(Revised PC-II)

GOVERNMENT OF PAKISTAN
PLANNING COMMISSION

PC-1I FORM

PROFORMA FOR DEVELOPMENT PROJECTS (SURVEY AND FEASIBILITY STUDIES)

1. **Name by which Survey/Feasibility will be identified** : Technical Assistant (TA)

   Grant for Feasibility Study of Establishment of National Science & Technology Park (NSTP) at Central Campus NUST

2. **Administrative authorities responsible for**

   i) **Sponsoring**

   Ministry of Science and Technology (MoST)

   ii) **Execution**

   National University of Sciences and Technology (NUST)

3. **Details of Survey/Feasibility Study**

   a. **General Description and Justification**

   The most important project for NUST is the development of National Science and Technology Park (NSTP), that is planned to be developed through public private partnership. It is required to dedicate about fifty acres of NUST land for NSTP, that will house R&D centres of industry and a few production units of selected items, like software/IT, animation, nano materials etc. The Park will have a large incubator for start up companies and venture capital companies to fund new ventures. It will have facilities for conferences and exhibitions and technology demonstration complex. One of the units of the science park will be used to promote scientific education through educational technology devices, models, concept demonstrators etc for the school children.

The above concept of NUST was presented to the NUST BoG in its meeting held on 08 Feb 2013 which principally approved the NSTP project and instructed to conduct a Feasibility Study for NSTP. NUST has planned to conduct the Feasibility using the National/International experts.

Background

In today's knowledge driven world, **"World-Class Universities**" play a critical role in developing and nurturing knowledge workers, professionals, scientists, and researchers to generate new knowledge and support national innovation systems. In this context, countries across the globe are looking to ensure that their top universities operate at the cutting edge of intellectual and scientific development, so as to support the needs of a knowledge driven economy.

Vision 2030, the premier policy document for future growth in Pakistan, crafted by the Planning Commission in 2007, envisages:

"A developed, industrialized, just &prosperous Pakistan through rapid & sustainable development in a resource-constrained economy by deploying knowledge inputs"

New Growth Framework and Medium Term Development Framework (MTDF)

The "New Growth Framework for Pakistan" prepared by the Planning Commission in 2011 also lays a lot of emphasis on the "Software of Economic Growth", which is defined as the human capital that is in synchronization with globally successful experience. It is capable of generating sustained productivity and efficiency and allows for innovation and entrepreneurship at all tiers, in all sectors and regions, incorporating talent, technology and learning aspects into the overall development strategy of the country.

The Second Medium Term Development Framework covering the time period 2010-15 seeks to encourage and direct universities to focus on the development of national economy, promotion of community service and development of future leaders of Pakistan. The aspects of relevance and quality continue to influence the academic landscape even today and tomorrow. Increase in access may however be slowed down a bit. Growth of NUST will thus be influenced by the larger national

framework for growth as enunciated by the Planning Commission of Pakistan and the Higher Education Commission.

Guidelines of National Science, Technology and Innovation (NST&I) Policy - 2012

The National Science, Technology and Innovation (NST&I) Policy-2012 of Ministry of Science and Technology provides following guidelines for the universities:-

- The universities/institutes of higher learning will be encouraged to actively participate in the technology parks in order to develop skills related to product design, invention, innovation, adaption, and technological reproduction.
- The higher education system should be in line with the worldwide paradigm shift from "Teaching" to "Learning".
- Changing innovation processes and evolution of the relative contribution made by the private and public sectors have emphasized the need for strong industry – university linkages.
- Movement in the global knowledge society would require universities to develop into diverse, self-analytical and adaptable enterprises.
- Technology Incubation and Business Development Centres in research and educational institutions will be set up to provide platform for the young entrepreneurs.

The Establishment of Science & Technology Park is also part of the MoST Strategic Plan-2013.

NUST as a Premier Higher Education Institution

NUST, being a premier science and technology university, also follows the guidelines provided by the National Science, Technology and Innovation Policy (NST&I) of its parent Ministry of Science and Technology. The main focus of the policy is on ST&I Planning and Management Structure, Human Resource Development, Indigenous Technology Development, Technology Transfer, International Cooperation and R&D in the required areas. Our universities need to function as centers for creation of new knowledge, produce research scientists capable of working at the leading edge of science. Universities will be encouraged to actively participate in the technology parks in order to develop their skills related to product design, invention, innovation, adaption and technological re-production.

- **Introduction to National Science & Technology Park (NSTP)**

  In this fast changing global environment, the nature of global economic struggle continues to place an ever greater premium on realizing the true potential of science and technology as the engine of economic progress. More than 5 decades have passed since the world witnessed the transformation of Silicon Valley in the USA into a global hub for technology, finance, education and research. This awe-inspiring transformation was triggered by the establishment of one of the first Science and Technology Parks (STPs) centered on the prestigious Stanford University.

  Based on the same premise; and in line with its forward-looking mission and vision, NUST aims to develop a"**Triple Helix Alliance**" between the University, the Government &Business Enterprises in order to create a dynamic *Knowledge Ecosystem:* viz., the **"National Science & Technology Park (NSTP),** which shall bring on one platform, the best intellectual minds, their innovative research and the latest technologies in a wide number of areas to catalyze economic activity in the country and develop a unique Knowledge Based Multi-Industry Cluster.

  Today, educational institutions are required to play a critical role in the development process to generate, adapt, and disseminate knowledge and technology at international, national, and local levels. Technology transfer is accomplished most effectively by those countries which have scientific establishments capable of evaluating and adapting knowledge and technologies to local conditions.

  With this in view, the NSTP is envisioned to catalyze economic activity in the country by exploring new ways to harness Pakistan's natural resources to sustain long-term growth. While it is indisputable that technology can lead to faster business growth, higher wages and a large multiplier effect for the economy, one thing is left unclear- How can we ensure that our intellectual capital is retained in the country and positioned to lead the technology-based revolution? For the said purpose, Pakistan must develop, retain and expand the country's workforce to Ensure a sufficient intellectual entrepreneurial and technological talent base. To address this challenge and sustain the spirit of

creativity and entrepreneurship that had made the United States a world economic leader, the senior leadership at NUST conceived the establishment of the first university hosted Science and Technology Park in the country at the varsity's H-12 Campus in Islamabad.

- **Goals and Objectives of the Project : NSTP**

Goals

- To facilitate, support and enhance high-tech R&D in the country.
- To facilitate, support and enhance high-tech manufacturing in the country.
- To support Small & Medium Enterprise (SME) Sector through improved production techniques/process improvement. An institutional arrangement must be put in place to provide guidance and support to the SMEs to upgrade their existing technology and management capacity.
- To act as a knowledge hub and develop knowledge based Multi-Industry Cluster.
- To help build a nation whose development is measured by economic growth as well as the quality of life enjoyed by its people.
- To encourage freedom of enterprise and innovation in Pakistan by providing them a platform for technology incubation, business development and commercialization**.**
- To forge collaboration between the university and industry in the areas of research and development, and to create value out of it, through the creation of a community of companies, scientists, businessmen from within the NUST which will include following sectors;
  - Materials and Nano-Technology
  - Hi-Tech Manufacturing / Automotive
  - Robotics and Industrial Engineering / Electronics
  - Bio-technology
  - Information and Communications Technology
  - Energy (Renewable energy, solar energy, fuel cells etc)
  - Chemicals
  - Agriculture

Objectives

The university's underlying purpose for NSTP goes a significant step beyond the fairly usual concept of developing an elite business complex. Instead, the need for providing a commerce and research driven exchange between academia and industry is stressed. The means to achieve this given the above goals can be visualized through the following objectives:-

- Conduct and prepare a comprehensive Feasibility Study to assess Program viability.
- Identification of all critical prerequisites required to ensure Program viability. The prerequisites must include but are not limited to legal and policy framework required for making the Program viable. The Feasibility Study must inter alia assess, evaluate and determine the viability of the Program from financial, economic, technical, technological, social and environmental aspects.
- Conduct an extensive evaluation and analysis of potential sectors/industry & businesses (startups and running concerns) that can benefit from the establishment of the NSTP. This should encompass the current industrial profile (list and size of industrial subsectors, the number of public/private/mixed companies per subsector) Also assess the market of possible products and services that will be created in the NSTP.
- Development of an optimal strategy to attract renowned international market players in line with the stated objectives of establishing the NSTP. It is important that the NSTP is able to attract and partner with the world's leading business enterprises, Industrial and R&D firms, renowned Academies of Sciences, and other science & technology-based organizations.
- Conducting an extensive economic and financial evaluation of the Program and resultantly development of different financing/investment options for the Program. The various funding options should include but are not limited to: investment under PPP modality, project financing from the Government, or funding from multilateral development agencies such as Asian Development Bank (ADB) and The World Bank Group (WB) and other agencies of The United Nations (UN) or donor agencies such as USAID, DFID etc., or a combination of the above-mentioned options.
- Development of robust business and corresponding financial models based on the above-mentioned options and recommendation of the most optimal option. Once the Client has identified and approved the most suitable option, the Consultant is required to develop a detailed Program Implementation and Execution Plan including appropriate legal, capital and organizational structures.
- Analysis and evaluation of financial, economic, technological, social and environmental benefits/implications of the Program.
- Develop an aggressive and effective marketing strategy for the Program to help bring in potential investors.
- Commercialization of research, both in terms of focusing the university's endeavors towards commercially feasible areas of study as well as minimizing the transition period between technological innovation and its commercial deployment.
- Presenting the university and Pakistani Industry to the international community as a significant player in high-end research and innovation.

- Providing a strong point of presence for major international companies and enterprises thereby channeling world-class technology and practice into local and regional businesses.
- Providing incubator programs to promote emerging small-businesses and enterprises with the required technical, financial and administrative support.
- Utilizing industrial presence for the benefit of students and faculty members, thereby providing significant real-world exposure that will enhance their academic performance.
- Generating employment opportunities for students during their course of study and upon graduation.

Existing Facilities

(1) **Academic and Research Facilities**

NUST central campus has been established at H-12, Islamabad. Following facilities have been created:-

- School of Electrical Engineering and Computer Science (SEECS) comprising the following:-
  - NUST Institute of Information Technology
  - Research Institute of Microwave and Millimeter Wave Studies (RIMMS)
  - Institute of Applied Electronics and Computing (IAEC)
  - Institute of Telecom (I of T)
  - Centre for Cyber Technology and Spectrum Management (CCT&SM)

- School of Civil and Environmental Engineering (SCEE) comprising the following:-
  - National Institute of Transportation (NIT)
  - Institute of Environmental Science and Engineering (IESE)
  - Institute of Geographic Information System (IGIS)
  - Department of Construction Engineering and Management
  - Department of Urban and Regional Planning
  - NUST Institute of Civil Engineering (NICE)
    - Department of Geotechnical Engineering
    - Department of Civil Engineering

- Department of Structural Engineering
- Department of Water Resources and Hydropower Engineering
- Department of Engineering Survey

- School of Chemical and Material Engineering (SCME) comprising the following:-
  - Department of Chemical Engineering
  - Department of Material Science/Engineering
  - Department of Chemistry
- NUST Business School (NBS) comprising the following:-
  - Department of Management Sciences
  - Department of Mass Communication
- School of Mechanical and Manufacturing Engineering (SMME) comprising the following:-
  - Institute of Design and Manufacturing Engineering
  - Department of Mechanical Engineering
  - Department of Robotics and Artificial Intelligence
  - Department of Bio-Medical Engineering and Science
- School of Art, Design and Architecture (SADA) comprising the following:-
  - Department of Architecture
  - Department of Industrial Design
- Centre for Energy Systems (CES) comprising the following:-
  - Department of Renewable Energy
  - Department of Clean Coal Technologies for Power
- School of Social Sciences & Humanities (S^3H) comprising the following:-
  - Department of Social Sciences
  - Department of Humanities
  - Department of Economics
  - Department of Behavioral Sciences
  - Department of Public Policy and Administration

