

## **NUTECH INNOVATION CENTRE**

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# **CONCEPT OF INNOVATION** **& NUTECH INNOVATION CENTRE**

## **Introduction**

1. National University of Technology (NUTECH) is Federally Chartered University, established through an „Act of Parliament“ in February 2018. On February 18, 2018 Parliament approved the Charter of NUTECH and on February 26, 2018, the President of Pakistan as Chancellor signed its Act. It is the first National Technology “*University for Industry*” in Pakistan. NUTECH is envisioned to be an internationally acclaimed research driven University established to create, develop, implement, promote, transfer and export existing, emerging and future technologies and allied skills. The University aspires to become bastion of learning excellence and seat of academics, research, skills and scholarship in the country. Academia transforms industry and society into technologically advanced ones through innovation. NUTECH aspires to be the “*Flag Bearer University of 4<sup>th</sup> industrial revolution (Industry 4.0)*”. Concept of innovation is imbedded in Industry 4.0. Innovation is defined as the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service. The application of practical tools and techniques that make changes, large and small, to products, processes, and services that result in the introduction of something new for a university that adds value to students as customers and contributes to the knowledge store of the organization. The innovation as a value driver concept is very important for assessing the efficiency of innovation in a university. In this concept, innovation is defined as a source of competitive advantage and is seen as a decisive factor for intellectual, academics, professional and economic growth and the basic condition of University development in a competitive knowledge-driven environment. From an organizational point of view, the adoption of innovation may lead to improved intellectual and professional efficiency; create better knowledge eco-system, intellectual competitive advantage and flexibility that ensure sustainable development of university products, invention etc. in a dynamic changing knowledge driven environment. Therefore, it is vital for NUTECH to focus, cherish and foster innovation as culture of each segment of the university.

## **NUTECH Vision**

2. To be a world-class technology-driven research university committed to best serve society and industry through purposeful education, research and innovation.

## **Innovation Philosophy**

3. Creativity is the essence of industrial and societal development and panacea of success in a world driven by technology.

## **Concept of Innovation at NUTECH**

4. NUTECH will act as hub of excellence in innovation, creativity and technopreneurship through world-class research, science, arts, skills and scholarship to develop innovation driven industry and society. NUTECH will strengthen innovation and entrepreneurial community, innovation infrastructure, initiate innovative programs, innovative partnerships and imbed innovation culture and ecosystem from skills-to undergraduate-to graduate and Post doc researchers. NUTECH will develop and strengthen the innovation and entrepreneurial community, innovation infrastructure, initiate innovative programs, innovative partnership for the realization of wish into product development and commercialization through the stages of innovation and entrepreneurship (I&E). NUTECH will facilitate students, faculty and researchers to execute innovative projects in various stages mentioned below:-

- a. **Stage-I:** Learning about „Ideas & Exploration“, to be called NUTECH-Idea Exploration (NIE)
- b. **Stage-II:** Launching an idea, to be called as NUTECH Idea Launch (NIL)
- c. **Stage-III:** Conversion into product, to be called NUTECH Innovative Product (NIP)
- d. **Stage-IV:** Product Commercialization, to be called NUTECH Innovation Commercialization (NIC)

5. **Goals of NUTECH for Innovation.** NUTECH will act as a catalyst for innovation community and provide innovation infrastructure that will facilitate innovation process from wish to product commercialization with following goals:-

- a. Bridging the linkages between students groups, programs, NUTL and NIC dedicated to innovation and entrepreneurship.
- b. Provide support to successful innovation and entrepreneurship programs and their access to more students, national and international partners.
- c. Identifying growth opportunities through the creation of innovative educational programs, research efforts and physical infrastructure.

