

**TASK FORCE ON ESTABLISHMENT OF
INTER-INSTITUTIONAL AND INTER-UNIVERSITY
CENTRES ON SPECIFIC AREAS**

A Draft Report

Introduction

With a view to formulate the Twelfth Five Year Plan for the Science and Technology Sector, Planning Commission has constituted a Steering Committee under the Chairmanship of Dr. K. Kasturirangan, Member (Science), Planning Commission. The Steering Committee in its first meeting constituted 14 Working Groups, and 3 Task Forces to assist it in this process. One of the three Task Forces is on Establishment of Inter- Institutional and Inter-University Centres on specific areas.

The objective of this Task Force is to make an assessment of the performance of existing Inter-University Centres (IUCs) in strengthening university research system in the country and creating excellence and providing access to major research facilities to researchers working in Indian Universities in inter-disciplinary areas of Science and Technology and examine the need for replicating this concept. Similarly, there has been some attempt in the past to set up Inter-Institutional Centres (IICs) to leverage upon the expertise of individual institutions for achieving desired goals. There is a need to look at the functioning of these Inter-Institutional Centres for replicating this concept.

The composition of the task force is as follows:

S. No.	Name and Designation/Affiliation	
1.	Dr. V.S. Ramamurthy, Former Secretary, DST, Presently Director, NIAS, Bangalore.	Chairman
2.	Dr. P. Chaddah, Director, UGC-DAE Consortium for Scientific Research, Indore.	Member
3.	Dr. Amit Roy, Director, Inter-University Accelerator Centre, Aruna Asaf Ali Marg, Near Vasant Kunj, Post Box No. 10502, New Delhi - 110 067.	Member
4.	Dr. G.K. Mehta, Distinguished Honorary Professor, Deptt. of Physics, IIT, Kanpur.	Member

5.	Professor N. Sathyamurthy, Director, IISER (Mohali), MGSIPAP Complex, Sector 26, Chandigarh - 160 019.	Member
6.	Professor Shridhar R. Gadre, Professor, Department of Chemistry, University of Pune, Pune - 411 007.	Member
7.	Dr. Balram Bhargava, Department of Cardiology, AIIMS, New Delhi.	Member
8.	Dr. Alok Ray, Department of Bioengineering, IIT, Delhi.	Member
9.	Dr. S. Ramaswamy, Institute of Stem Cell Biology and Regenerative Medicine, National Centre for Biological Sciences, GKVK, Bellary Road, Bangalore - 560 065.	Member
10.	Dr. S. Natesh, Senior Advisor (Scientist - H), DBT, New Delhi.	Member
11.	Professor B.N. Goswami, Director, IITM, Pune.	Member
12.	Dr. Satish R. Shetye, Director, NIO, Goa.	Member
13.	Professor Dinesh Singh, Vice Chancellor, University of Delhi.	Member
14.	Professor Mohan Kumar, Indian Institute of Science, Bangalore.	Member
15.	Professor N. Mukunda, Indian Institute of Science, Bangalore.	Member
16.	Professor Charusita Chakravarty, IIT, Delhi.	Member
17.	Professor Partha Majumdar, Director, NIBMG, Kolkata	Member
18.	Dr. P. Prakash, Addl. Secretary, UGC, New Delhi.	Member
19.	Shri. Ajit Kumar Verma, Adviser (S&T), Planning Commission, or his nominee.	Member
20.	Shri. Pawan Aggarwal, Adviser (Education), Planning Commission.	Member
21.	Professor Ajit Kembhavi, Director, Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune - 411 007.	Member Secretary

Meeting of the Task Force

The Task Force met at the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune on June 13, 2011. The members and invitees present at the meeting were as follows:

Sr.No.	Name	
1.	Dr. V.S. Ramamurthy	
2	Dr. P. Chaddah	
3	Dr. Amit Roy	
4	Dr. G.K. Mehta	
5	Prof. Shridhar R. Gadre	
6	Dr. S. Ramaswamy	
7	Dr. S. Natesh	
8	Prof. B.N. Goswami	
9	Dr. Satish R. Shetye	
10	Prof. Mohan Kumar	
11	Prof. Charusita Chakravarty	
12	Prof. Partha Majumdar	
13	Shri. Ajit Kumar Verma	
14	Shri Pawan Aggarwal	
15	Prof. Ajit Kembhavi	
16	Shri R.K. Gupta (Planning Commission)	Invitee
17	Prof. P. Majumdar (SINP, Kolkata)	Invitee
18	Prof. N. K. Dadhich (IUCAA, Pune)	Invitee

Members who could not attend the meeting are:

1	Prof. N. Sathyamurthy
2	Dr. Balram Bhargava
3	Dr. Alok Ray
4	Prof. Dinesh Singh
5	Prof. N. Mukunda
6	Dr. P. Prakash

At the meeting, to set the platform for discussions about Inter-University, presentations were made on the organization, functioning and achievements of the Inter-University Accelerator Centre (IUAC), UGC-DAE Consortium for Scientific Research, and the Inter-University Centre for Astronomy and Astrophysics (IUCAA) by their respective Directors. A summary on some of the existing Inter-Institutional collaborations was provided by the concerned

task force members, who were involved in them and who described the benefits which have been derived from them, and the issues to be addressed in expanding the scope of such collaborations. Subsequently, various issues regarding Inter-University Centres and Inter-Institutional collaborations were discussed in detail, keeping in mind the terms of reference of the task force. The various facts and recommendations which emerged from the discussions are reported below, first for the Inter-University Centres and then for the Inter-Institutional Centres.

INTER-UNIVERSITY CENTRES

Across the world, the Universities are the acknowledged cradles of human resources. India is no exception. For historical reasons, research in the Indian Universities are individual centric. Consequently, they are poorly funded and lack continuity. In an effort to encourage research in cutting edge areas in the Universities and to enable access to high end facilities to the University faculty and students, the scheme of Inter-University Centres was initiated about twenty years ago with very encouraging results. It is necessary to examine the performance and achievements of the existing Inter-University Centres (IUCs) and the impact they have made on the university system.

Presently Established Inter-University Centres

There are, at the present time, three research IUCs, which are:

- Inter-University Centre for Astronomy and Astrophysics (**IUCAA**), Pune.
- Inter-University Accelerator Centre (**IUAC**), New Delhi.
- UGC-DAE Consortium for Scientific Research (**UGC-DAE CSR**), Indore.

There are three other IUCs which provide important specialized services to the University sector:

- Information and Library Network Centre (INFLIBNET), Ahmedabad.
- Consortium for Educational Communication (CEC), New Delhi.
- National Assessment and Accreditation Council (NAAC), Bangalore.

INFLIBNET is involved in creating infrastructure for sharing of library and information resources and services among Academic and Research Institutions. INFLIBNET works collaboratively with Indian university libraries to help shape their future in the evolving information environment. INFLIBNET is the nodal agency for the execution of the UGC-INFONET programme for providing connectivity and access to E-journals to the whole university system. CEC develops multimedia programmes for higher education and disseminates them using various technologies. It also guides, coordinates and facilitates the activities of the Education and Multimedia Centres set up by the UGC in various universities. NAAC assesses and provides accreditation to universities and colleges of higher learning in the country.

A brief description of the three research IUCs and their achievements are given below.

IUCAA

IUCAA caters to astronomy, astrophysics and related areas, and since its establishment at the end of 1988 has created excellent facilities for research and development in these subjects. IUCAA presently has a faculty strength of 16 academics, who are recognized nationally and internationally for their contributions to their areas of research. IUCAA has about 10 post-doctoral fellows and about 25 research scholars at any given time, and about 55 technical and administrative support staff. The academic members of IUCAA carry out research in theoretical and observational areas, and are involved in the development of advanced instrumentation for astronomy. IUCAA faculty members are internationally recognized as being leaders in their fields, have won numerous grants, awards, academy fellowships and other recognitions.

IUCAA has its own 2 metre optical and near infrared telescope, is a partner in the 11 metre Southern African Large Telescope, which is run by an international consortium, and is expecting to join, along with other astronomy institutions in India, the new Thirty Metre Telescope Consortium led by Caltech, USA. IUCAA has an excellent library, high performance computing facilities, a data centre, and instrumentation laboratories, and has facilities like the Virtual Observatory and a highly developed public outreach programme. IUCAA is making important contributions to the development of ASTROST, which is India's first satellite devoted wholly to astronomy.

At the present time, IUCAA has about 85 Visiting Associates from the universities and colleges, who regularly come to IUCAA along with their research students for collaborative research and for using the facilities. Many university students carry out their research work with members of the IUCAA faculty members as co-guides. IUCAA conducts a number of workshops and other meetings every year on its own campus, as well as on various university and college campuses in the country. There are now six IUCAA Resource Centres (IRCs), located in different parts of the country, where resources are created for use by the local and regional astronomy community, and astronomy programmes are supported by IUCAA in three other universities and in three colleges.

IUCAA programmes for university system have led to a significant increase in the number of university departments where astronomy is taught, and also in the number of university and college faculty and students, who are involved in research in frontier areas of astronomy using the state-of-the art techniques.

IUAC

The IUAC was the first Inter-University Centre, founded in 1984, and was dedicated to the nation in 1990. The objective of IUAC is to provide, within the university system, world class facilities for accelerator based research in focused areas of nuclear physics, atomic physics, material science, radiation biology, etc. The major instrument of the IUAC is the Pelletron Accelerator, on which a number of experiments are based.

