTEC itself has not taken action to get the recommendations implemented | | |
| 42. NASTEC should be an APEX body under the President or Prime Minister of Sri Lanka for effective implementation of S & T policy | | |
| 43. No consistent S & T Plan | | |
| 44. Lack of mechanisms to identify research that can be accepted by SME's for national | | |
| 45. AR & FR frustrate R & D worker development | | |

### 5.4 Situation Analysis by Group C (Private Sector)

| Inimical Factors, Gaps/ Impediments | Causal Factors | Suggestions to Overcome |
|---|---|---|
| 1. SLSI Standards not updated | No plans to update standards | SLSI /others to update their standards at least every 2 years |
| 2. Neutreaceuticals & Cosmoceuticals are in gray areas for regulation | Ministry of Health has not taken action on regulatory measures | Take immediate action to regulate Neutreaceuticals and Cosmoceuticals |
| 3. Drug Authority not functioning effectively | No funds & authority | Allocate funds and provide a greater degree of independence |
| 4. Not selecting right people to Boards and not allowing them to function independently | Political interventions | Appoint competent people and allow to function and to complete their term independently |
| 5. Absence of a written policy document for S & T | Policy is not prepared | Policy to be prepared and approved by the scientific community and |

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| | | cabinet |
| 6. Absence of proper funds for R & D and innovation | Lack of Government commitment | Allocate at least 1% of GNP for R&D |
| 7. Absence of tax incentives for R & D | Lack of commitment | Provide adequate tax incentives for R & D |
| 8. Poor allocation of funds for R & D Institutions | Lack of commitment | Adequate funds and risk capital at low or zero cost |
| **Inimical Factors, Gaps/ Impediments** | **Causal Factors** | **Suggestions to Overcome** |
| 9. Absence of confidentiality to work with Government R & D Institutions | Organization culture | Organizational training |
| 10. Absence of confidence in IPR Law - Reluctant to get IPR | - Organization culture & weak law<br>- Absence of assistance to litigate | - Education<br>- Review IPR Law<br>- Fund litigation |
| 11. Excise duty for local alcohol is a disincentive to use it for industry while imports are cheaper | Unfavorable excise policy & imports policy | Government to review policies |
| 12. Policy regarding alcohol preparations / use / exports not clear | Policy regarding industrial uses unfavorable | Enable greater uses for local alcohol for industry |
| 13. Absence of standards for Ayurvedic Products (Herbal) | No regulatory body | Establish regulatory body |
| 14. Absence of market and technology information with R & D institutions | Lack of market and technical research on end user | HR development & Technology improvement. |
| 15. Reluctance to invest in newly developed research ideas to commercialize | - Uncertainty about market,<br>- Inadequate information | - Generate confidence with intelligence |
| 16. Poor collaboration and relations between R & D and the Industry | R &D not related to end-user / customer | Funding based on customer /demand oriented R & D |
| 17. No policy on food and nutrition (security) | - No policy on Food & Nutrition Security<br>- No commitment | Policy to be prepared and approved by the scientific community and the government |
| 18. Inadequate protection for local industries | Lack of priority and patriotism | Change fiscal policy etc. |
| 19. Absence of policy to exploit agricultural resources / value addition.<br>e.g. Coconut, Sugarcane, etc. | Absence of policies taking full economic advantage of agricultural resources | Evolve industries to add value to all components of agricultural resources<br>e.g. Coconut |
| 20. Depletion of agricultural resource base<br>e.g. Coconut | No zoning and enforcement | Effective zonal policy & enforcement |

### 5.5 Situation Analysis by Group D (Non-Governmental Organizations)

| **Inimical Factors, Gaps/ Impediments** | **Causal Factors** | **Suggestions to Overcome** |
|---|---|---|
| 1. Absence of a right political will and environment to encourage S & T / R & D | Lack of appreciation of the role of S & T development within political hierarchy | Influence by creating pressure from grassroots |

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| 2. BICOS II & I are not translated as a Govt. policy and action plans /programmes for raising funds and allocate responsibility. | Plans were not incorporated to relevant organizations<br>-No funds<br>-No accountability/ obligations | BICOST decisions to be made an integral part of national plans |
| 3. Lack of specific power & authority of NASTEC to implement or influence implementation BICOST-I & II | 4. Law does not give NASTEC required power to implement/ influence implementation | 5. NASTEC should be given sufficient authority and funds to coordinate & monitor |
| 4. Gaps between research outputs and implementation | Lack of proper Institutional mechanism<br>Lack of ownership of R & D output by institution responsible for implementation | |
| 5. Lack of system to interpret BICOST-I & II inputs in terms of community needs. | Communities have not been consulted | Create awareness amongst scientists on participatory Tec./ Research & Development |
| 6. Community needs are not prioritized as research problems | -Do- | Applied scientists should realize that communities are their primary stake holders |
| 7. Lack of a bottom-up process to interact with community | -Do- | |
| 8. Gaps between communities and scientists, No focus on community problems | -Do- | |
| 9. Constant change of priorities | Constant change of political priorities; no continuity in policy implementation | To have national policy that does not change with change of governments |
| 10. Quality of proposals failed funding access | | |
| 11. Decisions not implemented unless pressured (no monitoring) | Accepted working style where lethargy is a cornerstone | New work ethics Recognition, ownerships incentives |
| 12. Lack of ownership of the plan | | |
| 13. Emphasis on hardware side of technology over the soft side of it. | Insufficient recognition of available simple, adaptable and practical indigenous knowledge | |
| 14. Lack of implementation capacity within govt. institutions | Constraints in human resources | Recruitment, training & improvement of access to knowledge |
| 15. Lack of public awareness of NASTEC & BICOST plans | | Efficient use of media |