6. **NUTECH Innovation Initiative (NII).** Following initiatives will be taken by the university to foster innovations:-

- a. Innovation incubation program
- b. Community innovators lab program for freshmen
- c. Innovation entrepreneurship forum
- d. Innovation Challenge Program
- e. Innovation Entrepreneurship Program
- f. Innovation Startup Labs Program
- g. Corporate Innovation Program

- h. Innovative energy society program
- i. Innovative robotics society program
- j. Innovative design initiative program
- k. Innovation for society challenge program

7. **Learning Opportunities for Innovation.** NUTECH will create learning and mentoring opportunities to students and faculty, crucial for various innovation challenges. NUTECH will arrange classes for guided study in order to prepare students, faculty and researchers for innovations. Learning will focus on following main themes of innovation:-

- a. **Engineering Innovation.** It will entail conversion of „Wish“ into product commercialization. The classes will be on design for future technology applications in industry in order to bring innovations to the market.
- b. **Venture Engineering.** An integrated approach to the development and growth of new innovative ventures.
- c. **Innovation Ecosystems for Entrepreneurship Leaders.** The concept is of inclusive innovation through a research-based but action-oriented understanding of how to accelerate innovation-driven entrepreneurship and build vibrant and inclusive industry systems.
- d. Academic programs, trainings, courses, subjects and workshops on Innovation &

8. **NUTECH Strategies for Innovation.** Following strategies will be adopted by NUTECH for the advancement of innovation culture:-

- a. **Forum for Innovation Themes.** NUTECH will seek Open-ended innovation themes and arrange workshops for innovators to participate and develop products in special organized workshops. NUTECH will pursue disruptive innovations “imagine the impossible” and mission to deliver “breakthrough solutions”.
- b. **Heterogeneous Participants.** NUTECH will engage a wide range of participants, industries, innovative professionals (a diverse disciplines and multidisciplinary areas) for the development of innovate challenging products.
- c. **Diverse Collaborations.** NUTECH shall particularly focus on collaborations with industry, innovative academia, innovative students and innovative researchers through various forums for the realization of wish-to-product development.
- d. **Discovering the Future.** NUTECH will act as vehicle for “discovering the future” and aim to “innovate to ensure development of innovative products. The concept is to create space for blue-sky thinking and activities for innovations.

- e. **Stimulate Creativity.** NUTECH will apply a wide range of methods and tools to stimulate creativity, guide innovative discussions, innovative based collaborations to bring together the brains, methodology, and diverse tools for innovation.
- f. **Focus on Experimentation.** NUTECH will encourage participants to “try things out on a small scale, take risks, prototype, test and accept failure as part of progress”, re-inventing their own methods and approaches as they go along.

### **NUTECH Innovation Center (NIC)**

9. Keeping in view the university vision and translation of NUTECH Innovation philosophy concept, intended innovation goals, innovation initiatives, learning opportunities for innovation and strategies for innovation into reality will be done by establishing NUTECH Innovation Center (NIC) at the university under the Office of Dean of Research (DoR).

10. **Mission of NIC.** Conversion of Science into Art for the development of industry and society.

11. **Objectives of NIC.** Following are the objectives of NIC and will be implemented by the DoR office:-

- a. Promotion of innovation, creativity and intellectual investment in science and technology, to achieve development of wide range of useful products for the Society.
- b. Creation of conducive echo-system to foster interdisciplinary problem solving ability for successful interdisciplinary novel projects, execution for Industry and Society.
- c. Nurture culture of innovation to excite young minds about innovations and channelize youth to make innovative inventions.
- d. To enable NUTECH researchers achieve success through innovation on the face technological challenges for sustainable economy and society.

12. **Guiding Principles to Achieve Mission and Objectives.** NUTECH intellectual, academic, research and industrial resources shall be made in-sync with NIC and all activities executed according to the following guiding principles:-

- a. Innovators shall be elite stakeholders of Industry 4.0 (NuInnovation 4.0).
- b. Development of national and international partnerships in Innovation.
- c. Development of innovative human resource (HR) for advancement of creativity in industry and society.
- d. Innovation pursuits for transformation of industry into innovation enterprise by following best international practices.
- e. Innovation driven research initiatives to develop novel technologies and align with the needs of national industry in particular and international industry in general.