IUAC has about 50 scientific staff that carries out research and developmental activities, supported by technical and administrative staff. IUAC has a user base of 300 faculty members from about 81 universities and 58 colleges, which are spread all through the country. There is also participation in its experimental activities from the IITs and various research institutions. University faculty and students visit IUAC regularly for experiments, and students spend extended periods at the centre for undergoing courses.

UGC-DAE CSR

The UGC-DAE CSR, Indore, has centres at Indore, Kolkata and Mumbai, and a node at Kalpakkam. The aim of this IUC is to provide the university

system regular access to the big-science facilities of the Department of Atomic Energy (DAE). UGC-DAE CSR also has its own laboratories that provide excellent high-tech facilities, that are internationally competitive in material science, condensed matter physics and other related areas. While providing access to large DAE facilities, the IUC makes important value additions by developing special research capabilities.

The UGC-DAE CSR facilities have a large number of users (over 500 a year) from the universities, who carry out original research, which have led to a number (over 200 per year) of publications in international journals. A major thrust has been provided in last five years through a large range of experimental facilities with the sample environment allowing studies at high magnetic fields and at low temperatures. These unique facilities have led to many high impact research publications from the university system.

Funding and Governance of the Inter-University Centres

The IUCs are autonomous registered societies under the University Grants Commission (UGC), which provides Plan and Non-Plan funds. Also, IUCs obtain additional funds through competitive proposals made to various national agencies and to international programmes.

The IUCs are governed by a Council and a Governing Board. The members of these two bodies are from the UGC, Universities and research institutes. All the stake holders are adequately represented in the Council and the Board. A person of eminence in the field of the IUC is appointed as a Director for a period of five years at a time, following well defined procedure. The academic and administrative functions of each IUC are carried out through various committees, consisting of internal and in some cases external members, which advice and assist the Director.

Researchers from the universities and colleges are very well integrated into the activities of the IUCs. Substantial impact on the university system has been made by the IUCs through (1) The encouragement provided to faculty and students to participate in research; (2) Encouraging the faculty and students to participate in national and international research forums; (3) Guidance provided in the development of syllabi and facilities in the universities; (4) Through the organization of a large number of training workshops and meetings of various kinds and (5) Encouraging the faculty to

prepare proposal to receive research grants from various national and international funding agencies.

Assessment of the Performance of the Present IUCs

The presentations made before the IUCs were followed by detailed discussion leading to the assessment of the present IUCs as follows:

- The existing IUCs have developed as centres of excellence in their areas of research, and have made substantial contribution to developing these areas in the universities.
- The IUCs have created excellent human resources in their fields, who carry out high class research, as well as work with university faculty and students, providing opportunities for collaboration and sustained guidance.
- The IUCs have created advanced experimental, observational, computational and other facilities, which are extensively used by faculty and students in the IUCs, universities and colleges. The facilities have enabled people from the university system to carry out advanced research in areas, which were previously not accessible to them.
- The IUCs organise workshops, conferences and other academic activities on their campuses as well as other university and college campuses in the country. This has led to the development of human resources in the universities, and has helped to attract new talent to the universities, and has also made an impact on teaching, curriculum development, and creation of new facilities in the universities.
- The IUCs have proved to be highly cost effective, since all the facilities created by them serve a large number of users from the university system. Many of the facilities are very expensive, and it would not have been possible for any one university to create and sustain them. In this respect, the IUCs emulate the practice followed

internationally, where the most sophisticated and expensive facilities are shared by a number of institutions and universities.

Recommendations of the Task Force Regarding the Creation of New IUCs

After reviewing the working of the existing research IUCs and detailed discussions, the Task Force makes the following recommendations:

- Given the excellent performance of the existing IUCs and the positive impact that they have made on the University system, several new IUCs in carefully chosen areas should be set up during the XII Plan period.
- The new IUCs should address emerging areas, keeping in mind interdisciplinary elements. The areas chosen should be broad and inclusive, so that high quality and productive research can be carried out over the years in a number of fields covered by the area. The IUCs should develop their own cutting edge facilities, but should make substantial use of major new facilities being set up by various research institutions. IUCs could also be built around planned new facilities.
- The IUCs should be able to attract university faculty and students to use its facilities. There should also be a reverse flow to the universities with various academic activities catalysed on university campuses. Over the years, various universities should be able to acquire their own standing in the fields of the IUCs that they interact with.
- The IUCs should specifically address human resources development in the university system through on site academic activities, and helping with developments in teaching methods and curriculum.
- The new IUCs should not be a part of any one university or institution, and should emerge as autonomous centres to be used by the whole university system, and should draw their strength from university departments and research institutions of excellence. However, the

IUCs could be hosted by existing institutions related to their subjects in their early phases.