## 6.0 DEVELOPMENT OF A SCIENCE AND TECHNOLOGY RESEARCH AND DEVELOPMENT STRATEGY IN THE CONTEXT OF NATIONAL DEVELOPMENT ( *STRATEGIC DIRECTIONS )*

At the previous Conferences on Science and Technology the principal themes were "Role of Science and Technology in National Development " (BICOST-I) and "Role of Science and Technology in Infrastructure Development" (BICOST-II). Following up on the outcome of the two previous Conferences, and to assign a strategic significance on application of Science and Technology output in development initiatives, the objective and theme of BICOST-III was appropriately termed as development of "A Science and Technology Strategy for National Development". Therefore, it was important for the Workshop to clearly define the objectives and expected outcomes of the exercise.

The participants of the Workshop met at Plenary to deliberate on the **Vision** of BICOST-III, which is the Long Term Objective of a Science and Technology Strategy in National Development, and the **Mission**, which encompasses the specific purpose of the Conference. In a Project Planning process, Vision is explained as the Long Term Objective or Goal of the process, and Mission as the Intermediate Objective or the Purpose. Vision or Goal describes the wider or higher level objective, which the project is expected to contribute to, and the Mission or Purpose, as the intermediate objective intended for intermediate results and the improvements or changes through which exercise would contribute to the Vision or Goal.

The Workshop at Plenary discussed the objectives and expected outcomes of BICOST-III at length and decided that the Vision and Mission of BICOST-III shall be as follows: -

**Vision: -** ***Consolidation*** of the role of Science and Technology Research and Development as an indispensable driving force in National Development in order to enhance the well being and prosperity of Sri Lanka.

**Mission: -** ***Formulation*** and implementation of a National Strategy to create an enabling environment for Science and Technology Research and Development that would contribute effectively to National Development processes**.**

Having established the Vision (Goal) and the Mission (Purpose), the next stage in the Logical Framework Approach was to identify the ***Outputs*** and the ***Activities***. Outputs are described as the results that the management of the process should be able to guarantee in order to achieve the Mission and the Activities as those actions that would have to be undertaken to produce the outputs identified.

Based on the results of the group work that identified the Inimical Factors and Gaps which acted as impediments in the achievement of BICOST-I&II recommendations, the following key areas were identified as the expected outputs of BICOST initiatives.

- ***Policy level issues*** - concerning National Policy on Science and Technology, Fiscal Policy issues, and issues pertaining to Inter Sectoral Coordination.
- ***Human Resource issues*** - concerning Human Resource deficiencies and issues relating to Science and Technology infrastructure.

- ***Research and Development Prioritization and S&T Dissemination issues*** - concerning development of a Science Culture, motivation of S&T personnel and determination of research priorities through a process of consultation.
- ***Knowledge and Data issues*** - concerning issues relating to lack of a comprehensive data base and information system, and
- ***S&T End-user issues*** - concerning issues relating to linking S&T R&D development with end-users of S&T outputs.

## 6.1 The detailed Outputs expected through BICOST-III

The following outputs were identified by the different Groups as initiatives to be achieved through BICOST III Strategic Plan (Strategic Directions) working as 05 mixed groups under the following themes. The detailed results of Group Work appear in **Annex 2.**

*6.1.1. Policy related Outputs: - Group A*

- A well designed Science and Technology Policy in the context of National Development formulated and operational.
- Fiscal Policy and related Procedures elaborated and formalized.
- A National level Inter Ministerial Coordination Committee under HE the President, chaired by the Minister of Science and Technology serviced by the NASTEC established and functioning.

*6.1.2. Human Resources related outputs: - Group B*

- A need-based Human Resource Development Plan prepared and implemented in collaboration with relevant institutions.
- Identified infrastructure facilities available at Science and Technology related institutions to provide services to end-users.
- Bi-lateral and Multi-lateral agreements, twinning and networking established and operational.

*6.1.3. Research prioritization and S&T dissemination outputs: - Group C*

- BICOST recommendations subjected to wider dissemination and discussion among stakeholders.
- A mechanism to determine research priorities through a process of consultation and participation of a wider clientele including end-users, established and operational.
- Salary and incentive packages in appreciation of innovative work of Science and Technology personnel contributing to National Development developed and operational.
- A Science culture promoted among communities at large.