- f. Alignment of innovation initiatives with **Key Enabling Technologies** (advanced material, Micro-and Nano-electronics, Nanotechnology, photonics, industrial biotechnology, advanced manufacturing etc.) and **Disruptive Technologies** (artificial intelligence, Internet of Things, space colonisation, 3D printing, medical innovations, high-speed travel, robotics, blockchain technology, autonomous vehicles, advanced virtual reality, renewable energy etc.)
  - g. Development of comprehensive system of regular audit, review, up-gradation and improvement of innovative learning, novel teaching methods, technology research labs and all related tiers of knowledge.
  - h. Development of patent writing and submission methodology to intellectual property organization (IPO), Pakistan (submitted patents shall be pursued actively until final approval by IPO on fast track basis).
  - i. Establishment of Innovation Hobby Shops (IHS) of each department with strong intellectual links with NUTL and technology research groups (TRGs) of NUTECH. All IHS shall be an integral part of NIC.
  - j. Implementation responsibility will be with Dean of Research office.
13. **Stakeholders in NIC.** Following are the stakeholders: -
- a. **Internal Stakeholders.** All offices and departments of academics, research, skills, industrialization, commercialization, quality assurance and administration/management at NUTECH.
  - b. **National Stakeholders.** Ministry of Science and Technology (MoST) and allied setups, universities, national research centres, national industry and labs, national R&D organizations, defence industry, defence forces, health care setups, Ministry of Industry and Production (MoIP) and allied setups, Ministry of Commerce and Trade (MoCT) and allied setups, Ministry of Planning, Development and Reforms, public and private sectors organizations, Ministry of defence production and allied organizations, Ministry of Education & Professional Training and allied organizations, Ministry of Information Technology (MoIT) and allied setups.
  - c. **International Stakeholders.** International universities, scientific R&D labs, multi-national companies and industry.

#### **Advancement of Innovation & NIC at NUTECH**

14. To ensure development of well thought out plans, policies, procedures, design systems, processes and support infrastructure including intellectual, academic, material and financial resources, it is most important to develop and strengthen the Office of Dean of Research (DoR) at NUTECH in the context of innovation and NIC. DoR Office shall be responsible for the

advancement of innovation and NIC in terms of NUTECH Vision and Mission on long-term sustainable basis through continuous endeavors in all pursuits of innovation excellence.