- School of Natural Sciences (SNS)
  - Department of Maths
  - Department of Physics
- Atta-ur-Rehman School of Applied Bio-Science (ASAB)
  - Departments of Healthcare Bio-Technology
  - Department of Industrial Bio-Technology
  - Department of Plant Bio-Technology
- NUST Institute of Peace and Conflict Studies (NPCONS) including Centre for International Peace and Stability (CIPS)
  - Department of Peace & Conflict Studies
  - Department of Military Art and Science
- NUST Institute of Leadership in Education (NILE)
  - Professional Development Centre (PDC)
  - Department of Higher Education Leadership (DHEL)
  - Department of Engineering Education Research (DEER)
  - Department of Medical Education Research (DMER)
- Research Centre for Modeling and Simulation (RCMS)
- Centre for Career Counseling and Advisory (C^3A)
- Department of Construction Engineering and Management at MCE
- Department of Disaster Management at MCE
- Corporate Advisory Council Secretariat and Think Tank

(2) **Major Research Labs at NUST**

NUST has extensive lab facilities at its new campus as well at its constituent colleges. Some of the major labs are as under and details are attached as **Annex-A**:-

- Microwave Engineering Research Lab
- Control System Lab
- Computer Aided Engineering Lab
- Automotive Lab
- Dynamics & Control Lab

- Embedded Systems Lab
- Computer Networks Lab
- Digital Signal Processing Lab & Digital System Design Lab
- Machine Vision Lab
- Robotics and Control Lab
- Industrial Automation Lab
- Centre for Research in Experimental and Applied Medicines (CREAM)
- Molecular Biology & Human Genetics Lab-2 / CREAM
- Molecular Biology & Human Genetics Lab-3 / CREAM
- Electro Magnetic Compatibility / Electro Magnetic Interference Lab
- Anechoic Chamber
- CoNNekT Lab: Research Laboratory of Communications, Networks and Multimedia
- System Analysis and Verification (SAVE)
- Centre of Excellence for Industrial Automation (CEIA) Lab
- Cognitive Radio Networking (Cognet) Labs
- Analog Mixed Signal Group (AMSG)
- Aerodynamics Lab
- Structures Lab
- Numerical Analysis Lab
- Radar Lab
- Communication Lab
- Microwave Lab
- Antenna Lab
- Strength of Materials Lab
- Soil Lab
- Microwave Communication Lab
- Electrical Machines Lab
- Virtual Reality Research Lab (VR)
- Modeling and Simulation Lab
- Image Processing Center (IPC)
- Transportation Laboratory
- Global Information System and Remote Sensing Lab
- Hydraulic Lab
- Surveying Lab

- Geo-Technical Lab
- Scanning Electron Microscope Lab
- X-Ray Fluorescence Lab
- X-Ray Diafraction Lab
- Heat Treatment Lab
- Thermal Transport Lab
- Chemical Analysis Lab
- Polymer Lab
- Advance Numerical Analysis Lab (A-NAL)
- Design & Drafting Lab (D&DL)
- Network Simulation Lab (NSL)
- Super Computing Research Centre (132 Terra Flop)
- Measurement and Instrumentation Lab
- Computer Integrated Manufacturing & Micro CIM Lab
- Computer Aided Design / Computer Aided Manufacturing Lab
- Computerized Numerical Control Lab
- Rapid Prototyping Lab
- Machine Vision Lab
- Advanced Robotics Lab
- Advanced Control Lab
- Artificial Intelligence Lab

- **Why NSTP be established at NUST**

  NUST is ideally suited to lead the national institutions in development of incubation/technology parks as supported by the following facts:-

  - NUST pioneered the start of Technology Incubation Center in 2005.
  - NUST is multidisciplinary center of excellence for research and development in multiple fields of sciences & technology.
  - NUST enjoys strong collaborative programs at MS/PhD level with reputed foreign universities.
  - NUST's faculty is over 950 and is trained by reputed international and national educational institutions.
  - NUST is ideally located at H-12 Sector Islamabad where 30% of nation's PhD work within 30 mile radius.

- NUST's 34,000 square feet Technology Incubation Center building is has been completed in H-12 sector Islamabad and is fully functional.
- NUST has designated 50 acres of land in H-12 for National Science and Technology Park (NSTP) including the business incubation.

(3) **Progress on NSTP at NUST**

- **Programme Conceptualization**
  - The first step taken towards the realization of the planned NSTP was the formulation of a Concept Paper (Feb 2011) duly vetted by world renowned experts on Science & Technology Parks (STPs).
  - The concept was approved by the NUST BoG in February 2012.
  - During the last 2-3 years, NUST has developed policies, plans, facilities and services to support the planned NSTP and is the only Higher Education Institute(HEI) from Pakistan to become a Full Member of International Association of Science Parks (IASP), a worldwide network of STPs having 375 members from 70 countries across the world; as well as an Associate Member of the World Technopolis Association (WTA), a multilateral international organization created with the purpose to connect the advancement of science and technology with local development. Needless to say, these prestigious associations would prove invaluable to NUST in the establishment of its own NSTP.

Building Blocks of NSTP: The key constituents in place in NUST, that have been consciously established and developed over the years, and are relevant to the NSTP, include the following:-

Research, Innovation & Commercialization (RIC): As per the guidelines of the Higher Education Commission (HEC) Pakistan, all S&T Universities are to establish offices of Research, Innovation and Commercialization (ORIC): this strategy is widely adopted by the world's leading Universities that have extended their activities

beyond discovery (research) and transmission of ideas (teaching) by taking an active role in technology commercialization leading to economic development. This office was established to assist innovative ideas to become useful products that can be commercialized by the Industry. The following Directorates and functions operate under the RIC umbrella at NUST:-

- **Directorate of Research:** This acts as a focal point for providing guidance and support to NUST's constituent institutions in all activities related to research & development, and liaises with other national and international academic, research and industrial organizations to facilitate research at NUST.
- **Directorate of Innovation & Commercialization:** Its role is to encapsulate NUST's research and Intellectual Property opportunities at the earliest possible stage, and to transfer these benefits to the Industry by working closely with them through partnerships, collaborations and licensing. It includes the following:-
  - **Intellectual Property Office (IPO):** Provides support to schools and researchers by determining the patentability of a technology and providing assistance with IP protection, hence contributing to a strong University economy, encouraging investment in innovation and fostering entrepreneurial spirit leading to new products and services for the competitive global market.
  - **Technology Transfer Office (TTO):** Assists in moving research results from the laboratory to the marketplace; it evaluates and manages invention portfolios, gets assistance from the IPO in patent prosecution, negotiates license agreements and periodically reviews cooperative research agreements already in place.
  - **Industry Liaison Office (ILO):** Combines Industry Relations and Alumni Affairs; IR focuses on placement for NUST graduates with the Industry, whereas Alumni Affairs builds

and maintains relationships with the Alumni through a common platform for the benefit of NUST.

- **Technology Incubation Centre (TIC):** TIC, NUST is the first technology business incubator of Pakistan established under the Academia, to provide an environment that attracts and nurtures technology-based start-up companies, and helps them become commercially viable enterprises. TIC provides a platform for NUST faculty/students, having commercially viable R&D output, to establish their own start-up companies in order to commercialize their R&D work as entrepreneurs. At present, the TIC hosts 09 incubatees and 04 pre- incubatees.

  TIC offers the following Incubation Services:

  Admin/Physical Support

  - Furnished office space with plug-in internet and phone
  - Access to fax, photocopy, printing and central mailing via courier
  - Conference room facilities equipped with multi-media
  - Display of company's profile on TIC's main website
  - Email address on TIC's domain
  - Real estate property service (security, maintenance, etc.)
  - Support staff assistance at reception and events
  - Canteen services for tea, coffee, meals, and soft drinks

  Business and Professional Support Services

  - Facilitate the availability of NUST knowledgebase and resources to add value to all stakeholders
  - Networking opportunities within NUST as well as industry and government resources
  - Support in marketing through website and use of NUST TIC name
  - Access to "Catalysts" to provide guidance and mentorship through TIC
  - Identification of various funding options for Incubatees
  - Advisory services in business plans formulation, marketing strategies, project selection etc
  - Training on basics of entrepreneurship
  - Identification and access to state-of-the-art labs
  - Advice in legal and financial consultancy

- **Professional Development Centre (PDC):** Conducts skill development training and courses for Industry and NUST members.
- **Career Development Center (CDC):** Provides services to help students and alumni explore and make effective career choices, foster professional networks with employers and assist employers in meeting their recruitment needs.
- **Corporate Advisory Council (CAC):** NUST has forged strong alliance with Industrial and business enterprises across 11 sectors of the economy, through the establishment of the CAC. In line with the vision of NSTP, the CAC is a unique triple-helix combination of advisory, consultation and R&D collaboration, facilitating communication and cooperation between university researchers and industry experts. The CAC brings the NUST institutes and the Industry together on a common platform, enabling them to join hands to find workable solutions, through R&D, to real-life problems encountered in product development, design and commercialization. The alignment of traditionally opposed academic and industrial worldviews is embodied in the 11 Sector Committees of the Council, including Automotive, Health & Pharmaceuticals, Infrastructure, Information & Communications Technology (ICT), Engineering, Banking & Financial Services, Energy, Chemical, Defence Technologies, Intellectual Property Rights (IPR), and the Social Sector. In a period of 2 years, the CAC membership has grown to include more than 120 members from top-line local and international business and Industrial firms, banking and investment houses, high-level public policy-makers, and intellectuals. Cooperation and collaboration between Industry and NUST academia has led to innovative projects aimed at providing solutions to industrial and corporate partners. Many of the Sectors that NSTP envisions to bring together are already represented in the CAC. Therefore, the CAC and the Industry linkages developed through it are a vital building block of the NSTP.
- **Global Think Tank Network (GTTN):** By capitalizing on its local and international collaborations with Industry, Government and others, NUST has taken a unique initiative by establishing the Global Think Tank

Network (GTTN), the first Academic Think Tank in the country. The GTTN aims to conduct high-quality, original policy research and advocacy on a range of areas of common and regional interest. It will interact with a global network of academia and industrial leadership, and utilize policy imperatives to be an agent of economic and social change. With NUST as the hub, the GTTN aims to further develop regional nodes, the first of which is the China-Pakistan Think Tank, launched in January 2012, with the collaboration of Tsinghua University, Beijing and Southwest University, Chongquin.

- **Design and Manufacturing Resource Center (DMRC):** An essential component of existing STPs around the world is the provision of a facility that could support low volume, high value manufacturing activities. In this context, the DMRC has been established at School of Mechanical and Manufacturing Engineering (SMME)at the NUST H-12 Campus and has been functional since December 2011. The Center has acquired a full range of basic manufacturing technologies. In addition to supporting students, it also facilitates local industry by accepting some of their projects. Industry projects worth Rs 1.5M have already been completed so far and more are in the pipe line. The DMRC has complete capability ranging from product design to component manufacturing, starting from design and ending up as a product. The DMRC is built on 15,253 square feet of space.

  It is concluded that the NSTP is fast-shaping into a reality, and since NUST is well-geared as is explained by the detailed account given above, it is safe to say that NUST is already in the Pre-NSTP Phase. In addition to the presence of Incubatees, NUST has signed MoUs with large multinationals for establishment of labs and research facilities at NUST, e.g. Huawei Pakistan is setting up a Network Academy on NUST premises. Similarly some local and international companies have set up their offices in NUST, including National Radio and Telecom Corporation (NRTC), Tech access Pakistan. More Industry partners are showing keen

interest in coming to the NSTP as tenants. The NSTP Core Team at the Advisor's Office is in negotiations with several companies from different Sectors that are interested in opening up management offices and / or research facilities / labs on NUST premises.