*6.1.4. Knowledge and Data related outputs: - Group D*

- A comprehensive database of Science and Technology, Research and Development personnel, institutions, facilities and resources prepared and accessible.
- A knowledge-base information system developed and established.
- Access to Digital Electronic Library available.

*6.1.5. Outputs that concern S&T end-users: - Group E*

- Product, service and process development as an integral part of manufacturing and service industries promoted.
- Cleaner production and environmentally processes promoted.
- A Revolving Fund to promote SMEs and Micro Enterprises through Science and Technology activities, with matching grants to non-SMEs, established and operational.
- Value addition to local resources promoted.

## 6.2 Key Activities as per Outputs

The 05 working groups identified the following Key Activities as per Outputs.

*6.2.1. A well-defined S & T Policy in the context of National development formulated and operational*

- Formulate National S & T Policy
  - Appoint a drafting committee
  - Examine similar policy documents
  - Hold meetings with stakeholders
  - Identification of key areas relevant to S & T
- Obtain feedback on the draft from the stakeholders and revise the draft
- Seek Cabinet approval

*6.2.2. Fiscal policy and related procedures elaborated and formalized*

- Seeking integration into other national planning policies
- Assessment of financial requirements to reach 1% of GDP in 5 years
- Modification of existing financial regulations to facilitate R & D activities

*6.2.3. A National level Inter-Ministerial coordination committee established under HE the President and chaired by the Hon. Minister of S &T with NASTEC as the Secretariat*

- Drafting of TOR for the Inter-Ministerial Committee and seeking cabinet approval for TOR
- Establishing S & T cells in relevant Ministries

*6.2.4. Need based HR development plan prepared & implemented in collaboration with relevant Institutions.*

- Need survey assessment of HR in S & T institutions.
- Preparation of a comprehensive needs assessment report
- Preparation of a HR Development Plan
  - at Micro level
  - at Macro level
- Implementation of the HR plan through short- term and long term- training for relevant personnel
- Identification of training institutions and expertise, both local and foreign for short term and long term training (educational & professional training)
- Training of trainers & other personal required

*6.2.5. Identified infrastructure facilities available at Science & Technology related institutions to provide services required by end users*

- Survey of S&T needs of the end-users depending on the infrastructure facilities available in the S&T Institutions.
- Survey of current infrastructure facilities available in the S & T Institutions.
- Assessment and prioritization of the requirement depending on the needs of the Institution and the end- users
- Determine mechanisms to acquire facilities that are needed but not presently available
- Influence amendments to Government procedures to import relevant facilities including equipment and consumables (critical chemicals) for S & T work

*6.2.6. Bi-lateral & Multilateral agreements, twinning & networking established & operational*

- Identification of relevant institutions and expertise relating to S & T work locally and internationally.
- Establish a database
- Mechanism to encourage and facilitate networking between the identified Institutions and persons
- Seek opportunities for networking between nations (regional and international)

*6.2.7. BICOST recommendations subjected to wider dissemination & discussion among all stakeholder groups*

- Identify relevant stakeholders
- Identify appropriate dissemination
- Disseminate BICOST recommendations to relevant stakeholders
- Obtain feedback from the stakeholders

*6.2.8. A mechanism to determine research priorities through a process of consultation and participation, established and operational including the end users*

- Develop a ranking system based on national priorities and needs-based survey

*6.2.9. Salary and incentive packages in appreciation of innovative work of S & T personnel (contributing to national development) developed and implemented – design a criteria based (rights based) transparent mechanism for incentives*

- A Proposal for increased salaries of S & T personnel
- Develop and recommend a suitable mechanism (transparent) to reward innovative research

*6.2.10. Science culture promoted among community at large*

- Declare Year 2006 as the "Year of Science" and follow-up activities
- Conduct popularization activities

*6.2.11. A comprehensive database of R & D personnel prepared and accessible*

- Identify the R & D institutions
- Write to heads of institutions or coordinators assigned, and get the list of S&T personnel
- Draft a questionnaire to gather information with predetermined subjects
- Compile a complete data base

- Update the data base once a year
- Have a web page to provide information online (NSF to have the responsibility)

*6.2.12. A comprehensive database of R & D Institutional facilities and resources prepared and accessible*

- Identify the institutions
- Write to the heads of institutions and get lists on type of instruments and facilities available to them
- Draft a questionnaire to gather information on availability of instruments and other resources
- Compile a complete data base
- Update the data base once a year
- Have a web page to provide information online (NSF to have the responsibility)

*6.2.13. Knowledge based information system established & developed*

- Every institution to prepare a databases on project reports, thesis and publications available at S & T Libraries and institutions of work carried out by Sri Lankan scientists and research related to Sri Lanka
- NSF to host all Sri Lankan bibliographic databases
- Heads of institutions to provide the information

*6.2.14. Access to digital electronic library available*

- "Web of Science" to be subscribed to be accessed from identified institutions (NSF to be the coordinating body)