- The governance structure of the new IUCs could be broadly similar to those of the existing IUCs, with the details possibly being different so as to address the special needs and concerns of different IUCs. The IUCs should have sufficient autonomy to take decisions which are in the best interest of the institution. The IUCs should act as a model for governance for the university system.
- The IUCs should have assured and timely flow of funds, and should be provided with block grants, to enable them to set up and sustain major new facilities.
- IUCs would be needed even in those areas which are already well funded and where leading research centres exist, as the aim of the IUCs would be to enable the university community to actively and coherently participate on the area.
- If an important area of learning needs an IUC, but that area is not sufficiently developed in the country, then faculty and adjunct faculty could be got from outside the country, so as to catalyse development of the area.
- Extensive use should be made of Information and Communications Technology to leverage the benefits that the IUCs can bring to the university system.

Proposed New Inter-University Centres

There are many areas in which inter-university centres could be set up. It is necessary to focus attention on broad areas, which are of importance and relevance at the present time, have an interdisciplinary nature and have interest from the point of view of pure research as well as applications. Members of the task force had detailed discussions on the matter during the meeting and this was followed by further exchanges of ideas between small sub-groups of the task force. From these discussions, some suggestions have

emerged for new IUCs and are listed and briefly described in Annexure A. The list is to be taken as being representative, with a final list emerging from detailed consideration by a panel of experts.

A novel university-centric structure for IUCs has also emerged from the discussion, and is outlined in Annexure B.

Budget

The cost of setting up an IUC would depend upon the subject area covered by it and the experimental facilities required. Using the experience of the present IUCs, it can be estimated that the cost of setting up an IUC would be about Rs. 100 crores. The running cost per year would be around Rs. 50 crores including Plan and Non-Plan expenditures. Additional sums would be required if very large facilities are to be set up.

The Planning Commission may consider setting up of five such IUCs over the XII Plan period.

Action Plan for New IUCs

It is recommended that a compact core group of experts be set up to

- Determine the best model for the new IUCs.
- Identify broad areas for the new IUCs.
- Call for proposals from individuals and groups to new IUCs in the identified broad areas, specifying detailed structure and function, mechanisms for involving the university system, and budgetary estimates.
- Prepare a short list of promising and viable proposals.
- Make recommendations for setting up the new IUCs.

INTER-INSTITUTIONAL CENTRES

The need for Inter-Institutional Centres

Currently, there are examples of inter-university centres for education/research. However, there is a need to expand such centres beyond the universities to other realms. Thus, in the XII Plan inter-institutional centres (IICs) need to be established. Such centres are expected to:

- Foster inter-disciplinarity.
- Link basic science to domain science.
- connect domain expertise to resources.
- enhance innovation capacity.
- encourage translational ability.

The potential paradigms for IICs could be many, but include:

- Engineering Schools - Medical Schools.
- Engineering Schools - Veterinary Schools.
- Engineering Schools - Food and Nutrition Schools.
- Mol. Biology Groups - Agriculture Schools.
- Physics Departments - Biology Schools.
- Funding Agencies - Universities/Institutes.

Examples of IICs do exist. However, they do not seem to have stood the test of time. Obviously it takes continuous nurturing and creation of appropriate institutional mechanisms to sustain inter-institutional relationships.

Types of IICs

Two types of IICs can be considered:

Type I: *Partnership Centres between two or more research-centric institutions.*

Type II: *Programme-specific partnership between funding agencies and research institutions.*

Examples of both Type I and Type II may be seen in Box 1 and Box 2 respectively.

Contours of IICs

Both Type I and Type II are necessary. In both the types, it is essential to ensure the following:

- a) It is absolutely necessary to evolve a standardized generic scheme for both Type I and Type II.
- b) In order to ensure compliance, a Memorandum of Understanding should be signed between the partner institutions. The MoU should clearly set out the terms of reference of the partnership, the governance mechanism, funding arrangement, and other relevant details of the partnership.
- c) Each IIC should have a separate and independent Expert Committee of its own (as opposed to the Scientific Advisory Committees and Governing Bodies of the host institutions) to provide scientific and governance oversights.
- d) It is absolutely important to ensure the appointment of quality scientific leadership in the partnership centres. This should not be left the vagaries of local leadership, but the Expert Committee must have a say.
- e) All the positions of scientists have to be absorbed by one or the other partner at the termination of the partnership. Otherwise, quality personnel will not apply.
- f) Predictability is vital. Long-term support should be ensured. This is easier for newer IICs (with Cabinet approval), but for older institutions this may be tougher. There must be a clear understanding of the duration for which partnership centres will exist.

The current types (e.g., Box 1 & 2) are difficult to replicate due to the following reasons:

- There is no standardization of the type; currently, they are left to the ingenuity (or apathy) of individuals who created them.
- Rapid scale-up is virtually impossible.
- Sustained, long-term support is tough, especially for partnership between existing institutions.