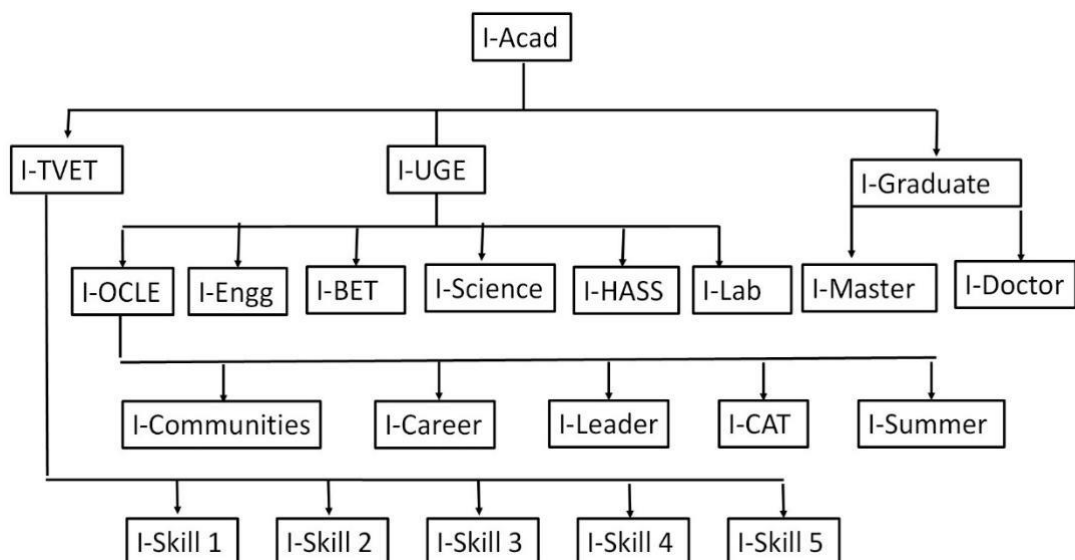
**INNOVATION STRATEGY AT NIC**

15. **General Strategy.** At NUTECH in general and NIC in particular, innovation advancement shall be considered as strategic goal to materialize NUTECH vision and mission in future. In order to develop comprehensive implantation plan for the development of NIC the strategic contours of innovation will be embedded in the academics, skills, research, industrial products development, internationalization and commercialization processes at the university. The contours of innovation strategy for successful design, development and progression of NIC entail creation of innovation based systems and intellectual support structure at respective academic units, technology labs, skills training facilities, research centers etc. The innovation dominating system and structures are briefly explained separately based on the broad contours, detailed policies and procedures will be developed at NIC to create an innovation eco-system at NUTECH in future.

**Strategic Contours of NIC Systems**

16. **Innovation in Academics (I-Acad).** Innovation based Academics at NUTECH will be called as I-Acad. In contrast to the general believe innovation has to do with the use of technology or new inventions innovation in academics at NUTECH will be creativity and described as doing things in a new way. I-Acad will do doing something differently, which will require coming up with an approach, process, product or strategy. I-Acad will encourage teachers and students to explore, research and use all the tools to uncover something new. It will involve a different way of looking at problems and solving them. The accompanying thinking process that goes into it will help students develop their creativity and their problem solving skills. Comprehensive I-Acad programs, trainings, mentoring, competitions and projects will be embedded in all academic programs at NUTECH. The design of I-Acad Strategy is shown in figure-1.

**FIGURE-1: DESIGN OF I-Acad STRATEGY**



17. **I-Acad Based I-TVET.** The strategy will entail all technical and professional skills education at NUTECH duly blended with innovation during all activities of teaching, learning and assessments. In this context, the rapid advancements of technology and their possible positive impact on the socio-economic development of our nation will be supported by world-class TVET system of our nation. Technological advancements will be translated into technological skills development for rapid global industrial development. NUTECH will develop and implement its own innovative TVET model and prepare youth to meet challenges of high-end technological skills in the national and international industry through innovation. To institutionalize its efforts, NUTECH will develop a comprehensive innovative system of TVET monitoring, assessment, regulation and control in pursuit of excellence in skills education.

- a. **Classrooms.** Innovation culture will be induced in the form of Hands-on, Minds-on and Hearts-on“ learning, Personal education plans and log-books for students, competency based curriculum - ICT, technical and specialised mechanical skills, project planning and design, language skills and intercultural awareness, enterprise education pilots and business and enterprise specialist schools etc.
- b. **Institutions.** Innovation culture will be induced in the form of project based learning in technology rich environments, use of collaborative and interactive teaching, Production Schools - based around one or more „workshops“ producing either goods or services etc.
- c. **Networks.** Innovation aspects will be introduced in the form of extensive collaborations with other departments and schools etc.
- d. **Systems.** Innovation aspects will be introduced with the implementation of new teaching and learning practices, supported by changes in progression routes (learning pathways), governance structures, accountability and performance frameworks etc.