*6.2.15. Product, service & process development as an integral part of manufacturing & service industries promoted*

- Encourage innovative research
- Strengthen IP literacy of S & T personnel
- Joint research activity industries
- Address all inimical factors to collaborations
- Introduce 6 sigma, 5 S TQM etc. skills development
- Improve work environment learning & growth

*6.2.16. Cleaner production & environmentally sound technology promoted*

- Promotion of project development
- Training/ Awareness programs

*6.2.17. Up-liftment of the SMI and Micro Enterprises and the rural Economy through S & T*

- Establish a revolving fund to promote SME & Micro Enterprises through S & T activities (Technology, Training, Marketing, extension, quality and surveys)
- Establish a funding scheme for R & D at NSF

*6.2.18. Value addition to endogenous (natural resources, bio-diversity) resources promoted*

- Prepare inventory of local resources
- Collection of traditional knowledge
- Promote R & D for sustainable product development based on domestic resources

## 6.3 Assumptions for achievement of outputs

- ***Political will prevails***: - It was assumed from the statements made by the Hon Minister of Science and Technology at the Inauguration of BICOST-III and at the Workshop Sessions that a strong political will should prevail to promote Science and Technology as a significant driving force in National Development.
- ***Collaborating agencies will cooperate*****: -** It was also assumed that all relevant agencies dealing with or having a role to play in Science and Technology will collaborate effectively to create an important niche for S&T in National Development initiatives. The appointment of an Inter Ministerial Coordinating Committee by HE. the President and chaired by the Hon. Minister of Science and Technology, serviced by NASTEC was expected to be of major assistance to promote collaboration and inter sectoral cooperation.
- ***End users willing to adopt research findings / technological innovations*****: -** The important assumption is that the end-user community both in the Public Sector as well as in the Private Sector, being the primary beneficiaries of Science and Technology outputs, will adopt research findings and translate the outputs as viable commercial pursuits, which ultimately contributes to National Development. It was also assumed that the stakeholder organizations would commit themselves for teamwork in producing Science and Technology outputs and use them in production processes contributing to national Development.
- ***Trained personnel will continue to serve their Organizations with commitment and dedication*****:** - In order to create an environment for Science and Technology Research and Development to make a significant contribution to National Development, and to make S&T an indispensable driving force in National Development, the Workshop assumed that the S&T personnel who are trained in the various fields of science and technology and who have acquired high qualifications, often with Government funding, will continue to serve their organizations with commitment and dedication.

## 6.4 Pre –Conditions for Activities

- ***Funding available on time*****: -** The primary pre condition for the attainment of the objectives of BICOST-III and the National Strategy developed at the Workshop is that necessary funding will be available on time for the interventions planned.
- ***Required personnel available*****:** - Availability of Scientific and Technology personnel possessing the required qualifications and aptitude at the S&T Institutions is vitally important for the purpose of moving the strategy forward. The Workshop decided that availability of the required human resources Therefore, is a key pre condition quality as well as quantity vise.
- ***Adequate infrastructure facilities available*****: -** Implementation of a S&T Action Plan necessarily required infrastructure facilities, and Therefore, is an important pre condition for the attainment of the success expected from the participation of the S&T community in contributing to national development
- ***Time Factor for implementation*****: -** Implementation of the National Strategy for Science and Technology for National Development involves a variety of disciplines, sectors, agencies and institutions including scientific/technology institutions. Organizing and implementing the strategy in unison Therefore, necessitates adherence to strict time schedules by all sectors concerned. Hence the Workshop decided that the important precondition of Time Factor would be adopted as a primary pre condition in the effort of detailed Action Planning and Implementation with responsibilities assigned.

## 6.5 Summary of Project / Programme Matrix ( PPM )

**National Strategy for Science & Technology in the context of National Development**
**(Directions)**

| Summary of Objectives | Objectively Verifiable Indicators (Targets) | Means of Verification/ Source of verification | Assumptions ( External Factors ) |
|---|---|---|---|
| **Long Term (Vision / Goal)**<br><br>Consolidation of the role of Science & Technology as the engine of growth (an indispensable driving force) in National Development in order to enhance the well-being and prosperity of Sri Lanka. | | | **Assumptions for long-term sustainability** |
| **Medium - term Objectives (Mission / Purpose)**<br><br>Formulation and implementation of a National Strategy to create an enabling environment for Science & Technology (Research & Development) that would contribute effectively to National Development processes. | | | **Assumptions for contributing to Vision / Goal**<br><br>• Political will prevails<br>• S & T R & D sensitive to NGOs and user needs<br>• New innovations appropriate and affordable |