- **Internationalization**

  Knowledge is growing at a breathtaking pace around the world and we have to remain connected with the world at large to have access to new knowledge, new skills and new technologies. Following steps will be taken to promote linkages with the international universities and industry:-

  - Acquire membership of global institutions to have access to their collective thought process, and new knowledge, and new concepts.
  - Establish bilateral and multi-lateral linkages with reputed international universities through student and faculty exchanges and joint research projects.
  - Actively participate in international conferences, seminars and workshops to gain new knowledge and network with the international academia.
  - Seek opportunities for joint and dual degree programmes with renowned universities.
  - Develop linkages with global industry through their local universities.
  - Encourage enrollment of international students by offering attractive tuition fee packages and even scholarships to students from the developing or under-developed countries.
  - Seek On The Job Training (OJT) opportunities in reputed foreign universities/training institutions.
  - Consider establishment of overseas campuses to attain greater internalization and generate more revenue.

Formation of NSTP Committees

- To ensure sustainability, high quality, world class governance and maximum performance of NSTP, the NSTP Steering Committee, chaired by Rector NUST, and consisting of NUST senior management, was constituted to undertake extensive due diligence, a process that has taken 3 years of high-level national and international multi-stakeholder consultations.

- An NSTP Executive Committee of 15-20 senior personnel from NUST was formed, which is headed by Advisor NUST. Under their able supervision, an NSTP core team was tasked to prepare a Prefeasibility Report for Phase I of the NSTP

Visits of International Experts

- Vice President TUSPARK:VP Tsinghua Research Park Dr. Herbert Chen visited NUST in January 2012. He shared his experience of Tsinghua University Science Park (TUSPARK) – one of the most successful STPs in the world. He also provided valuable guidance for the establishment of the NSTP, endorsed the NSTP Concept Paper, and reiterated how vital an STP is for Pakistan's socio-economic development.

- **WTA-UNESCO Experts – The Consultative Workshop:** In January 2012, a team of experts from the World Technopolis Association (WTA)-UNESCO visited NUST, including Prof. Deog-Seong-Oh, General Secretary, WTA, and Dr. Malcolm Parry, Managing Director Surrey Research Park, UK. The purpose of the visit was to work with the NUST team to develop a broad-based plan and a subsequent report for the development of the NSTP. A consultative workshop on STP Development also took place on 30th January 2012, where Dr. Parry and Dr. Oh shared their experience and knowledge. The workshop was attended by representatives from senior business and Industrial groups of Pakistan as well as by eminent GoP functionaries, including

Secretary MoST and Member Science & Technology Planning Commission of Pakistan.

- The Expert Team authored a report titled Development of the National Science and Technology Park-NUST which endorsed the establishment of the NSTP on NUST campus and concluded it as a vital step towards further development of Pakistan's economy. The report gave a high-level implementation plan for the NSTP, which served as a guideline for preparing the Pre-feasibility study, and taking the next steps towards realization of this aim. The report is attached as Annex-B.

(4) **Existing Collaboration:**

NUST-TIC is a signatory to Pak-China MoU on bi-lateral cooperation between the two countries on development of business incubation and technology parks in Pakistan. This MoU was signed during President of China's visit to Pakistan in 2006. During that visit TIC hosted an IBI (International Business Incubator) Beijing delegation for exchange of ideas on mutual cooperation. NUST-TIC staff also visited China in 2007 for training.

NUST also actively participates at international forums to learn from the experiences of its industry predecessors and benefit from their ideas and lessons. NUST-TIC holds memberships in prestigious organizations such as Asian Association of Business Incubation, Shanghai and National Business Incubation Association, USA.

(5) **Expertise and Services**

- **Faculty support**

The reputation of NUST as the leading university in Pakistan not only attracts the best students in the country (there were 1,800 places with 52,000 applicants for the current intake) but also the most qualified staff. The strong undergraduate and post graduate intake is reflected in the research base that has developed in the University. In comparison with other universities in Pakistan the University has a very high proportion of staff that have a PhD qualification and many of these have been educated

overseas at top universities in the US, Europe and developed countries in the Asia Pacific region. All Faculties are research active and many members of staff have developed significant applied research, product development, and product testing related work with both international and domestic companies. These include working relationships, with BP, Microsoft, IBM, Nokia and many other large companies; with the Pakistan government on e-government projects and with networks of leading international research teams in US and Europe. Examples of international relationships include strong and active relationships between the University's SCEE Faculty and the Stanford Linear Accelerator Laboratory, with MIT, Cambridge in the UK and a number of other European universities, for example, in Germany.

The research groups in NUST are active in IT product development, software for products and advanced sensing equipment for medical devices, engine technology, tribology, and the automotive industry. The standards being achieved meet international standards such as HL7 for delivering healthcare interoperability and other relevant ISO standards.

It is clear from discussions with many members of the Faculty that there is very strong support for the Senior Management Team's plans for the NSTP. All of the Faculties on campus have been structured in such a way as to supported working both with domestic and international companies and supporting young entrepreneurs that have the ambition to build their own technology companies. NUST has already established a policy of establishing active links between its faculties and business. It is clear that the all faculties on campus are committed to supporting the development of the NSTP.

NUST has an established Business School this is likely to add momentum to the project. Recent international experience has suggested that an active business school associated with a science and Technology Park can support: CPD programmes, help to organize relationships between business students and active businesses, can provide an "entrepreneur in residence" or equivalent that can work with the companies in the incubator

and, if appropriate, support a student entrepreneur's club. The Business School continues to attract very high caliber students who collectively are part of the process of capacity building that will support the development of the NSTP. To continue to build on the international reputation and contacts of a number of heads of Faculty many of whom have active international research and development contracts which are also a valuable base from which to continue to build R&D capacity that can support the development of the Park. These are proving to be of value to clients and leading to further research being commissioned. A proportion of the work being done is close to market. Among other benefits this work is building the reputation of NUST and helping to build R&D capability. Both of these features are important building blocks which will support the development of the proposed NSTP.

It is suggested that with the commitment of additional resources some of these working relationships could be extended and expanded and re-located on the science park with the companies paying rent for the facilities.

- **Research Equipment**

NUST has some of the best equipped laboratories and research facilities in the country as attached at Annex A. Experience on many science and technology parks has shown that for a number of early stage companies access to a range of equipment research and testing equipment and services is valuable. This helps companies as they undertake collaborative research to develop technology through the stages of the proof of principle and concept, testing viability and performance against market expectations and technical specifications and helping to assess its value and quality.

NUST is also connected into the academic infrastructure in Pakistan which enables connection to other research based organizations in the country. This professional network extends the capacity for the University to assist tenant companies on the site.

The University has already established policies that enable the utilization of this equipment as part of building market ready technologies. This positive approach to the efficient utilization of NUST's R&D facilities demonstrates the University's appreciation of the value of the assets on the campus to the commercialization process.

(6) **Strengths of NUST**

The identified strengths indicate those areas of activity that can either be exploited with the current resources (capital and human) or provide the greatest potential for expansion and wealth generation

Some of the strengths of NUST are:-.

- The Senior Management team of NUST and the Faculties in NUST are supportive of the project and a highly talented and qualified Pakistani external advisor has been appointed to drive the project.
- NUST has allocated resources to support this team in developing the project.
- The land for the development of the project has already been allocated as part of the development of the NUST campus in Islamabad.
- The Senior Management Team has opened a dialogue with the Government about the plans for a NSTP and has secure an "in principle" support for the concept. There is backing from some segments of the public sector including the Higher Education Commission and MoST for the project.
- The Senior Management Team and their advisors are well connected with the business and political community in the City of Islamabad which provides important network connections for the project.
- The planning phase of the project is well resourced with qualified staff many of whom have international experience.
- The zone of Islamabad in which the NUST campus and the site on which the NSTP is planned have many location related advantages which include being in the capital city, close to a good road and air links that connect to international destinations.
- NUST has attracted well qualified staff that have international research connections of which some are with multinationals.
- NUST has put in place the necessary policies to enable staff to work with companies on research, has agreed policies on IP ownership by staff and

policies that enable the use of its research equipment for tenant companies in the NSTP: this all simplifies the building the relationship between the Faculty and commercial companies.

- The NUST campus is located next to a planned teaching and research hospital which gives the site added attractions to international pharma companies as well as clinicians that are developing medical and health related technologies.

- Pakistan has excellent interactions and relationships between public-private-academe and learned societies all of which are likely to support the concept of the NSTP.

- There are agreements for international cooperation senior scientists, politicians and business people in the country already have valuable international connections which can be used to support, promote and guide the development.

- The country is politically stable. This creates a more attractive location for overseas investment.

- There are intellectual property laws in Pakistan which are managed through the Intellectual Property Office. This provides inward investors with the knowledge that the appropriate processes are in place to support the protection of intellectual property rights.

- The country has a strong higher education sector and a number of research institutes that understand local conditions.

- The Pakistan National Science Foundation has an obligation to support utilization of research results including pilot plant studies.

(7) **Pre-Feasibility Study Prepared by NUST:** (Attached as Annex-C)

- The NSTP Core Team, under the strategic guidance of the NSTP Steering and Executive Committees, prepared a Pre-feasibility Report for Phase I of the NSTP, where Phase I is defined as:-

    - Consolidation of existing facilities within NUST that will become a part of the NSTP.

    - Construction of 2 Enterprise Buildings for mature, self-sustaining businesses and R&D wings of multi-national companies. The building will also house an auditorium, conference rooms, labs, as well as consulting and business advisory services, and management offices.

    - The Sectors (from which tenant companies will be attracted in Phase I) identified in the Pre-feasibility include Information and

Communications Technology (ICT); Manufacturing; Automotive; Biotechnology; Energy (Renewable energy, solar energy, fuel cells etc); Chemicals, Materials, Nanotechnology; Robotics and Industrial Engineering/Electronics and Agriculture.

- The Pre-feasibility Study covers in detail the credibility and suitability of NUST for building the NSTP; progress made so far at NUST with respect to the program; benchmarking of STPs around the world; the external and internal stakeholders of the program; vision, mission, objectives and value proposition of the NSTP, structure, governance and funding models, as well as detailed financial / cost estimates for the program.

(8) **Feasibility Study for NSTP**

(a) The NUST BoG in its meeting held on 08 Feb 2013 principally approved the NSTP project and instructed to conduct a Feasibility Study for NSTP. NUST has planned to conduct the Feasibility using the experts.

(b) **Terms Of Reference (ToR) For Feasibility Report**

The Feasibility Study must cover the following aspects**:-**

Background Research

The Consultant should determine the number of established Science and Technology Parks (STPs) in the region and their impact on socio-economic development. In this regard, the Consultant must identify the impact of absence of STPs on Pakistan's economy. The Consultant is also required to conduct a need-benefit analysis of establishing the STP in Islamabad and at NUST and identify potential impact on economic growth. This task also involves identifying potential tenants from various sectors that can benefit from locating their businesses in the proposed NSTP. The Consultant is also required to conduct a detailed benchmarking exercise, study local/regional/international STPs and identify critical success/failure factors. The Consultant must be aware of the Government's relevant legislation(s), science, technology and industry policy initiatives, instruments and incentives, as well as Governmental public budget finance and project analysis. This task shall entail conducting relevant surveys.