18. **TVET Competence Levels.** Following are the five levels of skills, which will be translated into innovation-based in future:-

- a. **I-Skill 1.** Elementary level for unskilled workers
- b. **I-Skill 2.** Basic level for semi-skilled workers
- c. **I-Skill 3.** Advance level for skilled workers
- d. **I-Skill 4.** Semi expert level for highly skilled workers
- e. **I-Skill 5.** Expert / supervisor level

19. **Skills Types.** Following are the types of skills, which will be considered for introducing innovation:-

- a. Conventional skills
- b. Industrial skills



- c. Hi-tech skills
- d. Innovative skills
- e. Soft skills
- f. Professional skills

20. **I-Acad Based I = UGE**. The strategy will entail all types and categories of undergraduate education at NUTECH duly blended with „Innovation“ during all activities of teaching, learning and assessments. In this context, the rapid advancements of technology and their possible positive impact on the socio-economic development of our nation will be supported by world-class undergraduate system of education at NUTECH. Technology driven innovations will be translated into advancements including innovative projects and product developments. NUTECH will develop and implement its own innovation advancement model for all tiers of undergraduate education and prepare youth to meet challenges of technological advancements needed in the industry through innovation. To institutionalize its efforts, NUTECH will develop a comprehensive innovative system of undergraduate education monitoring, assessment, regulation and control in pursuit of excellence in undergraduate education.

- a. **I-Acad Based I-Engg**. I-Engg implies innovations, promotion and advancement in all tiers and levels of undergraduate engineering education at NUTECH.
- b. **I-Acad Based I-BET**. I-BET implies innovations, promotion and advancements in all tiers and levels of undergraduate engineering technology education at NUTECH.
- c. **I-Acad Based I-Science**. I-Science implies innovations, promotion and advancements in all tiers and levels of undergraduate science education at NUTECH.
- d. **I-Acad Based I-HASS**. I-HASS implies innovations, promotion and advancements in all tiers and levels of undergraduate education in humanities, arts and social sciences at NUTECH.
- e. **I-Acad Based I-Lab**. I-Lab implies innovations, promotion and advancement in all types of lab based teaching, learning and assessment activities at the teaching and technology labs during the academic learning pursuits at NUTECH.
- f. **I-Acad Based I-OCLE**. I-OCLE implies innovations, promotion and advancements in all types and shades of Outside Classroom Learning Education in terms of teaching, learning and assessment activities at NUTECH.

21. **I-OCLE Based UGE**. Following are the types and shades of outside classroom education at NUTECH duly blended with innovation during all activities of teaching, learning and assessments:-

- a. **I-OCLE Based I-Communities**. I-Communities implies innovations, promotion and advancement in all the teaching, learning and assessment activities as part of

multi-discipline any communities program for undergraduates in the freshman year at the university.

- b. **I-OCLE Based I-Career**. I-Career implies innovations, promotion and advancement in all the teaching, learning and assessment activities as part of multi-discipline any career acceleration program for undergraduates in the freshman year at the university.
- c. **I-OCLE Based I-Leader**. I-Leader implies innovations, promotion and advancement in all the teaching, learning and assessment activities as part of multi-discipline any industrial leadership program for undergraduates in the junior year at the university.
- d. **I-OCLE Based I-ICAT**. I-ICAT implies innovations, promotion and advancements in all the industry projects, creative projects and social service projects during industrial and Creative Activity Term (ICAT) program at NUTECH.
- e. **I-OCLE Based I-Summer**. I-Summer implies innovations, promotion and advancements in all the industry projects, application of technology for industry and society projects and creative activities based projects during the 8-week summer term for students of sophomore, junior and senior year at NUTECH.