**PPM Contd.**

| Summary of Objectives | Objectively Verifiable Indicators (Targets) | Means of Verification/ Source of verification | Assumptions ( External Factors ) |
|---|---|---|---|
| **Short Term Objective (Outputs/ Results)**<br><br>1. Well-defined S & T Policy in the context of National development formulated and operational<br><br>2. Fiscal policy and related procedures elaborated and formalized<br><br>3. A National level inter-ministerial coordination committee established under the President and chaired by the Minister of S&T with NASTEC as the Secretariat<br><br>4. Need based HR development plan prepared & implemented in collaboration with relevant Institutions | • Within 09 months from the commencement of the formulation of the policy, instructions issued to all institutions for implementation<br><br>• Annual Budgetary allocation provided in keeping with the assessment<br><br>• Committee appointed and becomes functional within 06 months of Cabinet approval<br><br>• S&T Institutions equipped with more than 90% trained personnel by end of 2007<br>• A rational ratio between research and non-research HR established | | **Assumptions for achievement of Mission /Purpose**<br><br>• Political will prevails positively<br><br>• Trained personnel continue to serve in their Institutions /Organizations<br><br>• Stakeholder organizations commit themselves for team work<br><br>• Industrialists entrepreneurs willing to make use of S & T innovations |

**PPM Contd.**

| Summary of Objectives | Objectively Verifiable Indicators (Targets) | Means of Verification/ Source of verification | Assumptions ( External Factors ) |
|---|---|---|---|
| 5. Identified infrastructure facilities available at Science & Technology related institutions to provide services required by end users<br><br>6. Bi-lateral & Multilateral agreements, twinning & networking established & operational<br><br>7. BICOST recommendations subjected to wider dissemination & discussion among all stakeholder groups<br><br>8. A mechanism to determine research priorities through a process of consultation and participation, established and operational including the end users | • 50% of required infrastructure facilities in place by 2009<br>• Complete local & regional (SARRC) network operational by 2007.<br><br>• A plan to network with International organization prepared by X year<br>• % of identified stakeholders, who have been made aware of BICOST recommendations within 06 months of dissemination (to be revised)<br>• % of stakeholders, who have made use of it in their own planning process within 01 yr. of receiving it<br>• Number of Research Projects in prioritized areas, commenced within X No. of months | | |

**PPM Contd.**

| Summary of Objectives | Objectively Verifiable Indicators (Targets) | Means of Verification/ Source of verification | Assumptions ( External Factors ) |
|---|---|---|---|
| 9. Salary and incentive packages in appreciation of innovative work of S & T personnel (contributing to national development) developed and implemented – design a criteria based (rights based) transparent mechanism for incentives | • Increased salaries by X%<br>• Number of incentive schemes introduced | | |
| 10. Science culture promoted among community at large | • Number of Programs implemented<br>• 75% of the information collected & database to be completed in 3 months | | |
| 11. A comprehensive database of R & D personnel prepared and accessible | • 100% of the information collected & database to be completed by 6 months | | |
| 12. A comprehensive database of R & D Institutional facilities and resources prepared and accessible | • 75% of the information collected & database to be completed in 3 months | | |
| 13. Knowledge based information system established & developed | • 100% of the information collected & database to be completed by 6 months | | |

| Summary of Objectives | Objectively Verifiable Indicators (Targets) | Means of Verification/ Source of verification | Assumptions ( External Factors ) |
|---|---|---|---|
| 14. Access to digital electronic library available | • Within 3months from the commencement<br>• Within 6 months from the commencement<br>• Within 6 months if funds are available | | |
| 15. Product, service & process development as an integral part of manufacturing & service industries promoted | • No. of patents/ license applied for & granted<br>• No. of patents successfully commercialized<br>• No. of new ventures<br>• No. of successful new products<br>• No. of trade marks | | |
| 16. Cleaner production & environmentally sound technology promoted | • Improvement of productivity (as a percentage)<br>• Increased employment of S & T personnel<br>• Increased employment opportunities<br>• No. of ISO 14000 companies registered<br>• No. of carbon trading companies | | |

**PPM Contd.**

<table>
<tr><th>Summary of Objectives</th><th colspan="3">Objectively Verifiable Indicators (Targets)</th><th>Means of Verification/ Source of verification</th><th>Assumptions ( External Factors )</th></tr>
<tr><td>17. Up-liftment of the SMI and Micro Enterprises and the rural Economy through S & T<br><br>18. Value addition to endogenous (natural resources, bio-diversity) resources promoted</td><td colspan="3">• Percentage utilization of funds<br>• No. of successful SMEs established using revolving fund<br>• No. of competitive bids for research<br><br>• Completed inventory<br>• No. of new products & ventures using local raw material</td><td></td><td></td></tr>
<tr><td rowspan="2">Activities<br>(Action Plan to be elaborated)</td><td colspan="3">Inputs</td><td rowspan="2">Assumptions for achievement of outputs<br><br>• Political will prevails<br>• Collaborating agencies co-operate<br>• End users willing to adopt research findings / technological innovations</td></tr>
<tr><td>Local</td><td>Foreign</td><td>Community</td></tr>
<tr><td colspan="4"></td><td>Pre – Conditions for Activities<br>• Funding available on time<br>• Required personnel available<br>• Adequate infrastructure facilities available<br>• Specific time frame to be decided</td></tr>
</table>