Need Analysis

The Consultant is required to carry out a need analysis study that includes and is not limited to the following; any additional areas which are considered essential may also be included:

- Evaluate the resources at hand for development/implementation of the NSTP, and determine the NUST's present and future needs.
- Demonstrate that the Program aligns with NUST's strategic objectives, policies and priorities.
- Identify whether NUST has the ability and the capacity to undertake and manage this Program.
- Conduct a detailed assessment of the Client's institutional capacity to provide the services that the NSTP will need to offer to its potential clients and to propose the optimal arrangement and structure to ensure the seamless provision of such services.
    - In this context, the Consultant shall be required to assess the on-ground situation and hold in-depth interviews/discussions with key stakeholders at NUST including relevant departments, NSTP Committees and NUST's constituent schools.
    - In this context, the Consultant would be required to critically assess the past performance of the RIC and its individual components including the existing Technology Incubator Center (TIC) set up at NUST and give a detailed mechanism and methodology for its integration with the NSTP
- The Need Analysis should also include identification of;
    - Significant Government assets which will be used for the Program (such as land and equipment).
    - Extent of adequacy/suitability of the existing facilities at NUST.
    - How the Program will complement other developments taking place in the area through review of sector master plans/studies.
    - Review existing land use plans

Identification of Critical Prerequisites

The Consultant is required to carry out a detailed assessment of all the critical prerequisites that need to be in place to ensure Program viability. This includes, but is not limited to, identifying essential technological, legal and policy framework. Legal aspects include applicable/relevant legislations, tax laws, etc. The Consultant must ensure that legal aspects pertaining to development and implementation of the Program are

identified, studied and addressed. The Consultant has to analyze site ownership and availability issues in order to determine whether the land designated for the construction of the NSTP is clear of all legal, institutional, technical and other issues pertaining to its availability.

The Consultant should also assess energy and water supply requirements, as well as other physical infrastructure requirements pertaining to the NSTP.

Phase-Wise Development Plan

The overall development of NSTP is envisioned to be carried out in phases spanning over a period of 2-5 years. This phase-wise construction is envisaged to involve consolidation of existing facilities (such as CIE Building) as well as construction of new infrastructure at NUST to accommodate start-ups as well as mature companies from different sectors. This arrangement will provide requisite momentum to the project, while capitalizing on the existing areas of expertise available within NUST constituent schools.

The Consultant shall be required to prepare a complete **Phase-Wise Development Plan** as per the stipulated timeframe along with a detailed **Program Implementation and Execution Plan** for the NSTP. The Consultant shall also be required to give an analysis of the **Phase-Wise Development Plan** given in the Pre-feasibility study.

Market Analysis and Identification of Potential Tenants

Based on earlier consultations with prospective tenants, business entities (tenants) from following Sectors can have a presence in the initial phase of the establishment of the NSTP;

- Materials and Nano-Technology
- Hi-Tech Manufacturing* / Automotive
- Robotics and Industrial Engineering / Electronics
- Bio-technology
- Information and Communications Technology
- Energy (Renewable energy, solar energy, fuel cells etc)
- Chemicals
- Agriculture

** Manufacturing Sector is vital for the economic growth of Pakistan. Development of hi-tech industry is imperative for Pakistan's economic progress. One of main objectives for developing the NSTP is to stimulate innovation and generate economic benefits by assisting knowledge-based firms and knowledge intensive activities in this sector.*

Established Concerns as well as Incubatee / Start-up companies in the above-mentioned sectors will be housed in the NSTP during the initial phase.

The Consultant shall be required to reconfirm our earlier findings/consultations and will need to carry out a detailed market analysis including survey of local Industry in the above-mentioned Sectors (including list and size of industrial sector/sub-sectors, the number of private/public/mixed companies per Sector). This survey should include current trends and technologies, R&D (applied and basic research), education programs, innovations, and future trends and developments in the area. Based on this survey, the Consultant shall be required to give a detailed analysis of the above-mentioned proposed sectors and any other sectors the Consultant deems suitable (based upon his findings and keeping in view market demand and NUST's strengths) to be included in the initial as well as subsequent phases of the Program. The survey should also assess the possibility of establishing linkages between enterprises located in the NSTP with other businesses and institutes of learning in the area.

The market analysis should help determine the kind of potential clients/tenants that could be housed in NSTP, what kind of goods and services shall be provided by these firms and the potential markets for such goods and services; This analysis should also estimate likely scenarios of occupancy/tenancy by clients, thereby estimating the likely operating income stream to be used in preparing financial model.

NSTP-Space Allocation, Design and Architecture

The current land allocation for NSTP, as per the updated NUST Master Plan (to be provided to the final shortlisted Consultant), is approx. 50 acres.

- The Consultant is required to incorporate in the Feasibility Report, a detailed analysis of the adequacy of the allocated land, keeping in view its phase-wise expansion.
- The Consultant should develop specifications regarding the architecture and design of the NSTP and resultantly furnish a conceptual design of the infrastructure in the Feasibility Report.
- The Consultant should identify critical ICT infrastructure and equipment requirements, resulting capital expenditure and operating costs.
- Indoor furnishings and basic amenities. The Consultant should identify requirements of furniture and other basic amenities for these facilities, and should also provide cost details of the same.

Proposed Features/Services Offered in the NSTP

The NSTP is envisioned to offer a range of services for business tenants (legal, Venture Capital firms, accounting and consulting and marketing) to support all stages of growth. This includes:-

- Business Advisory Support, mentoring, networking, management, incubation and business acceleration services, IP Protection, legal services, etc.
- Facilitated access to capital either through investors or VC firms housed or are members of the NSTP.
- Training and facilitated access to skills through a combination of education and training providers onsite and links to local education institutions, Industry training organizations, etc.
- Facilitated access to markets through active Industrial linkages.
- Provision of amenities such as conference/seminar halls, cafeterias, tele-presence & video conferencing facilities, access to state-of-the art research laboratories, etc.
- Residential/housing and recreational facilities.

The Consultant shall be required to give a detailed analysis of proposed features/ services and also suggest other facilities that may be required by the tenants and university researchers to accelerate the commercialization of University Innovation.

Desired Outputs, Outcomes, Success Indicators & Risk Factors

The Consultant is required to identify desired Outputs; Outcomes, Success Indicators & Risk Factors and suggest/identify suitable strategy to make NSTP self-sustaining.

Management Structure

The **NSTP Steering Committee**, chaired by Rector NUST, and consisting of NUST senior management, was constituted to oversee the initial due diligence, a process that has taken 3 years of high-level national and international multi-stakeholder consultations. The Steering Committee takes strategic decisions recommended by the Executive Committee and the Core Team. **The NSTP Executive Committee** is the senior management team from NUST, chaired by Advisor NUST. The Executive Committee guides and approves operational activities related to the program. It also consolidates recommendations for the Steering Committee, implements decisions taken by the Steering Committee, and ensures compliance to program plans and deadlines. The **NSTP Core Team** (comprising members from Advisor's Office) was also formed last year to execute operational activities related to the program. The Core Team works closely with external and internal stakeholders, and reports to the Executive Committee. The NSTP Prefeasibility Report prepared by the Core Team gives a detailed NSTP management structure.

The Consultant shall be required to analyze the proposed management structure, the possible future role the aforementioned committees/ or members of the committee (given this is a national level Program) and resultantly prepare a detailed Organizational/Management Structure. This structure must clearly delineate reporting lines and interrelationships between key stakeholders.

Human Resource Requirement and Induction Plan

The Consultant is required to prepare a Human Resource Requirement and Induction Plan in line with the operational model approved by the Client for the NSTP. This **Human Resource Requirement and Induction Plan** should include but is not limited to;

- Phased HR Induction Plan based on NSTP occupancy rate/growth.
- Define respective roles & relationships of the personnel to the university, Government, or tenants.
- Review current human capital deployment along with required capacity-building measures.
- Qualification of required HR.
- Remuneration packages.

NSTP-A Green Initiative

The NSTP is envisaged as a green initiative.

The Consultant should suggest in the Feasibility Report energy efficiency measures in the NSTP architecture, alternate/ renewable means of energy provision.

Environmental Impact Assessment

The Consultant will be required to conduct an Environmental Impact Assessment of the Program and compatibility with both local regulations and the requirements of potential donor agencies and potential tenants. The Consultant needs to evaluate as to how any potential significant negative impacts can be minimized, identify stakeholders' expectations, priorities, opportunities, and trends.

Financing/Investment Options for NSTP

The Consultant shall be required to prepare and present different financing/investment options for the NSTP. These options can include, but are not limited to investment based on a PPP-BOT modality, JV/land leasing options with developers/qualifying companies; combination of loan/grant from national/international financial institutions, grant from GoP etc.

The Consultant shall recommend to the Client, the most optimal method of financing the Program based on a sustainable business model and supported by a detailed financial model.

Financial Study

The Consultant is required to propose and recommend a **Business Model** for the Program. The model must be designed with the objective of ensuring financial soundness and sustainability of the Program. In developing the business model the consultant is expected to review the successful business models of the existing STP's in the world especially in countries similar to Pakistan as well as similar or related initiatives within Pakistan.

Based on the business model, the consultant is required to prepare a detailed financial model of the program. The consultant is also required to identify the viability gap funding, if required, to make this program commercially viable and also show the relevant financial indicators for the investors under PPP.

The financial model shall include but is not limited to the following:

- Revenues of the Program including all direct and other revenues.
- All costs of the Program differentiating between fixed and variable costs and direct and indirect costs.
- Assumptions of the model.
- Option function in the model (scenario analysis).
- The Consultant is required to construct a risk matrix so it can be integrated with the construction of the financial model. It involves the following inter-related stages:
    - Identifying risks* involved in the Program.
    - Assessing the impact of these risks.
    - Assessing the likelihood of these risks.
    - Calculating the impact of risk (and ranges of possible outcomes).
    - Allocating risks to party best able to manage risk.
    - Identifying strategies for mitigating/managing risk.

**Some risks to be considered are "Program Related Risks" (including but not limited to; completion risk, operational performance risk, market risk, financial risk, environmental risk) and "Non-Program Related Risks",*

(including but not limited to political risk, contractual [regulatory] risks, macroeconomic environment, legal environment etc.)

- The cost estimates & comprehensive financial plan shall be prepared keeping in view the phase-wise development of the NSTP. The financial model shall include but is not limited to the following financial indicators:
- Return on Investment (financial, economic & social returns),
- Net Present Value,
- Internal Rate of Return,
- Break-Even Analysis,
- Payback Period.
- Economic rate of return

Economic Assessment

The Consultant is required to assess the possible benefits and costs of the NSTP to the society as a whole based on "with" and "without" Program. The Consultant is required to:

- Determine the economic costs of the project (investment cost and operating cost) derived from the financial costs.
- Undertake calculation of Economic Internal Rate of Return (EIRR) and Economic Net Present Value (ENPV).
- Determine major assumptions to be applied to the economic analysis and estimate expected economic benefits to be generated from the Program such as increase in employment generation, etc.

Governance Structure

Options for governance depend on the current ownership of the proposed NSTP site and how the Program is finally funded. Once the Client has approved appropriate mode of funding, the Consultant shall accordingly prepare an optimized and performance based governance structure for the NSTP.

Demonstrate Program Viability

Based on the above, the Consultant is required to assess Program viability taking into account if the Program is:-

- Technically deliverable.
- Affordable to users.

- Economically viable.
- Financially viable to the Client and potential investors.
- Socially and environmentally sustainable.

Verify Information and Sign-Off

The Consultant must ensure that all information used in the Feasibility study is as accurate and verified as possible. This will include:

- A statement from all stakeholders on the reasonableness of the information collected and the process by which the information was collected.
- A description of how the assumptions used in constructing the financial model are realistic and appropriate, taking into account past practice, performance, current practice and anticipated future developments. In this context, the financial model prepared by the Consultant shall be required to be audited independently
- A record of the methodologies used for valuing various costs, including the costs of key risks.
- Ensuring that all the inputs into the feasibility study are signed off as accurate and verified by the Consultant.
- Once this information verification and sign off has been completed the approval process must be completed in accordance with applicable law.