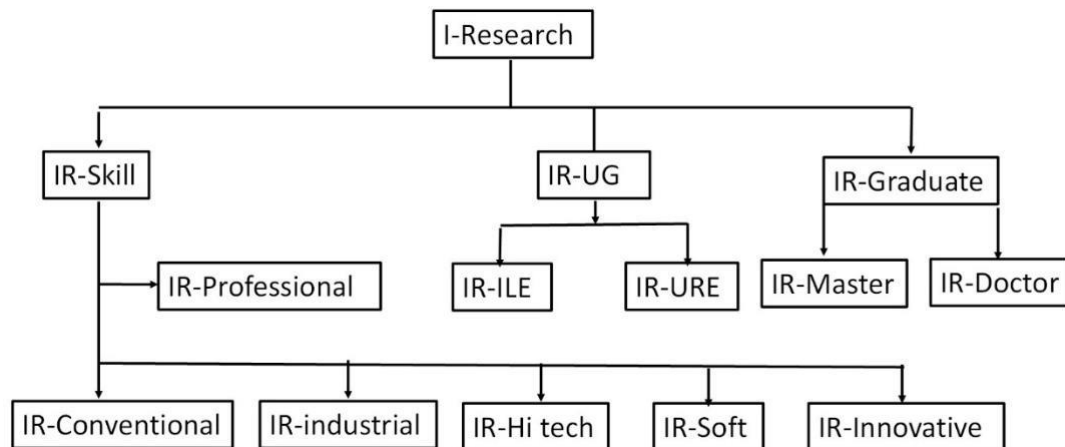
22. **I-Acad Based I - Graduate**. The strategy will entail all technical and professional skills education at NUTECH duly blended with innovation during all activities of teaching, learning and assessments. In this context, the rapid advancements of technology and their possible positive impact on the socio-economic development of our nation will be supported by world-class innovative graduate program. To institutionalize its efforts, NUTECH will develop a comprehensive innovative system of graduate training, research, monitoring, assessment, regulation and control in pursuit of excellence.

- a. **I-Acad Based I- Master**. I-Master implies innovations, promotion and advancement in all the teaching, learning and assessment activities as part of inter-disciplinary programs at graduate level research at the university.
- b. **I-Acad Based I- Doctor**. I-Doctor implies innovations, promotion and advancement in all the teaching, learning and assessment activities as part of inter-disciplinary programs at doctorate level research at the university.

23. **Innovation in Research (I-Research)**. Innovation based research at NUTECH will be called as I-Research. I-Research will encourage teachers and students to explore, research and use all the tools to uncover something new. It will involve a different way of looking at problems and solving them. The accompanying thinking process that goes into it will help researchers to develop their creativity and their problem solving capability. Comprehensive I-Research programs,

trainings, mentoring, competitions and research projects will be embedded in all academic programs at NUTECH. The design of I-Research Strategy is shown in figure-2.

**FIGURE 2: DESIGN OF I-RESEARCH STRATEGY**



24. **I-Research Based IR Skills.** The strategy will entail all research activities at NUTECH are duly blended with innovation during teaching, learning and assessments process. In this context, the rapid advancements of technology and their possible positive impact on the socio-economic development of our nation will be supported by world-class innovative research. NUTECH will develop and implement its own innovative research model and prepare youth to meet challenges of national and international industry through innovation. To institutionalize its efforts, NUTECH will develop a comprehensive innovative system of research, monitoring, assessment, regulation and control in pursuit of excellence.

25. **IR Skill Competence Levels.** Following are the six levels of IR Skills competence levels:-

- a. **IR-Conventional.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research conducted particularly focusing on conventional skills at NUTECH.
- b. **IR-Industrial.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research conducted particularly focusing on industrial skills at NUTECH.
- c. **IR-Hi-tech.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research conducted particularly focusing on Hi-tech skills at NUTECH.
- d. **IR-Soft.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research conducted particularly focusing on soft skills at NUTECH.

- e. **IR-Innovation**. It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research particularly focusing on innovation skills at NUTECH.
- f. **IR-Professional**. It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research particularly focusing professional skills at NUTECH.

26. **I-Research Based IR - UG**. The strategy will entail all research activities at NUTECH are duly blended with innovation during teaching, learning and assessments process. In this context, the rapid advancements of technology and their possible positive impact on the socio-economic development of our nation will be supported by world-class innovative research at undergraduate level. NUTECH will develop and implement its own innovative research model and prepare youth to meet challenges of national and international industry through innovation. To institutionalize its efforts, NUTECH will develop a comprehensive innovative system of research at undergraduate and its monitoring, assessment, regulation and control in pursuit of excellence.