# 7.0 WAY FORWARD ACTION PLAN

The Workshop participants met at Plenary for the final session of the Workshop to formulate the Way Forward Action Plan to operationalize the key outcomes of the BICOST-III Workshop. It was noted that the BICOST-III Workshop activities were restricted to making a **Situation Analysis** primarily comprising of Identification of inimical factors and Gaps impeding the implementation of BICOST-I&II outcomes, developing consensus on the **Goal, Purpose and Key Objectives/Outputs for a National Strategy** to create an environment for Science and Technology to be a significant and indispensable driving force in National Development and **Identification of Key Indicators for the Main Activities** in regard to the Objectives/Outputs. In the process of identifying the key activities and Indicators, Group exercises also produced Short term, Medium term and Long term activities. However a technically precise Activity Plan in the form of a GANT chart was not attempted due to the time constraint.

In order to follow-up on the outcomes of the BICOST-III Workshop, the participants decided on the following 3 stage Post BICOST-III Way Forward Action Plan.

## 7.1 Stage I. Determination of Key Researchable Areas

A Post-BICOST-III Workshop would be held to determine the Key Researchable areas in the context of creating a niche for Science and Technology Research and Development to make a significant contribution to National Development. The Workshop focused on the need to address issues, which are of strategic importance for national development, and to enhance the well-being and prosperity of Sri Lanka. The Workshop reflected on the observations made by Dr. R.O.B.Wijesekera in the course of his presentation, which focused on four areas, or Goals, considered as primarily important and current in the context of National Development. They are (i) Security in Food and Nutrition (ii) Security in Water and Energy (iii) Security in Health and Shelter, and (iv) Competitiveness in Trade and Industry. Using these four key areas, which the Workshop agreed, as strategically important National Goals, the key researchable areas could be identified and prioritized.

The Post BICOST-III Workshop on Determination of Key Researchable Areas will have the participation of a small representative group of Scientists and Technologists, Researchers, Policy makers and Administrators, Industrialists and other End-Users including the SME and Micro Enterprise interests and Civil Society groups. The Workshop considered the options available to have a wide representation keeping the numbers practically small in order to have more focused discussion and reaching consensus. It was left to NASTEC to come up with proposals to constitute the follow-up working group. Prior to the working group session, NASTEC will develop Criteria for identification and prioritization of researchable areas.

The role of the Post BICOST-III Workshop will be to determine key researchable areas in the context of strategically important National Development priorities.

## 7.2 Stage II. Presentation of Post BICOST-III Workshop findings

The findings of the Post BICOST-III Workshop on Determination of Key Researchable Areas would be presented to key Organizations, Institutions and Agencies, Donors and International agencies, Politicians, Policy makers and Administrators critical to making decisions to allocate funds and other resources and also for decision-making with regard to implementation. The principal objective of Stage II of the Way Forward Action Plan is to

influence politicians, decision makers and donors to attach the required importance to Science and Technology Research and Development to make a significant contribution to National Development.

### 7.3 Stage III. Operationalizing Action Plans of Workshop Outcomes

At the final stage of the Way Forward Action Plan, an Action Planning Committee will be constituted to prepare Final Action Plans, determine the priorities learning from the observations that would be offered at the Presentation of Key Researchable Areas (to be undertaken under Stage II) and communicate the outcome to the parties responsible for the implementation. The essential characteristics of the persons who will comprise the Committee are that (a) they should be knowledgeable (b) they should be stakeholders, and (c) they should have time available at their disposal. The Action Plan will have specifically identified activities and tasks with fixed responsibilities for their implementation.

For the purpose of implementing the outcomes, each head of Institution responsible will nominate a Senior Official equipped with the necessary competence and authority to make decisions to undertake and be responsible for the implementation and also to liaise with other concerned organizations, institutions and NASTEC.

## 8.0 CLOSING SESSION

**8.1 The Hon. Minister of Science and Technology, Prof. Tissa Vitarana** making his closing remarks stated that the BOCOST III Workshop produced more than what he originally assumed as the expected outcome. Having gone through the unsuccessful experiences of BICOST-I& II, the outcome of BICOST-III, certainly is praiseworthy. The Workshop has formulated a good product. Hon. Minister said that he wished to pay a humble tribute to all who worked tirelessly to produce the outcome of the Workshop and to congratulate them. He added that what the Workshop produced is a blue print to take the process forward. The product of the Workshop comes at the opportune moment when he has planned a meeting with the Hon. Minister of Finance to seek enhanced budgetary allocations for Science and Technology. Prof. K.K.Y.W.Perera and Dr. A.M.Mubarak have been entrusted the responsibility to make a strong case for enhanced budgetary support.