4. **Implementation period** - **One Year** (Efforts will be made to complete Feasibility Study within 6 months after the approval of PC-II)

5. **Financial Plan** - Rs 55.00 Million (US$ 0.55 M) will be required to complete the feasibility study for the proposed project.

Deliverables

The proposed cost will be spent on the deliverables of the feasibility study which is as follows:-

a. Executive Summary
b. Pakistan's Socio-Economic Review
c. The Feasibility Report to include the following:-
    i. Need Analysis.
    ii. Critical pre –requisites.
    iii. Phase wise development plan.

iv. Market analysis and identification of potential tenant.

v. Proposed features/services offered in NSTP.

vi. Desired output, outcomes, success indicators and risk factors.

vii. Management structure.

viii. Human resource requirement and induction plan.

ix. Environmental Impact Assessment.

x. Financing/Investment options for NSTP

xi. Financial study.

xii. Economic assessment

xiii. Demonstrate programme viability.

xiv. Verify information and sign-off.

6. Economic Benefits

The university's underlying purpose for establishing the NSTP rests in promoting innovation, successful commercialization of research and enhancing synergistic interactions between academia, government and industry to capitalize upon education's transformative power to foster economic as well as social development. The NSTP is envisioned to bring about the following benefits for the country;

- Enhancing the image of Pakistani Industry and academia as a significant player in high-end research and innovation.
- Laying the foundation for developing a national culture of innovation.
- Help build a nation whose development is measured by economic growth as well as the quality of life enjoyed by its people.
- To help the country achieve self-reliance through indigenization.
- Increasing the competitive strength of Pakistan's knowledge economy.
- Improving commercialization of research, both in terms of focusing the university's endeavors towards commercially feasible areas of study as well as minimizing the transition period between technological innovation and its commercial deployment.
- To encourage freedom of enterprise and innovation in Pakistan by providing a platform for technology incubation, business development and commercialization**.**
- To strengthen collaboration between the university and industry in the areas of research and development, and to create value through maximizing collaboration between academia, private and public sector entities.
- Creating a location for inward investment with the potential for technology transfer with foreign companies.
- Creating the opportunity of economy of scale by delivering business support services at a single location.

- Providing a strong point of presence for major international companies and enterprises thereby channeling world-class technology and practice into local and regional businesses.
- Providing incubator programs to promote emerging small-businesses and enterprises with the required technical, financial and administrative support.
- Helping to build a technology cluster which in turn can help the private sector to share the risk of further growth of the cluster.
- Improving the return on investment in education and R&D.
- Enhance future tax base of the country by attracting high value added international businesses.
- Create employment prospects and entrepreneurship opportunitiesfor a burgeoning young population of 110 million.
- To facilitate the retention of talented young people in the country and avoid brain drain.
- Creating a role model for the Higher Education and Research Institutes in Pakistan in relation to technology transfer.
- The NSTP will bring together in one place the resources, connections, services and opportunities to launch high-tech innovative ideas and products to the local and regional markets. Collaboration and exchange opportunities will be exploited amongst and between the following:-
  - Commercial anchor tenants.
  - Established hi-tech manufacturing concerns.
  - Start-up companies.
  - Providers of specialized business advisory services.
  - Providers of legal services.
  - Venture Capital (VC) firms and other investors (e.g. angel investors).
  - Government-backed R&D organizations, e.g. organizations that are part of the Ministry of Science & Technology (MoST), Pakistan, can be housed within the NSTP.
  - Small and Medium Enterprises (SMEs).

Unique Advantages of NSTP

NUST has many unique advantages which make it the ideal location for establishment of a Science and Technology Park on its campus. Over the years, management systems have evolved to strengthen the University's linkages with local business concerns and the Industry. Some of these unique advantages are:

- NUST brand value
- Credibility of NUST research expertise

- Intellectual Capital
- International collaborations
- Strong industry linkages through NUST's Industry-Academia collaborations platform – the Corporate Advisory Council (CAC)
- A functional Technology Incubation Center (TIC)
- Location advantage
- Proximity to Industrial clusters
- Proximity to airport & motorway
- Easy access to Ministries & other Government agencies
- Proximity to major Universities (multi-disciplinary)

7. **Expected outcome of the survey feasibility study and details of projects likely to be submitted after the survey.**

- **<u>Tangible Outcomes</u>**

  The above goals and objectives can be achieved through a wide sphere of activities and joint ventures between the industry and the university. Some of the expected outcomes of these activities would be:-

  - Joint research projects, especially industry-linked projects sponsored by government or fully funded by private industrial clients, bringing researchers and scientists from the university and industry together. This would bring the technologies and industrial practices into an academic perspective.
  - Technology transfers allowing tenant industries to commercially deploy and utilize university patents and copyrights
  - Technology scouting and technology monitoring services provided by the university to the industries through NSTP.
  - Work experience programs for undergraduate students during their course of study. This would provide the needed industrial exposure and experience.
  - Industry research projects for graduate and doctoral students. Such collaborations would help identify commercially viable areas of research and development.
  - Mentoring opportunities for management students. These tenant firms could provide administrative and accounting internships.
  - Consulting activities provided by management faculty members to tenant and external companies through NSTP, including market studies, business development etc
  - Financial services and/or business mentoring provided by venture/seed capital organizations and business angels to tenants and incubated startup companies, through NSTP

- Custom-designed management and technical education programs for tenant companies. Such courses can be administered in the form of short-courses or part-time degree programs.
- Courses about entrepreneurship and SME management as well as case studies presented by testimonials with first hand experiences, offered to most of the students, independently on their disciplines, in order to stimulate new entrepreneurial vision and enthusiasm.
- Inclusion of senior management and technical personnel from tenant firms onto the university advisory boards. Their contributions would be important factors in the redesign and establishment of courses and programs.
- Adjunct appointments of industry experts as faculty and researchers in the university.
- Commercialization of the University research.

- **Stakeholders**

The primary stakeholders in the development and sustenance of the NSTP are:-

- The University - NUST
- The Research Institutes – NUST and other HEC, PEC, PMDC accredited institutions
- Tenant firms and enterprises
- Investors and Private Start-up Companies
- The Government
- Each of these stakeholders plays a vital role in the development and growth of the NSTP. Correspondingly, each of them has individual interests and potential benefits to be achieved through NSTP. These are listed below:
- **Benefits to NUST**

  - A further enhancement of the strong international reputation in academic and business circles for its high standards of education, research and innovative leadership.
  - Increase in NUST revenues through collaborative efforts between the NSTP's businesses and tenants and the university's faculty, researchers and students.
  - Improvement of the worldwide NUST visibility and attractiveness, necessary to attract and retain the best in faculty and research.
  - The presence of International major companies and enterprises will help keep the university abreast of the latest technological, industrial and market trends and developments. Undergraduate and graduate programs could be modified to reflect these changes.
  - Significant student absorption into these businesses, both during their course of study and upon graduation.

- **Benefits to Tenant Firms and Enterprises**

Tenants could include local, regional and international companies who presently have a market presence in Pakistan, or desire to achieve it.

Tenant companies will achieve a significant point of presence in the region especially from an R&D perspective like:

- Convenient economic terms and conditions for access to the research infrastructure at NSTP.
- Access to a community of high quality businessmen, technologists, managers, consultants professors, students and venture capitalists sharing the same professional interest in technology, in the same place and at the same time, with the NSTP management committed to stimulate and nurture such a community
- Availability of a skilled work-force pool from graduate and undergraduate students of NUST.
- Assistance in identifying university programs and resources that best relate to the company's research programs.
- Opportunity for commercially deployment of university's proprietary patents and innovations. (The terms and contract for this would be decided later).
- Access to the University's advanced educational and training programs for company employees.

- **Benefits to Investors and Private Start-up Companies**

- Venture Capital companies can find in the NSTP tenants and incubated companies an interesting reservoir of projects to be evaluated for their direct investments.
- Private start-up companies would have access to the incubator program at NSTP, which would provide a stable growth catalyst effect. This is in addition to other research and development facilities as available to other tenants.
- Prestige, reputation, access to infrastructures and relationships in Industry, will be important benefits for small startup companies in the NSTP.
- Developing companies would benefit from the mentoring, investment and marketing support that Business Development Corporate Service unit at NSTP will provide.

- **Benefits for the Government**

The Government of Pakistan will benefit from its funding and participation in the activities of NSTP because this initiative helps the achievements of the Government policy aimed to enhance the competitiveness of the national economy and is in line with Vision 2030 of Pakistan.

In fact, NSTP will contribute towards the improvements in industrial activities in Pakistan, generate jobs and improve the worldwide reputation of Pakistan in terms of both knowledge and economic development.

Prepared by

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Engr. Ahmed Naseem Shahzad
Deputy Director Planning & Development NUST
Phone No. 90851237

Checked by

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Engr. M. Ashfaq Sheikh, SI (M), TBt
Director Planning & Development NUST
Phone No. 90851233

Approved by

_____

Engr. Muhammad Asghar, HI (M)
Rector, NUST
Phone No. 90851001

Countersigned by

_____

Mr. Kamran Ali Qureshi
Secretary MoST Islamabad

Dated:_____ October 2013

Annexure A

LIST OF LABS WITH MAJOR CAPABILITIES / FEATURES AT NATIONAL UNIVERSITY OF SCIENCES & TECHNOLOGY (NUST)

College of E&ME

S/No	Labs with Major Capabilities/Features	Department/ Discipline
1.	**Microwave Engineering Research Lab** • Design and development of Analog electronics circuits, Antennas RF/Microwave circuits, sub-systems and modules, Digital system design and development and implementation on high end FPGA/DSP boards. • Design, simulation and realization of complete system such as Radar. • System integration expertise. **Major Equipment** • PSG Vector Signal Generator 250KHz-20GHz • PNA Series Network Analyzer 10Mhz-40Gbz • Vector Signal Analyzer • PSA Series Spectrum Analyzer 3Hz-26.5GHz • Probe Station • DC Power Supply 0.20V, 0.25A • Infinium Osiloscope • Wire Bounder • LPKF Proto Mat H-60 • Logic Analyzer • Signal Source Analyzer 10Mhz to 7Ghz	Electrical Engineering
2.	**Control System Lab** • To support the undergraduate projects and graduate theses in Control Systems, Robotics, Signal Processing, Medical Electronics, Power Electronics, and Aerodynamic Systems. • To execute graduate research projects. • To design closed loop linear systems and study their behaviors. • To design PID controllers. • To implement and study the behavior of a robotic arm. • To study and assimilate the principle of magnetic levitation. • To study the principle of operation of a gyroscope. **Major Equipment**. • MP-Loab ICD2 In-Circuit Debugger Including Evaluation: Kit USB & RS 232 Microchip Model:DV164006. • KHK Gears (SS1-15) • Xilinx High Volume Starter Kit Bundle • Ds PICDEM 1.1 General Purpose Board • WORKSTATION Grounding Kit 8024,Blue	Electrical Engineering

S/No	Labs with Major Capabilities/Features	Department/ Discipline
3.	**Computer Aided Engineering Lab** 40 PCs installed with Mechanical Engineering softwares such as Pro-Engineer, ANSYS, ADAMS, MATLAB, etc for training and Projects/ Research work both at UG and PG level are the main attractions in this lab.	Mechanical Engineering
4.	**Automotive Lab** Engine dynamometer, Chassis dynamometer and sectionized cut away working models of almost every type of engine and other assemblies for training and Research work both at UG and PG level are the main attractions in this lab.	-do-
5.	**Dynamics & Control Lab** • Hydraulic Test Rig, Pneumatic Test Rig (controlled through PLCs) and Process Control Simulator for training and Projects/Research work both at UG and PG level are main attractions in this lab. • Journal Friction Apparatus that can be used for training and Projects/Research work in the field of tribology both at UG and PG level are the main attractions in this lab.	-do-
6.	**Embedded Systems Lab** **Lab Activities** Software Development Using Different Data Structures and Algorithms, Implementation of Operating System Structures, Assignments Using Different Programming Languages and Environments, Design and Development of Database Applications , Interface Design, Testing and Validation Using Software Engineering Methodologies, Computer Graphics Applications, Applications of DSP, DIP, MBD and DSD, Software-Oriented Projects in Professional Languages, Computer Network assignments.	Computer Engineering
7.	**Computer Networks Lab** Software Development Using Different Data Structures and Algorithms, Implementation of structures. Assignments Using Different programming Languages Design and Development of software for class projects Interface Design, Testing and Validation Using Software Engineering Methodologies Computer Graphics and Database Applications, Applications of DSP, DIP, PLE, MBD, and DSD Implementation of Networking Solutions Software-Oriented Projects in Professional Languages.	
8.	**DSP & DSD Lab** DSD projects, Implementation and Testing of Computer Architecture Algorithms, Use of Verilog / HDL, Hardware / Software Co-Design, System Design using Verilog and HDL Tools, Design of Multi Layer Digital Systems, Design of PCBs, DLD Circuits through Verilog, Project Implementation for Microprocessor Based Design Applications.	