- a. **IR-UG Based IR-ILE**. It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research during industrial learning experience at NUTECH.
- b. **IR-UG Based IR-URE**. It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research activities performed during undergraduate research experience at NUTECH.

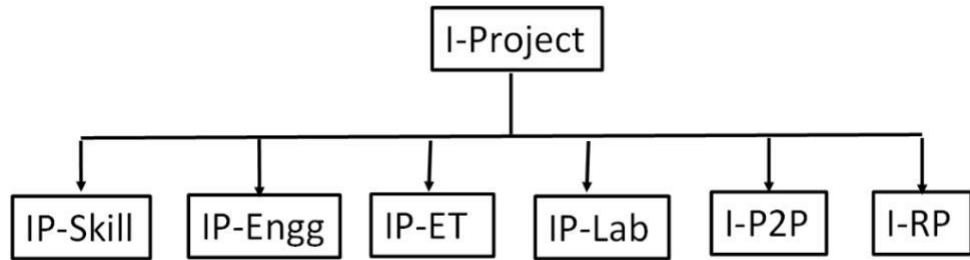
27. **I-Research Based IR - Graduate**. The strategy will entail all research activities at NUTECH are duly blended with innovation during teaching, learning and assessments process. NUTECH will develop and implement its own innovative research model and prepare youth to meet challenges of national and international industry through innovation. To institutionalize its efforts, NUTECH will develop a comprehensive innovative system and ensure practicing of advance concepts of graduate studies in graduate research.

- a. **IR-Graduate Based IR-Master**. It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research conducted at graduate level and practicing of advance concepts at NUTECH.
- b. **IR-Graduate Based IR-Doctor**. It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative research conducted at doctorate level and practicing of advance concepts at NUTECH.

28. **Innovation in Project (I- Project)**. The strategy will entail all research activities at

NUTECH are duly blended with innovation during project executions. NUTECH will develop and implement its own innovative research project model and prepare youth to meet challenges of national and international industry through innovation. The design of I-Project Strategy is shown in figure-3.

**FIGURE 3: DESIGN OF I-PROJECT STRATEGY**



29. **I-Project Competence Levels.** Following are the six levels of I-Project competence levels:-

- a. **IP-Skill.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative projects conducted at skill levels at NUTECH.
- b. **IP-Engg.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative projects conducted at bachelor of engineering levels at NUTECH.
- c. **IP-ET.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative projects of bachelor engineering technology at NUTECH.
- d. **IP-Lab.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovative lab based projects at NUTECH.
- e. **I-P2P.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovation from project-to-product at NUTECH.
- f. **I-RP.** It implies innovations, promotion and advancement in all tiers during teaching, learning and assessment activities as part of multi-disciplinary innovation in Lab based research projects at NUTECH.

### **Innovation as Part of SCI System**

30. Innovation in Student Competence Index (SCI) is critical and shall be part of evaluation in terms of following:-

- a. Innovation in industry projects completed by the students.