The outcome of the BICOST-III Workshop will substantially strengthen the argument and to make a case in favor of increased budgetary support for Science and Technology Research and Development. He stated that in pursuing action to create effective space for Science and Technology to contribute to National Development, there are both macro issues and micro issues. While macro issues can wait to be dealt with in time, it is the micro issues that need immediate attention. If it is possible to make a case for increased budgetary support for the most urgent activities, there is a possibility to provide the necessary funds in the 2005 Budget, which is being formulated and move forward as planned at the Workshop.

The Hon. Minister stated that he was glad that the Workshop has identified the need to establish an Inter Ministerial Coordinating Committee appointed by H.E. President and chaired by the Minister of Science and Technology. Quite appropriately, the Workshop has recommended that the Committee should be serviced by NASTEC. He was confident that H.E. president would agree to the recommendation and provide the high level leadership that the initiative deserves. With that kind of leadership, activities of NASTEC can move forward rapidly. However, there are problems that we have to encounter. It is essential that we change the mindset of Scientists and Technologists who have been brought up in the traditional way, who are complacent with what they are doing now. Scientists and Technologists should attune themselves to the needs of the country and its priorities. They must change their mind-set and think in terms of National Development. This however does not mean that they must give up the research activities they are engaged in at present. But it is necessary that Scientists and Technologists, in addition, should devote a considerable amount of time on social and economic development issues as well. The National Science Foundation and the Sri Lanka Association for the Advancement of Science have a major role to play in this direction.

The Hon. Minister noted that the Workshop has not examined one matter, which in a way is highly controversial. This concerns the urgency with which we have to face the challenges of the dynamic world. If Sri Lanka needs to be competitive, our Scientists and Technologists have to come up with cutting-edge technology, quickly. Drawing reference to the observations made by the two internationally reputed scientists who graced BICOST-III, Professors Atta-Ur-Rahman and Ramamurty, Hon. Minister suggested that Sri Lanka should explore the possibility of engaging Sri Lankan scientists working and living abroad to contribute their knowledge and experience to the cause of National Development. For instance through a process like “Technology Watch” they can effectively contribute to science and technology in Sri Lanka whilst working abroad and help our scientists to keep

abreast of the new developments as they happen. He was confident that our scientists would see this in a positive perspective.

Quite rightly, the Workshop has dealt with the question of quality. The Sri Lanka Standards Institute was a part of the Ministry of Science and Technology at one time, although it is not with us now. We have to get the Institute on track to assist the SMI sector to improve the qualitative aspects of their products, Hon. Minister added.

The Hon. Minister stated that Industry-Institute interaction is an important aspect to be revamped. Out of 10 thrust areas contained in the ADB Project, only 3 have got off the ground, while the 4$^{th}$ is just moving forward. The minister said that he was extremely happy about the output produced by the Workshop, but added that its implementation involves a tremendous amount of time and commitment. Every one genuinely interested in Science and Technology and National Development should devote a great deal of time and energy to fulfill the objectives and outcomes of this workshop. The necessity may arise for the NASTEC to be expanded. It may even be necessary to evolve new organizational structures. It we do the right thing; it is possible to influence decision makers in our favor. We have also to use mass media very effectively.

The Hon. Minster said that what is to follow in this exercise is certainly an uphill task. He urged the Science and Technology community not to be daunted. He thanked the participants of BICOST-III and the Workshop, the staff of NASTEC headed by Dr. Noble Jayasuriya, and the IPID team headed by Ms. Mallika Samaranayake for the excellent job done.

**8.2 Dr. M.C.N. Jayasuriya, Director/CEO of NASTEC** making his concluding remarks said that BICOST-III was a landmark event, in that it coincided with the fifth year of NASTEC. It was also the first time that the Head of State H.E.President of Sri Lanka agreed to inaugurate the Conference. Although she was unable to grace the occasion due to unavoidable circumstances, the Hon Minister has assured that he will convey the outcome of the Conference. The presence of Hon. Prime Minister was a great encouragement to BICOST-III.

The Conference was fortunate to have the participation of several eminent scientists. Particular mention needs to be made regarding the participation of Prof. Atta Ur Rahman, Minister of Education and former Minister of Science and Technology of Pakistan, and of Prof. Ramamurthy, Secretary, Department of Science and Technology Government of India, both of whom made very valuable presentations with regard to the status of Science and Technology in their countries. There were three Scientists from NAM S&T Center who participated in the BICOST-III as well as the workshop. Their presence too was very valuable. The participation of Scientists from our friendly countries Cuba and Indonesia was also an encouragement.

BICOST-III was also important in that it provided the forum to felicitate an eminent scientist and former Chairman of NASTEC, Dr. R.O.B.Wijesekera, on the occasion of 50 years of service to Science and Technology.

Dr. Jayasuriya thanked the Hon. Minister Prof. Tissa Vitarana, himself an eminent Scientist, for the leadership and cooperation extended to NASTEC and BICOST-III. The success of BICOST-III would not have been possible if not for the excellent support extended by the

small band of dedicated staff of NASTEC. He thanked all of them citing their names individually. Dr. Jayasuriya very specially thanked Ms. Mallika Samaranayake, Chairperson of the Institute for Participatory Interaction in Development and her team for the very successful manner in which they conducted the Workshop.