Box 1: Examples of Partnership Centres between two or more research-centric institutions

- a) **Partnership Centre between Institute of Stem Cell Science & Regenerative Medicine (InStem), Bangalore and Christian Medical College (CMC), Vellore**



- b) **Partnership Centre between All India Institute of Medical Sciences (AIIMS) and IIT-Delhi for collaboration with Stanford University for Biodesign**

There is a Programme Advisory Board with external experts. Currently, there is a proposal for expanding Biodesign programme to other medical schools and other IITs

- c) **Partnership Centre between National Institute of Biomedical Genomics (NIBMG), Kalyani and Calcutta Medical College, Kolkata**

Box 2: Examples of Programme-specific partnership between funding agencies and research institutions

- a) **DBT-Institute of Chemical Technology (ICT), Mumbai Partnership Centre on Energy Biosciences**



- b) **DBT-Indian Oil Corporation (IOC) Centre for Advanced Research in Bioenergy**

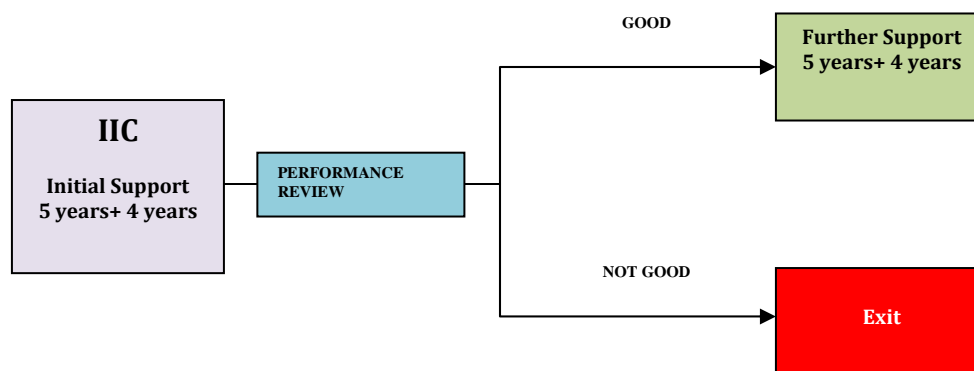
The Centre will have strong scientific and governance oversight. Partners have each contributed 50% of the budget. Current support is for 5 years extendable for 5 years more, subject to review of performance. The faculty will be absorbed by IOC at the end of the project. MoU has been signed by DBT and IOC.

Human Resource for IICs

The most crucial element of IICs constitute the human resource component. Usually, it is difficult to create permanent faculty positions under our current system. One of the ways of circumventing this is to create a limited number of core faculty positions, and the rest as contract positions. For this, it is necessary to create a multi-tiered contract career pathway, through which, scientific personnel who perform well can move up the ladder. The contract positions should have built-in incentives to compensate for lack of permanency and therefore, attendant benefits that go with such positions.

Duration of IICs

The tenure of IICs may vary depending upon the domain area and the purpose for which they are created. However, predictability is very essential, and therefore, as is done in other countries (e.g., Max Planck Centres in Germany), a duration of 5+4 years, extendable by a further 5+4 years could be a good practice. Of course, this would be subject to a thorough review of the performance (See diagram below).



Budget

Budget for IICs would, obviously, vary according to the nature of work carried out and the domain involved. For most life science-related IICs, a budget of between Rs. 25 and Rs. 50 crores should be adequate over a period of 5 years.

How many IICs?

It is suggested that between 50 and 70 IICs may be set up in different areas of S&T through a generic scheme.

Acknowledgements

This report has been prepared by Professor Ajit Kembhavi, Member-Secretary of the task force, with valuable inputs from Dr. V. S. Ramamurthy, Chairman of the task force, Shri Ajit Kumar Verma, Adviser (S&T) and Shri R. K. Gupta, Joint Adviser (S&T), Planning Commission, as well as the other members of the task force and invitees, who were present at the meeting on June 13, 2011. The sections on Inter-University Centres were wholly provided by Dr. S. Natesh.

Annexure A

IUC on Functional Materials

Functional materials have played a major role in technology evolution, and there is now a surge of research with both new concepts and new materials. This research is highly interdisciplinary, and derives inputs from physics, chemistry, materials science and metallurgy, biology, and computer-aided design. The frontline research areas include organic semiconductors and photonic devices, electronic transport in molecular and polymeric materials, bulk metallic glasses with superior metallurgical properties, magnetic shape-memory alloys and magnetic actuators, magneto-caloric materials for refrigeration, and sensors. Miniaturized forms, with biocompatibility, are required for biomedical purposes. Essential scientific inputs into this area of work come from multiple disciplines. Some of these disciplines are well represented in traditional universities, such as: (i) condensed matter physics: theory, experiments and simulations, and (ii) chemistry, specially organic and inorganic synthesis and computational chemistry. Other contributing areas, such as materials science and electrical engineering, require inputs from institutes of technology and research laboratories. This area would, therefore, appear to be ideal for developing and stimulating inter-disciplinary and inter-institutional linkages, with potential for significant spin-offs in industry.