S/No	Labs with Major Capabilities/Features	Department/ Discipline
9.	**Machine Vision and Embedded Systems Lab** • This lab consists of digital trainers for logic design and microcontroller trainers including 8051, PIC & AVR controllers. • It is also equipped with web cameras and FPGA training boards.	Mechatronics Engg
10.	**Robotics and Control Lab** • Main attractions in this lab are state of the art industrial and educational robotic equipment like ABB industrial robot, Rhino robots, Janome Screw Tightening robots and PeopleBot. • Educational kits for control experimentation such as inverted pendulum, ball on a beam etc are also part of this lab.	**-do-**
11.	**Industrial Automation Lab** • This lab boasts state of the art industrial Computer-integrated manufacturing (CIM) system that is comprised of automatic storage and retrieval system (ASRS), conveyor system, robotic arms for picking and placement and computer numerical control (CNC) milling & lathe machine. • A real modern industrial environment is presented to the students in this lab for their practical training.	**-do-**
AM College		
1.	**Centre for Research in Experimental and Applied Medicines (CREAM)** The CREAM has been setup to promote research molecular level. The lab is equipped with state-of-the- Art and hi-tech laboratory equipment. The following facilities are available with the Lab:- • Genetic Analysis (Squencing) of humans, plants, viruses etc using DNA Squencer (Beckman Coulter). • DNA amplification with real time quantification using Real Time PCR. • DNA amplification using Thermocyclers (PCR). • Visulization of Gel & mutation analysis using Gel DOC System. • Sepration of genomic / proteomic samples on the bases of charge & size using Horizantal Electrophoresis. • Fine sepration of genomic / proteomic samples on the bases of charge & size using Vertical Electrophoresis. • Quantification of DNA, RNA etc. in Genomic samples using Genomic Spectrophotometer. • Safe & sterilized handling of genomic samples & techniques using Laminar Flow Cabinet. • For long duration storage of samples / samples that are sensitive to temp using Cold Storage Freezers (-20°C & -80°C). • High speed & accuracy Centrifugation of Genomic samples using Ultra Centrifuge (Refrigerated).	Biochemistry and Molecular Biology

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	• Centrifugation of blood / other samples at variable speeds & temperature using Centrifuges (Benchtop + Refrigerated). • Incubation of samples with or with out stirring from +5°C to 95°C using Hot & Cool Shaker Incubators. • Incubation / Heating of samples from +25°C to 250°C using Ovens.	
	• Weighing of samples in very minute quantity with high precission/accuracy using High Precission Analytical Balance. • Incubation of samples with or with out stirring from +25°C to 95°C using Water Bath (Shaker). • Check the pH & conductivity of samples / solutions using pH / Conductivity Meter. • Two stage (Touch, Continious) homogenous mixing of samples using Vortex Mixer. • Sterlization of lab equipment, glassware, water etc using Autoclave. • Fast & efficient production of Ice using Ice Machine. • Magnified visualization of cross section of opaque objectives using Inverted Microscope.	
	• Magnified and digital interpratation of objectives using Digital / Compound Microscope. • Magnified visualization of objectives using Compound Microscope. • Ultra Violet Illumination of Gel for visulazing DNA fragments using UV Transilluminator.	
2.	**Molecular Biology & Human Genetics Lab-2 / CREAM** • Pharmacokinetic Profile, Bioavailbility, Bioequivalance, Drug Analysis etc using HPLC (UV + Fluroscence) Perkin Elmer. • Detection of Pescticides, Aanalysis of Pharmaceutically active compounds using HPLC (UV) Shimadzu. • Detection of minute amounts / traces of drugs, elements in a given sample using GCMS Shimadzu. • Fine Analysis of Drugs and their traces with variety of detectors using GC (FID, ECD, NPD) Perkin Elmer. • Detection of Harmones, Microbes, Drugs etc by Antigen-Antibody reaction using ELISA. • Incubation of samples with or with out stirring from +5°C to 95°C using Hot & Cool Shaker Incubators. • Incubation / Heating of samples from +25°C to 250°C using Ovens. • Weighing of samples in very minute quantity with high precission/accuracy using High Precission Analytical Balance. • Incubation of samples with or with out stirring from +25°C to 95°C using Water Bath (Shaker). • Dispensing of Hazardous chemicals having harmful fumes using Fume Hood. • Homogenization of viscous samples using Homogenizer.	

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	• Centrifugation of blood / other samples at variable speeds & temperature using Centrifuges (Benchtop + Refrigerated). • Check the pH & conductivity of samples / solutions using pH / Conductivity Meter. • Easy removal of minute air bubbles from solutions to be run on HPLC using Sonicator. • Two stage (Touch, Continious) homogenous mixing of samples using Vortex Mixer. • For long duration storage of samples / samples that are sensitive to temp using Cold Storage Freezers (- 20°C & - 8°C). • For Deionized, microbe free, HPLC grade, Highly Purified Water using Water Ultra Purification System. • Production of Biotechnological products by fermentation using Fermentor. • Quantitative & Qualitative analysis of drugs & samples using UV / Vis Spectrophtometers. • Quantitative & Qualitative analysis of drugs & samples with higher accuracy using Flourospectrophotometer.	
	• Extraction & purification of samples from two or more phases using Rotary Evaporator. • Drugs, Pesticides etc. extraction by Solid Phase method using Solid Phase Extraction.	
3.	**Molecular Biology & Human Genetics Lab-3 / CREAM** • Safe & sterilized handling of microbial samples & techniques using Sterile Area. • Safe & sterilized handling of microbial samples & techniques using Laminar Flow Cabinet. • Growth & Incubation of anerobic micro organisms etc using CO2 Incubator. • Incubation of samples from +35°C to 120°C using Incubator. • Magnified visualization of cross section of opaque objectives using Inverted Microscope. • Haemotological Analyzer using Sysmax. • Electrolyte Analyzer using EasyLyte. • Dry sterlization of Glass ware & Labware etc using Hot Air Sterlizer. • Wet sterlization of glass ware, solutions, water etc using Fully automatic Autoclave. • Magnified visualization of objectives using Compound Microscope. • Detection of Harmones, Microbes, Drugs etc by Antigen-Antibody reaction using ELISA Reader. • Centrifugation of blood / other samples at variable speeds & temperature using Centrifuges (Benchtop + Refrigerated). • Incubation of samples with out stirring from +25°C to 95°C using Water Bath. • Washing of Glass ware & Labware using Turbomatic Washer.	

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	• Water Conditioning (Deionization, Distillation, ultra Purification using Automatic Water Conditioner. • Various applications, Lyophilization using Freeze Dryer. • Cell culturing, Growth etc using Anaerobic Jar. • Check the pH & conductivity of samples / solutions using pH / Conductivity Meter.	
School of Electrical Engg and Computer Sciences (SEECS)		
1.	**EMC / EMI Lab** EMC /EMI Lab has been setup at Research Institute of Microwave and Millimeter-wave Studies (RIMMS), working for SEECS, in order to cater test & measurement of electromagnetic interference (EMI) and electromagnetic compatibility (EMC) of electronics and electrical products as per national/international standards & regulations. This lab aims at imparting EMI/EMC awareness, shielding analysis and research studies for students, and collaborating with local and international industries in order to provide product EMI/EMC pre-compliance. Presently, the lab has the capability to perform testing as per European Union standards In this lab six different tests namely Conducted Emission, Radiated Emission, Radio-frequency Immunity (Susceptibility), Harmonic & Flicker, Electrostatic Discharge and Surge, Burst & Power Fail test are presently conducted.	(Electrical Engineering)
2.	**Anechoic Chamber** An elaborate antenna test and measurement facility is available at RIMMS complementing NUST-SEECS labs in the research related to RF/Microwave area. Students interested in the research related to antenna theory, design, and development use this facility. This facility is used to characterize and evaluate various antennas in the frequency range from 0.8 GHz to 40GHz. The anechoic chamber is equipped with the near-field planner scanner, and far-field tower to test and measure the radiation pattern of a given antenna under test (AUT).The measurement software installed in the facilities control room has the capability to transform the near-field data to far-field data for plotting antenna radiation patterns in 3-D. Antennas, single element or antenna array can be tested. This facility is also used to evaluate antennas and related issues of the industry. The anechoic chamber of the facility can be used for any application were electromagnetic isolation is required from the environment.	
3.	**CoNNekT Lab: Research Laboratory of Communications, Networks and Multimedia** The mission of CoNNekT Lab is to perform basic and applied research in communications and networks domain with an emphasis on representing information for accurate and efficient communications. We aim to design practical tools, determining fundamental limits, and understanding interactions between information representation, communication and	

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	networking across a variety of transmission media. We are interested in pursuing high impact cross-disciplinary research to cultivate innovation across multiple disciplines remaining within information and communication domains. CoNNekT Lab is actively engaged with international partners on joint research ventures with collaborators in Korea, United States, United Kingdom and Kingdom of Saudi Arabia, Currently, CoNNekT Lab is accepting Ph.D applications in Electrical Engineering and Information Technology (Networks Track) from students with excellent academic track record with an aptitude to undertake cutting-edge research. There is a strong possibility of Scholarships for full-timers and student exchange / research visits to international labs of repute.	
4.	**System Analysis and Verification (SAVE)** These days hardware and software systems are increasingly being used in safety-critical domains, such as electronic military and medicine equipment and automated transportation systems. This fact makes the accuracy of their analysis very important as an uncaught system bug may endanger human life or lead to a significant financial loss. Traditionally, the verification of these systems has predominantly been accomplished by computer simulation. However, it does not ascertain 100% correctness and thus has primarily been responsible for many unfortunate incidents that happened due to an erroneous hardware or software system deployed in a safety-critical domains. The focus of our research is on using formal methods, which are based on mathematical techniques and thus unlike simulation ensure 100% precise results for the analysis and verification of hardware, software and embedded systems. In particular, we aim at using theorem proving which is one of the widely used formal methods, to develop methodologies, algorithms and tools for the accurate analysis of systems that are continuous in nature or interact with continuous physical environments.	
5.	**Centre of Excellence for Industrial Automation (CEIA) Lab** School of Electrical Engineering and Computer Science (SEECS) and Buraq Integrated Solutions (BIS) have mutually established the Center of Excellence for Industrial Automation (CEIA) at SEECS, NUST campus for the Research & Development in the field of Industrial Automation. CEIA aims to educate and train students for Industrial Automation, share resources to mutually conduct the training, software development and work jointly on projects related to Process Control and Industrial Automation. This center will be used for implementation of industrial projects.	**Industrial Automation**
6.	**Cognitive Radio Networking (Cognet) Labs** The Cognet lab, part of the IP technology center of excellence at SEECS, NUST, is focused on addressing research issues related to the emerging field of Cognitive Radio networks. Cognitive radio networks utilize software defined radio techniques, along with intelligent estimation of current network conditions, to share efficiently the scarce wireless spectrum resources. Cognet lab activities focus on a wide range of issues related to cognitive	