### 8.3 Evaluation of the Workshop

At the conclusion of the Workshop, the participants were requested to individually evaluate the conduct of the Workshop through a structured format. The ratings given by individual participants were thereafter analyzed and the final results of the evaluation is indicated below.

## 9.0 CONFERENCE / WORKSHOP EVALUATION – BICOST III

The assessment was on the basis of 5. Scale ranging from Very Good, Good, Average, Below Average and Poor. The results of the evaluation appears in the table below. Which is self-explanatory. Participants were requested to responds to a structured format in assessing the achievement of the Objectives of BICOST III as perceived by them individually. It is observed that 97.6 % of the participants have assessed the overall conference and the Workshop BICOST III as above average.

| | **Very Good** | **Good** | **Average** | **Below Average** | **Poor** |
|---|---|---|---|---|---|
| 1. Presentations by International Consultants | **43** | **33** | **07** | **-** | **-** |
| 2. Presentations by Sri Lankan Consultants | **26** | **40** | **12** | **-** | **-** |
| 3. Identification of inimical factors impeding progress of implementation of BICOST I & II recommendations | **14** | **43** | **14** | **03** | **02** |
| 4. Analysis of causes and suggestions to overcome inimical factors, impediments and gaps | **14** | **35** | **23** | **02** | **01** |
| 5. Identification of Vision, Mission and Key Outputs for a National Strategy on S & T ( Basic directions ) | **22** | **38** | **13** | **04** | **03** |
| 6. Identification of key output indicators and activities as per outputs | **10** | **35** | **24** | **04** | **-** |
| 7. Workshop facilitation in general | **23** | **45** | **08** | **-** | **-** |
| 8. Group work facilitation | **19** | **42** | **18** | **-** | **-** |
| 9. Conference / Workshop organization | **27** | **44** | **08** | **01** | **-** |
| 10. Support facilities / meals, lodging and transport | **25** | **41** | **04** | **03** | **-** |
| 11. Composition of workshop participants and their presence | **07** | **41** | **21** | **06** | **01** |
| 12. Overall Conference and Workshop of BICOST III | **15** | **54** | **11** | **01** | **01** |

## 10.0 CONCLUSIONS / OBSERVATIONS

- BICOST-III brought together the right mix of sectors, disciplines and persons critical to achievement of the objectives of the Workshop and also created the right atmosphere to discuss issues freely, exchange ideas in an unrestrained manner and to reach consensus on the way forward.

- Science and Technology constitute the key to development in a developing economy. It further considers that judicious prioritization of scientific and technological interventions in the development processes, right policy orientations and firm commitment on the part of the various players are the primary pre requisites to create an effective space for science and technology to contribute effectively to national development.

- During the two and a half days of intensive discussions and exchange of views, the participants were able to discuss Science and Technology, the importance it deserves as a significant driving force in National Development. It was also possible to reach consensus on the issues, accept responsibility for the proposed activities and to move towards the common goal of National Development.

- Science and Technology contributions to National Development require determination of policy, establishment of priorities, identification of strategies and development of activities in a logical manner, followed by acceptance of responsibility for the implementation of the activities by the various stakeholders in the sectors concerned. This needs a well-coordinated planning process and a committed leadership.

- In view of the crosscutting nature of interventions and the multiplicity of disciplines involved, the development of a National Strategy for Science and Technology in the context of national development needs equal and active participation of all sectors concerned for the preparation of a well-defined Plan of Action.

- The continuous, unassuming and active participation of the Hon Minister of Science and Technology, Prof. Tissa Vitharana, rendering his position as a Minister to play an invigorating role at the Workshop was a key element that contributed to the success of the outcome.

- The formulation of a National Strategy for Science and Technology in the context of National Development through the application of the Logical Framework Approach involves intensively moderated and specifically focused participatory discussions and entails the accomplishment of a logical sequence of activities. This would essentially need a minimum of 5 days of a concentrated process.

- However, the serious time constraint, and the difficulty for senior Scientists, Technologists, Policy makers, Administrators, Private sector participants and members of Civil Society Organizations to spend a long period continuously leaving aside their routine affairs, necessitated the application of an adapted version of the Logical Framework Approach. Yet precautions were taken to ensure that the quality of the process was not compromised.

- The success of the Strategy formulated at the Workshop would however depend on the extent to which the proposed activities are elaborated at the Way Forward Action Planning Process to follow and the manner in which the various sectors will take responsibility for their implementation.

- It is observed as evident from the interest shown at the Workshop that the Way Forward Action Plan too will move forward with the same vigor and vitality, and that the facilitation required from the various sectors will be forth coming both in quality and the desired quantity.

- The Institute for Participatory Interaction in Development wishes to record its heartfelt appreciation to the Ministry of Science and Technology, Director/CEO of NASTEC and participants of the Workshop for the support and assistance extended to make the outcome of the Workshop a success.