India has many isolated groups in various universities, national labs and research institutes, doing research on various aspects of functional materials. Research on related phenomena like multiferrocity, modification of properties on reduced length scales (as in nanoparticles), and on preparation methodologies, which is also being undertaken in various university groups as Ph.D. problems. Some of these groups are highly competitive internationally, while many groups in the university system are trying to make a mark. Many of the state-of-art facilities required for internationally competitive research in this field are not accessible to the vast manpower available in our university system and they would thus benefit from such an IUC. The Inter-University Consortium on Advanced Functional Materials will not only provide the state-of-art facilities, but also foster collaborative and focused research between the University groups and research institutions.

IUC/IIC on Biodiversity and Genetic Epidemiology

India is one of the global biodiversity hotspots. Biodiversity, both of humans and of infectious pathogens, is also intimately related to human health and disease. Biodiversity and Genetic Epidemiology are intrinsically interdisciplinary, cutting across disciplines of biology, soil science, environmental science, medical science, statistics and epidemiology.

Even though there have been considerable efforts in cataloging biodiversity, through governmental and non-governmental agencies, a large fraction of microbial biodiversity remains uncatalogued and unidentified, particularly because many microbes (soil, human gut, etc.) are unculturable. Within the past few years, technology platforms for deep DNA sequencing have become available, opening up the possibility of estimating the diversity and number of unculturable microbes. These technology platforms have also thrown up huge challenges of data management and statistical analyses.

These next-generation DNA sequencing platforms are expensive and require specialized infrastructures and skills. Because it may not be feasible to provide such technology platforms to many universities/institutions, formation of one or a few inter-university/inter-institution centres is desirable. Pooling of intellectual resources from multiple universities/institutions to leverage the availability of technology platforms for pursuit of scientific activities also carries the potential of resulting in innovative methodologies of drawing inferences from high-throughput and multi-dimensional data.

IUC on Mathematical Modelling

A new Inter-University Centre is proposed with the following objectives:

- To initiate a comprehensive programme, based on state-of-the-art computer systems, of constructing mathematical models for use in basic sciences, like physics (including astrophysics and biophysics), chemistry (including biochemistry and molecular biology), biology

(including genetics), earth and atmospheric sciences, and economics and social sciences.

- To enable experimenters planning expensive resource-intensive experiments in some of these areas to perform extensive simulational studies before actually embarking on procuring equipment and infrastructure.
- To provide university academics working in these broad areas an ultra-modern platform to pursue their research goals.
- To venture out into challenging areas of computational science (not Computer Science), where currently there is little participation in India. Examples include: numerical general relativity, wavelets in fusion research, genetic modelling, simulation studies of earthquakes, cyclones and tsunamies, etc.
- By making a larger, more modern array of software options available to researchers, the plan is to use the traditional advantage in theoretical sciences that we have had in India over centuries, to really make cutting edge contributions in these areas.
- To enable training of future generations of students in modern computational sciences, currently almost non-existent in universities.

IUC on Computer Science and Cyber Security

Cyber Security is emerging as a focal point in computer and information sciences. Besides, the technological advances in transmission and switching technologies, coupled with ubiquitous developmental efforts in Open Source has created numerous creative opportunities for the world in general and India in particular. The creative space opened up by this opportunity is beyond the capacity of a single research group or even a single institution.

National Knowledge Network has been established by Government of India to usher in coherent synergy across education (including higher education), science and technology. Cyber Security related work is

an ideal candidate for establishing synergy across the creative endeavours in various institutions.

An innovative experiment in collaborative research focused on Cyber Security is being implemented by IIT, Chennai in collaboration with NIT Trichy, Anna University, Pondicherry University, Madurai Kamaraj University, Alagappa University, PSG Tech and Thyagaraja College. The project had all the ingredients of a research project with a difference - every researcher and institution can align their creative element towards one common frame work. Quarterly workshop organized every third Friday and Saturday provided the platform for physical contact for discussions. SSE Testbed was a collective development platform that glued the researchers together. Besides, the Testbed was used to showcase the results on a continuing basis, thereby creating a "memory" for the system or a process of institutionalizing the knowledge that was created. The SSE Testbed was reviewed during the quarterly workshops.

International exposure was given to all the SSE institutions by forging a close relationship with Australian counterpart. The focus was simpler, and was related to critical sector considered important by both countries - India and Australia - the theme was Distributed Denial of Service. The entire work was published as a monograph by Springer at the end of three years of work. More than 50 publications and 50 working products resulted from the project.