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	radio networks (from spectrum sharing, channel assignment, routing issues, transport layer issues, etc).	
7.	**Analog Mixed Signal Group (AMSG)** The AMSG was formed to initiate activities in the domain of mixed signal design at SEECS-NUST. This group aim to enhance our skills in the area of analog and mixed signal design, develop skilled work force in the area of analog and mixed signal design and develop state of the art solutions in collaboration with industry. The focus of this group is to solve the design challenges faced by the IC world because of technology scaling as determined by the Moore's law. However, this technology scaling brings new challenge for the analog designers because of transistor's increased leakage noise, limited output resistance etc. the group is fully aware of the design challenges and targets to solve the analog problems using the digital circuits as digital techniques are more robust and cost effective. The research areas of this group include Switch mode transmitter architectures, High speed and low power data converters, Digitally Assisted Analog Circuits, Electrostatic Discharge (ESD) protection and design for nanometer IC's.	
College of Aeronautical Engg (CAE)		
1.	**Aerodynamics Lab** One supersonic and two subsonic wind tunnels for training and Project/ Research work are the main attractions in this lab. These wind tunnels are used to investigate flow (Aerodynamic loads) over various types of geometries/ configurations. Fluid friction apparatus to evaluate pressure head losses in various types of pipes, elbows, valves etc. The apparatus helps in building students understanding regarding mechanical system designs and evaluations. Multiple type of Flow Visualization equipment for qualitative study of fluid flow.	**Aerospace Engineering**
2.	**Structures Lab** Universal tensile testing machine for tensile testing of different material. Optical microscope (1500x) for metallographic analysis of material. Micro Hardness tester for Hardness testing of material. Abrasive Cutting Machine for cutting of specimen for metallography. Mounting Press for Mounting of specimen of metallography.	**-do-**
3.	**Numerical Analysis Lab** High end Computing facilities with licensed ANSYS 13.0 (for structural and computational fluid analysis problems)	**-do-**
4.	**Radar Lab** • A portable, table top miniature radar system is available in the lab to demonstrate most of the basic concepts and operations of a radar system. The experiments that can be conducted on this system are as follows: (a) Pulsed Radar Operation	**Avionics Engineering**

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	(b) Range measurement and waveform design (c) Radar Cross Section (RCS) measurements (d) MTI and Pulse Doppler filtering (e) Tracking Radar (f) Electronic Warfare (EW) and Jamming	
5.	**Communication Lab** • This lab is equipped with many advanced trainers to gain hands on experience related to modern communication systems. The experimental equipments can demonstrate following communication operations: (a) Analogue modulation and communication system (b) Digital modulation techniques such as ASK and FSK (c) Operation of a modern switching matrix and digital exchange (d) Optical Communication System (e) Computer Networks	**-do-**
6.	**Microwave Lab** • This lab is equipped with Microwave probe Station which is capable of Wafer Level Measurement (150 mm). This device provides the capability of Device Calibration, Device Modeling and Yield Enhancement of micrometer level devices. • Vector Network Analyzer (10 MHz-20 GHz) is a two port Device used for microwave device characterization. This device provides an ability to determine parameters of electrical networks which include S,X,Y,H Parameter measurement. • The lab has two Spectrum Analyzers that provide capability to measure the power spectrum of received signals for a frequency range of 9 KHz to 26.5 GHz. • In addition to the above mentioned key Precision Measurement Equipment, the lab is also equipped with Microwave Counter, Power meter and power reflection meter that are used for Microwave measurement, calibration and characterization.	**Avionics Engineering**
7.	**Antenna Lab** • This Lab deals with practicals related to four subjects: Transmission lines & Wave Guides, Electromagnetic field Theory, Antenna engineering, and Microwave engineering. • The Lab experiments are designed to give students an understanding of theory and application of Electromagnetic field, Antenna Engineering and Microwave Engineering.	**-do-**

S/No	Labs with Major Capabilities/Features	Department/ Discipline
8.	**CNC Lab** • The lab is equipped with one CNC lathe machine capable of performing various machining operations on different work pieces. • Other attractions in the Lab are one CNC Milling and two CNC engraving / small milling machines. • A coordinate measuring machine is also available in the Lab. The machine is used to check the coordinates of different work pieces.	**Industrial Engineering Department**
Military College of Engineering (MCE)		
1.	**Geo Lab** All samples of rocks and minerals are used for identification of structural / geological features of rocks.	Transportation and Geo tech
2.	**SOM Lab** **50 Ton Universal Testing Machine:** It is a universal testing machine and plays a vital role in the research and training. It is used for the graduate and post graduate classes. The machine is utilized for the following tests: a. Tensile test on metal b. Shear test on metals c. Shear test on wood d. Transverse test on timber e. Brinell Hardness No of thin & thick cylinder	Civ Engg Dept
3.	**Transportation Lab** Transportation engineering is playing a vital role in the field of civil engineering. The following major tests of transportation engineering can be conducted. a. Impact Value of Aggregate b. Crushing Value of Aggregate c. Abrasion value of Aggregate d. Aggregate Shape Test e. Specific Gravity Test of aggregate. f. Penetration Test of Bitumen. g. Ductility Test of bitumen. h. Softening point test of bitumen. j. Flash & Fire Point test of bitumen. k. Viscosity test of bitumen. l. Marshall Stability & Flow Test. m. C.B.R Test. n. Plate load test o. Benkelman beam test.	Civ Engg Dept

S/No	Labs with Major Capabilities/Features	Department/ Discipline
4.	**Soil Lab** The lab has the capability to carry out following experimental tests related to soil: a. Sieve Analysis of Soil for identification and classification of soil. b. Moisture Content Determination through Oven / Speedy Moisture tester. c. Specific Gravity of Soil through Sp gr Bottles d. Atterberg Limits through Cassagranda Apparatus e. Hydrometer Analysis through Hydrometer f. Permeability Test through Permeability Apparatus g. Compaction Test through Compaction Apparatus	
	g. Determination of in Situ Density using Core Cutter/Sand bottle (Field Test) h. Direct Shear Test using Direct shear Machine j. Unconfined Compression Test using UCC Machine k. Triaxial Compression Test using Triaxial Machine l. Standard Penetration Test (SPT) through SPT App (Field Test) m. Plate Load test using Plat Load Apparatus (Field Test) n. Vane Shear test using Vane Shear App (Field test) o. Resistivity Test using Terra Meter Machine (Field Test)	
Military College of Signals (MCS)		
1.	**Microwave Communication Lab** • Equipment used for research project in RF & Microwave Lab is given as:- - Spectrum Analyzer (9 KHz to 30 GHz). - Signal Analyzer (20 KHz to 26.5 GHz). - Vector Networking Analyzer (10 MHz to 20 GHz). - Portable Spectrum Analyzer (30 KHz to 13.2 GHz). - 1690 Display 2A-6 Slot Logic Analysis system Mainframe w/built in touch Display. - MST 532-1 complete micros trip Trainer comprises. - Lab Volt Antenna Training & Measurement system Model 8092-05.	Microwave Engineering

S/No	Labs with Major Capabilities/Features	Department/ Discipline
2.	**Electrical Machines Lab** ECP Model 220 Industrial Plant Emulator complete. Industrial plant Emulator is used to measure and plot Gain, Damping ratio and other characteristics of closed loop control system. Lab Volt computer Assisted 0.2 KW Mechanical Training system Model 8006-05. Motor & Generator experiments are conducted for UG course. Speed torque Voltage ACIDC and characteristic of different types of votors & Generators are analyzer.	
3.	**Virtual Reality Research Lab (VR)** Students and faculty uses VR technology in areas such as remote robotic control and factory design. This lab has 5x sets of Virtual Reality Kits.	
4.	**Modeling and Simulation Lab** Simulation lab designed for group work experimentation to support innovative simulations Students working in this lab can gain practical and valuable hands-on experience with simulation techniques.	
5.	**Image Processing Center (IPC)** Image Processing Center (IPC) is a research and development facility established at Military College of Signals (MCS), with the aid of Ministry of Science and Technology in 2006. IPC has been facilitating research activity and academic projects in collaboration with foreign and local universities and research organizations in areas of Image Processing and Computer Vision. The research carried out at IPC has resulted in a wide variety of applications including object tracking, mosaicing, image segmentation, UAV image analysis and 3D reconstruction.	
School of Civil and Environmental Engineering (SCEE)		
1.	**Transportation Laboratory** • Testing of Construction Materials Including Asphalt Binder (Bitumen). • Testing of Soils for Building Foundation Design. • Testing of Aggregates and Asphalt Cement in Highway Construction. • Testing and Performance Evaluation of Highways and Bridges. • Civil Engineering Materials Testing & Evaluation. • Asphalt Concrete Materials Testing. • Asphalt Binder Testing &Evaluation.	NIT / Transportation Engineering
2.	**GIS and RS Teaching Lab** The lab is equipped with 32 state of the art PCs with high performance specifications suitable for professional GIS and RSsoftware's. The unique feature about the lab is that it has licensed software of Arc GIS 10, Erdas 2010, MS Office 2010, Adobe Acrobat Reader and Oracle 11g.The lab also has large scale plotter and scanner for GIS applications.	IGIS

S/No	Labs with Major Capabilities/Features	Department/ Discipline
3.	**GIS/RS Research Lab** The research lab is facilitated with 8 PCs and licensed software for research students carrying out their postgraduate research thesis.	IGIS
4.	**Hydraulic lab** The lab is well equipped to fulfill the teaching and research needs of the UG students following are the major equipments in the lab and their basic functions are also highlighted:- • S6-MKII 10.0 m Glass Sided Tilting Flumeis state of the art equipment and utilized for Research and Teaching purposes regarding the open channel flow, this is also having capability of simulating the waves in flowing water and observing their effects on sediment transport. • HF-401 Basic Hydrology Apparatus, this equipment enables the students to comprehend the rainfall and runoff measurements in catchments, formation of hydrograph and effect of tube-wells on phreatic line etc. • FM-04 Pipe Surge & Water Hammer Apparatus demonstrate the phenomena of pressure wave development in pipe flows due to sudden variation in discharge and also describes the effectiveness of the surge tanks in controlling the magnitude of pressure wave. • FM1-10 Hydraulic Benches with Accessories; these are used to explain the basic phenomenon of fluid mechanics and hydraulic engineering.	NICE
5.	**Structures Lab** Structures lab is well equipped to fulfill the teaching and research needs of the UG as well as PG students. Lab also provides testing and consultancy services in the field of Structural Engineering. Following are some major equipments available in the lab: • A 200 Ton Universal Testing Machine for Testing of Concrete, Steel and other metallic samples, both in Compression as well as in Tension. • Two 5000 KN servo-hydraulic Compression Testing Machines to perform compression tests on cement based materials. • A versatile range of Non-Destructive Tests (NDT) to evaluate in-service structures and to detect quality of concrete as well as corrosion in embedded steel bars. • State-of-the-art equipment satisfying the teaching requirements in the field of Structural Mechanics.	NICE
6.	**Surveying Lab** Our survey lab has been equipped with latest equipments which will very efficiently fulfill the demands of today market. With the arrival of RTK survey of large area can be done within few days and prepare printed map of	NICE