IUC on Cognitive Sciences

Of the various scientific disciplines that promise to revolutionize our lives in the 21st century, cognitive science is the least represented in the Indian scientific landscape. This lack of interest and investments in Cognitive Science appears strange, given that an understanding of the Mind/Brain is almost universally considered as the outstanding scientific problem of the 21st century. Apart from the purely scientific aspects of the field, cognitive science promises tremendous benefits in the realms of Mental Health, Social Engineering, Education, Computer Technology at the very least. For these reasons, India cannot afford to miss the cognitive revolution. Furthermore, the cognitive sciences are particularly attractive to Indians, since the Indian philosophical and scientific traditions have engaged with the nature of mind for centuries. Also, we do not share the philosophical assumptions that have stifled progress in cognitive science in the west. In other words, for once, we

are in the position to lead the way forward, rather than catch up with the west. This, however, calls for an interdisciplinary approach, combining natural science, social science, and both Indian and western traditions of humanistic inquiry. We strongly feel that the Indian University system should receive a massive boost in the form of a new centre for research in cognition sciences that will host research projects and create. National Institute of Advance Studies (NIAS), Kolkata can play an important role in mentoring this centre and give a unique shape to research in mind sciences in India.

Some of the thrust areas that have been identified for the proposed centre are Foundations of Cognition; Language, Communication and Cognition; Mathematical Modelling; Sociocognition; Cross Species Cognition; Computational Intelligence; Cognitive Psychology and Cognitive Neuroscience. The proposed centre, while bringing together the University community, will work closely with the scientists in other institutions such as:

- (a) NIMHANS, IISc, NCBS, CBCS (Allahabad), University of Hyderabad, with a focus on Cognitive Psychology and Cognitive Neuroscience, and the computational modeling of these fields.
- (b) IISc, NCBS, IIT's with a focus on Computational Modeling and AI/Robotics.
- (c) ISI Kolkata, IIT-Kanpur, University of Hyderabad, and others with a focus on Language, Communication and Cognition.
- (d) IISc, NCBS, and others with a focus on Cross Species Cognition.
- (e) ICPR, and others with a focus on Foundational Questions in Cognitive Science.

IUC on Plant Molecular Biology

Research in the plant and agricultural sciences is of strategic importance for the future of Indian agriculture, which needs to be strong and dynamic in order to support and stabilize India's growth as an economic power. Most research in agriculture happens in agricultural universities, where the emphasis is on applied research. However, there is also a major need to

strengthen basic research in plant sciences within the overall university system. An Inter-University Centre in plant molecular biology, carrying out high quality research in the plant sciences and in addition to its own research activities, would also participate in teaching and research programmes in the plant sciences for students in universities, would contribute towards meeting this need. High end molecular and cell biology is of increasing importance in plant science research and hence, the need for a centre which, functions in an integrated network with other institutions and centres through the development of interdisciplinary research programmes spanning genetics, functional genomics, cell biology, computational biology, as well as structural biology. The development of new tools and methodologies for agricultural biotechnology involving gene discovery and the application of innovative molecular approaches requires a combination of plant genetics and molecular biology, with advances in other areas, such as cell biology and imaging and ready access to platform tech.

IUC for Technology Development*

Government of India allocates considerable amount of funds for research at Universities through UGC, scientific departments like DST, DBT, etc. and extra mural research through Research Councils such as CSIR, ICMR, ICR, etc. The output of all such research is mainly published by way of research papers in scientific journals. Although, a considerable amount of intellectual property gets generated, but a very miniscule amount is protected legally and hardly any of this research is converted into products, processes and services. It is recognized that Universities are hot beds of innovation, and there is a scope to create new ventures and generate employment by commercializing the results of research through start-ups or by licensing them to existing industrial units.

The main reasons for failure are lack of policy initiatives and infrastructure at the University level and lack of trained man-power to manage IP protection and commercialization processes. The policy level initiatives are being addressed through an appropriate bill on the protection and utilization of publicly refunded research, which calls for creation of industrial licensing or technology transfer units at Universities. These units will have to be managed by appropriately trained professionals, who have appreciation of technology management functions. There is no institutional mechanism or professional training programme in the country to train such staff. Each of these units will employ a limited number of staff at each of the Universities, and it will be