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	required size using software and plotter facility. Major equipment available in lab are:- • Two sets of GNNS Real time Kinematics (RTK). • Sixteen Total Stations NIKON/LICA/HORIZON. • Eight Electronic Levels. • DIGI Detection and localization of underground services, cables and metallic pipes. • 44 inches Map Plotting facility. • Micro Survey Cad Software. • Eight Work stations for generating digital maps.	
7.	**Geo-Technical Lab** Geo-Technicallab of NICE has been equipped with latest equipments which will very efficiently fulfill the demands of today's market. With the arrival Cyclic Tri-axial, Resonant Column and Pressuremeter (Menard), 1 IP Resistivity Meter we are the one, who have these latest equipments in Pakistan. These latest and more sophisticated equipment will able usto perform us research work on PG level and testing on commercial bases. Geo-Technical Lab also provide the testing and Consulting services on commercial bases.Following are the major equipments in the lab:- • Cyclic Tri-axial Test Apparatus. • Resonant Column Apparatus. • Single Channel Memory Earth Resistivity and IP Meter(AGI- England). • Sub-Surface Seismic Testing Equipment with X-Hole, Testing. • Shear Scan Test Apparatus. • Pressure meter (Menard). France Made. • Electric Density Gauge.	NICE
School of Chemical and Materials Engg (SCME)		
1.	**SEM Lab** Scanning Electron Microscope is equipped with tungsten filament electron emitter and accelerating voltage of 30 KV. In addition, Energy Dispersive X-ray spectrometer (EDS) is also attached. Microstructural analysis at micro and nano scale along with chemical analysis can be performed on all kind of specimens. A gold sputter coated is available for analyzing non-conductive (polymers, ceramic) materials. Moreover, failure analysis studies are also performed on fractured parts.	Materials Engg
2.	**XRF Lab** X-ray fluorescence (XRF) spectrometer is an x-ray instrument used for routine, relatively non-destructive chemical analyses of rocks, minerals, sediments and fluids. It works on Energy-dispersive spectroscopic (EDS) principle.	-do-

S/No	Labs with Major Capabilities/Features	Department/ Discipline
3.	**XRD Lab** This lab is equipped with X-ray diffracto-meter (XRD) which is a versatile, non-destructive technique that reveals detailed information about the chemical composition and crystallographic structure of natural and manufactured materials.	-do-
4.	**Heat Treatment Lab** This lab is equipped with three high temperature furnaces, used to alter the properties of engineering materials by heating and cooling cycles. Furnaces with a wide temperature range (up to 1600 ^{0}C) associated with various cooling techniques are available.	-do-
5.	**Thermal Transport Lab** This lab is equipped with no of equipments which are used for the determination of thermal properties of materials:- • Universal Tensile testing Machine. • Charpy Impact Tester. • Brinel, Vicker & Rockwell hardness tester.	
6.	**Chemical Analysis Lab** The lab is equipped with hi-tech research instruments for analysis and purification. Details are as under:- • HPLC (High Performance Liquid Chromatography), Research analysis. It is used for purification. Qualitative and quantitative analysis of chemical compounds (provided that we have the authentic standards). • TG/DTA (Thermogravimetric and Differential Thermal Analyzer), Research analysis. It is used for thermogravimetric/differential thermal analysis. • FT-IR (Fourier Transform infrared spectrophotometer), Research analysis. It is used for infrared analysis of organic compounds. • GC/MS (Gas chromatograph-mass spectrometer), Research analysis. It is used for determination of mass spectrum. Qualitative and quantitative analysis of chemical compounds (provided that we have the authentic standards). • Micro Calorimeter, Research analysis. It is used for determination of calorimetry as well as heat capacity of very small amount of samples. • Bomb calorimeter, Research analysis. It is used for calorimetry as well as heat capacity. • Element Analyzer, Research analysis. It is used for determination of composition of carbon, nitrogen, hydrogen and sulfur in a chemical compound.	Chemical Engg
7.	**Polymer Lab** • GPC (Gel permeation chromatography), Research analysis. It is used for purification and molecular weight determination of polymeric compounds. • Rheometer, Research analysis. It is used to determine the flow of the liquids.	-do-

S/No	Labs with Major Capabilities/Features	Department/ Discipline
Research Centre for Modeling & Simulation (RCMS)		
1.	**Advance Numerical Analysis Lab (A-NAL)** ANAL supports 3-D Modeling and Fluid Flow Simulation (Advanced Level). It consists of SUN workstations.	CS&E Fluid Flow & Structures
2.	**Design & Drafting Lab (D&DL)** This lab provides facility to print and plot detailed designs that are being simulated in other labs.	CS&E Fluid Flow & Structures
3.	**Network Simulation Lab (NSL)** **Model Checking & Stochastic Optimization Lab (MCSOL)** NSC is utilized in demonstrating Network Modeling & Simulation, Design, Configuration & Troubleshooting of LAN & WAN and implementing Network Security. MCSOL is used for the analysis of hybrid models, using the model checking tool HyTech and PHAVer and for the stability analysis of the cyclic behavior, polyhedral libraries, PolyLib and Barvinok are used.	CS&E Computational Infrastructure & Visualization
4.	**Super Computing Research Centre (132 Terra Flop)** The lab is equipped with state-of-the-art and hi-tech super computers for modeling and simulation of engineering design for research purpose.	-do-
School of Mechanical and Manufacturing Engg (SMME)		
1.	**Measurement and Instrumentation Lab** Following state-of-the-art and hi-tech equipment used for measurement and calibration purpose- a. **National Instruments ELVIS II** Based on NI LabVIEW graphical system design software, NI ELVIS, with USB plug-and-play capabilities, offers the flexibility of virtual instrumentation and allows for quick and easy acquisition and display of data. b. **QNET Mechatronics Sensors kit for ELVIS II**: This board has different sensors i.e. infrared, piezo, pressure sensors, LEDs , Potentiometer, strain gage, thermisters and many more. This board can be mounted on ELVIS II and any sensor can be accessed from PC. c. **National Instruments Student USB**: The National Instruments USB-6009 provides basic data acquisition functionality for applications such as simple data logging, portable measurements, and academic lab experiments. d. **National Instruments cDAQ 9174 with TTL and Analog Input Modules**: The NI cDAQ-9174 is a 4-slot NI CompactDAQ USB chassis designed for small, portable, mixed-measurement test systems. Combine the	Mechanical Engg

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	cDAQ-9174 with up to four NI C Series I/O modules for a custom analog input, analog output, digital I/O, and counter/timer measurement system. e. **DIGIAC 1750 Transducers Trainer Kit**: This kit contains different sensors e.g. variable resistors, Wheatstone Bridge, LEDs, Voltmeters, Relays, Solenoids, Microphone, Airflow sensors, Strain gages, Humidity sensors, Tachometer and DC Motor. f. **Metallurgical Microscope**: This Microscope has the magnification of 5X, 10X, 20X and 50X to maximum. The dedicated camera mounted on the top of this microscope can be used to take photographs of the sample and can be seen on PC in Real Time. g. **Polari scope (Transmitted Light):** This apparatus can be used to measure the stress in a loaded member. h. **Ultrasonic Flaw Detector**: This is a portable device which can be used to detect any flaws i.e. cracks and voids in the work piece. i. **Ultrasonic Thickness Gage**: To measure the thickness of a work piece using the ultrasonic technologies. j. **Infrared Thermometer**: This thermometer emits infrared light and receives it back and is used to measure the temperature of objects for which conventional thermometer cannot be used. It can measure temperature of -50 to 500 degrees Centigrade's.	
2.	**CIM LAB & Micro CIM Lab** • Industrial prototype for milling and turning of a part for pg level training • Also used for the quality assurance of a part after milling and turning processes • The lab is also equipped with PCB designing machine LPKF • The lab is equipped with hydraulic and pneumatic equipments for UG level training • Micro CIM has all the features as of CIM as above	Mechanical/ Mfg Eng
3.	**CAD/CAM** High End Computation Facility to support Design and Analysis related tasks covering a wide range of engineering software's. Currently the lab is equipped with: 1. 3D modeling and CAM software Pro Engineer Wildfire 5.0. 2. Structural and Thermal problems solving through ANSYS 11.0. 3. Project Management Software, ARENA. and all the frequently used engineering utilities part of the curriculum are installed.	Mechanical/ Mfg Engg

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	This lab is equipped with all the latest tools available to execute jobs related to CAD and CAM.	
4.	**CNC Lab** It has two machining centres for Milling and Turning machining operations. The Milling centre is a 3 axis machining center which can machine parts from small to as large as 1 ton weight with length upto 1 meter and 600 x 600 mm cross section. Its tool changer of 24 tools is ready to be used. The machine control is of FANUC origin. Turning centre is a two axis machine with a capacity to turn a Job with 600 mm in length and 300 mm dia. It has a torrent for 5 internal and 5 external tools to support the production machining.	Manufacturing Engg
5.	**Automotive Lab** Taylor Engine Dynamometer: Taylor's engine dynamometers are the engine diagnostic tool available, allowing you to quickly troubleshoot problems such as low horsepower, insufficient torque, and leaks. The dynamometers help you verify that the repair is completed, that the engine is operating according to specifications and can be used to break-in engines before installation. This dynamometer is water braked and is capable of conducting test of engines up to 750 hp. Chassis Dynamometer: Chassis dynamometers serve to quickly identify service issues such as low horsepower, overheating, emissions compliance and speedometer accuracy. Once identified and repaired, the chassis dynamometer will verify the problem is corrected and can be used to perform engine break-in after rebuild. This is also water braked and can deal with Engines of power up to 1100 hp. Emission Analyzers: This analyzers can detect the level of O_2 and NO using sensors and hidden critical issues related to the combustion chamber can be addresses. Opacity Meter: To detect the smoke level from the exhaust of engines and very important to conduct for diagnostic purpose if the engine is reported for low power output. OBD Scanners: On Board Diagnostics Scanners.	Mechanical/ Mfg Engg
6.	**Rapid Prototyping Lab** 1. One, Fused Deposition Modeling machine with accessories for prototyping of parts for industry. 3 x MS students are utilizing this facility as a part of their research work. 2. One, 3D laser scanner is also available to scan the part and reverse engineer the existing component or for quality assurance. 2 x MS	Manufacturing Engg

S/No	Labs with Major Capabilities/Features	Department/ Discipline
	students are also utilizing this machine for their research work. 3. One, FAROARM coordinate measuring machine for measurement and quality assurance.	
7.	**Machine Vision Lab** Machine Vision lab at SMME focuses on the recovery of deformable and articulated 3D motion from single video/Image sequences. Lab equipment is oriented towards areas of multi-camera surveillance, augmented reality, and medical image processing. Furthermore, graduate teaching is also one of the services offered by this research lab.	Robotics
8.	**Advanced Robotics Lab** The Advanced Robotics Laboratory is aimed at research in perception, control and planning for robots that navigate through complex indoor and outdoor spaces. The lab has a multitude of equipment that enables researchers to map and navigate cluttered surroundings by stereo and monocular vision, by sonar, scanning laser rangefinder and other sensors. The lab also contains Lab volt equipment for training of various robotic and mechatronic technologies that are used in manufacturing systems. These systems along with accompanying RoboCIM software comprise a tool for hands on teaching of robotic manipulators and their associated kinematics / dynamics.	Robotics
9.	**Advanced Control Lab** The primary purpose of the laboratory is to facilitate fundamental and applied research in the general areas of systems and control. Planned research activities in the lab concentrate in nonlinear control systems, robust control, sampled-data control (linear and nonlinear), multi-rate systems, real-time computer control systems and fuzzy control.	Robotics
10.	**CAD/CAM/ Artificial Intelligence Lab** Teaching and basic research relating to Artificial Intelligence using various programming languages.	Robotics