sub-critical for each University to organize a training programme for them. It is, therefore, felt that an Inter-University Centre for Technology Management may be created, which will produce a cadre of Technology Management professionals, who will understand the pertinent national laws and regulations, philosophy of licensing for nonprofit research institutions, management of technology transfer office, development of appropriate intellectual property policies for the institution, conflict of interest policies, identification of intangible and tangible intellectual property, solicitation and evaluation of invention disclosures, protection of IP, marketing and licensing of IP, development of pertinent agreements for confidentiality, licensing, and collaborative research. The trainees will also be exposed for technology licensing involving equity, use of incubator and creation of start-ups. In order to pick the winners and avoid the losers and also to improve the efficiency of research budget, the staff of these units will also be trained in prior art search, so that they can guide the faculty and the students in selecting appropriate research problems. Considering the number of Universities, it is a daunting task. It is, therefore, proposed that the Centre during the XII Five Year Plan may train the trainers and each year about 30 to 50 persons can be trained. In addition, Continuing Education Programmes (CEP) can be launched in the relevant R & D management areas. The Centre will also prepare manuals for IP policy formulation and IP audit at the University level, management of technology including creation of templates for agreements. It may be worth noting that Association of University Technology Managers (AUTM) in USA, and Association for University Research and Industry Links (AURIL) in UK perform the similar roles. It is unlikely that a professional association in our country can take up this responsibility and sustain it over a period of time, so the Government will have to intervene to create such a Centre and initiate this activity. The Centre can be created in a project mode and funded for next 10 years and later on, if found feasible can convert into a nonprofit association

*The alternative name can be

Inter-University Center for Intellectual Asset Management (IUCIAM)

IUC on Interdisciplinary Approaches in Humanities, Social Sciences and Natural Sciences

The relationship between technology and society has undergone significant changes in the recent years. Many technologies that have been developed and tested in our laboratories fail to take off in the actual environments. Socio-economics of technology diffusion has become a subject of intense discussion among professionals and policy makers.

The recent emphasis on Science and Technology as the driver of economic development has resulted in weakening of humanities and social sciences in our universities. More importantly, these departments have got compartmentalized to such an extent that there is very interaction between social scientists and natural scientists and technologists.

The present proposal to establish an Inter-University Centre with a focus on Interdisciplinary approaches in humanities, social sciences and natural sciences aims at bringing together the different communities scattered in various universities and institutions of higher learning and facilitating them to address problems of national interest and of inter-disciplinary character.

The centre will host a core group of professionals drawn from our universities and institutions of higher learning and enable the faculty from all our universities to carry out interdisciplinary research through periodic training programmes and coordinated research programmes.

Annexure B

Inter-University Centres as Nodal Points for Promoting Research Excellence and Interdisciplinary Research

The traditional university, at its best, offers certain advantages as an environment for research that no other system appears to possess. These include access to diverse disciplines, student numbers that are large enough to address the problems of scale, clear connection between research and teaching, the possibility of cross-fertilization between disciplines such as, science, social science and the humanities, and the opportunity for serendipity and “blue-skies” research that underlie true innovation. It is regrettable that the existing Indian universities, despite localised centres of excellence, fall far short of this ideal. In order to revitalize and modernize research in the universities, it is essential to think of a model for an inter-university centre that leverages these advantages of universities and their relatively long tradition (by Indian standards) of research and teaching in multiple disciplines, in order to revitalise and modernise high-quality research in the university context. While research problems frequently arise on the boundaries between disciplines, a strong disciplinary base in one or more contributing disciplines is essential for any meaningful research. As a new discipline takes shape (for example, life sciences instead of botany/zoology/microbiology), it is also necessary that the research practitioners function directly in developing the pedagogy of emerging disciplines. This proposal is, therefore, based on the premise that the strong disciplinary base in different subjects in a university can be very effectively deployed towards more modern problems, specially, interdisciplinary problems. They should facilitate the formation of high-quality national and international networks, and enable universities to attract the very best talent at the faculty and student level.

Unlike existing IUCs that seek to provide services, facilities or expertise unavailable in universities, these IUCs should seek to promote excellence within the universities. They should, therefore, be actively nucleated by universities, possibly via the existing centres of excellence in universities, and they should bring in the other S & T institutions in to their fold, within a certain budgetary allocation. The process of setting up such IUCs could

involve inviting proposals in specific multidisciplinary areas, where such a research network is likely to pay the maximum dividends.

Such areas should potentially include:

- Molecular Structure and Spectroscopy, linking physical chemistry, physics, atmospheric sciences, multi-scale modeling and environmental chemistry.
- Soft Matter, linking chemistry, physics, chemical engineering and biology.
- Multi-scale Modeling and Computational Sciences.
- Complex Systems.
- Environmental Policy.
- Earth Sciences.

While, it is possible to delineate in detail some research topics under each of these areas, if the universities are to be the key players in this IUC model, they should be allowed the flexibility to design their programmes. A given IUC may serve a relatively small number of universities, but it should substantially enhance the research quality in any of these.

The IUC proposals should be evaluated on the basis of:

- Potential for delivering quality research.
- Degree and novelty of multidisciplinary connections: do they facilitate linkages that would otherwise not exist?
- Advanced graduate level courses to be run.
- Extent of inter-institutional networking: joint faculty and joint teaching programmes.
- Possibilities for attracting new faculty.