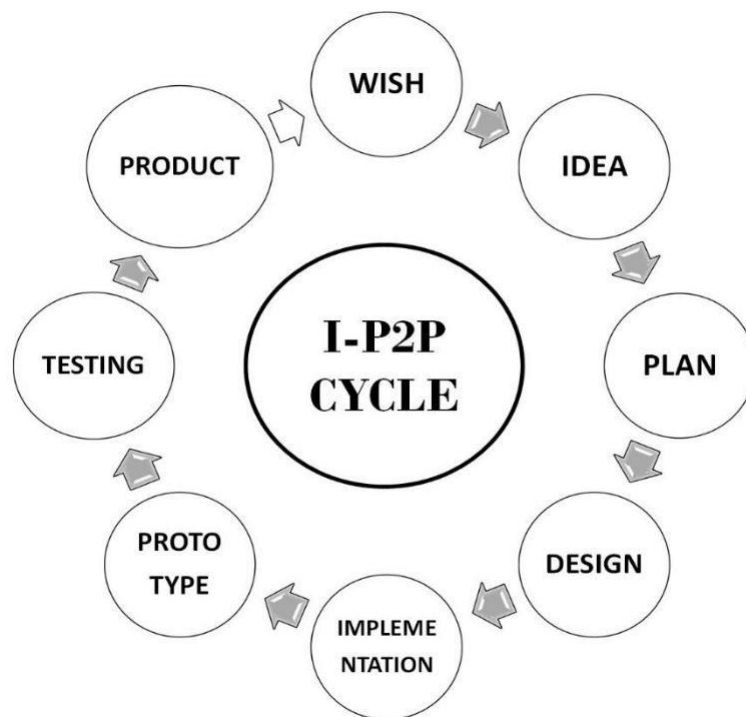
- b. Contribution in terms of innovation in creative society's participation.
- c. Innovation in technology service for society.
- d. Innovation in learning and advancement of sports and athletics environment.

**Innovation Based Project-to-Product Development System (I-P2P)**

31. A comprehensive framework will be devised by Dean of Research office through the assistance of academic departments of NUTECH, which will develop project to product strategy that will continuously facilitate the development and adjustment of the project capabilities over the journey from idea to commercialization. The P2P Framework (P2PF) shall focus on following (as shown in figure 4 below):-

- a. Innovations at university-level strategies and capabilities.
- b. Innovation in internal system characteristics and external contingencies.
- c. Innovation in P2P-level resources and capabilities.
- d. Innovations in key P2P success factors.
- e. Innovation in expectations to P2P value deliverables.

**FIGURE 4: I-P2P PRODUCT CYCLE**



**I-P2P Cycle**

32. The I-P2P cycle as shown in figure-4 involves following:-

- a. **Wish.** Students, faculty and industry.
- b. **Idea.** Students, faculty and industry.
- c. **Plan.** Students, faculty and industry.
- d. **Design.** Students, faculty and researchers.
- e. **Implementation Strategy.** Department and DoR.
- f. **Prototype Development.** DoR and NUTL.

- g. **Testing, Validation and Optimization.** DoR and NORIIC.
- h. **Product Commercialization.** NORIIC.

## **INITIAL IMPLEMENTATION PLAN**

### **Phases of NIC Plan**

33. The NUTECH innovation centre (NIC) will be implemented in following three phases:-
- a. **Initial phase.** Establishment of NIC in present form utilizing existing resources.
  - b. **Intermittent phase.** Expansion of NIC when NUTECH advanced research Labs are functional and Technology Research Groups (TRGs) start working in complete cohesion with industries.
  - c. **Advanced phase.** Expansion of NIC to advanced level when doctorate and post doctorate researchers undertakes executes projects in technology Labs at NUTECH and Composite Technology Research Groups (CTRGs) start working in complete cohesion with industries.

### **NUTECH as a University for Industry**

34. NUTECH as a university for industry, has taken its first steps towards venturing in the field of productive research and development. The aim is to enable the local industry, to produce much needed technology-based products, by developing total understanding of underlying technologies. NuVent, Pakistan's first ICU grade medical mechanical ventilator and NuPrint, which was conceptualised from an ICAT 2020 term student project, are such examples. These projects and others which are in inception phase are however needed to be channelised, by dedicating resources and by structuring them under a candid and practical framework. The many phases of product development like design, developing of lab, industrial and production prototypes require test instruments, fabrication facilities and most of all dedicated human resource. In the long run, NUTECH has envisioned the establishment of innovations lab which will be well equipped to cater for technical needs. The allocation of dedicated HR for such initiatives is also underway.

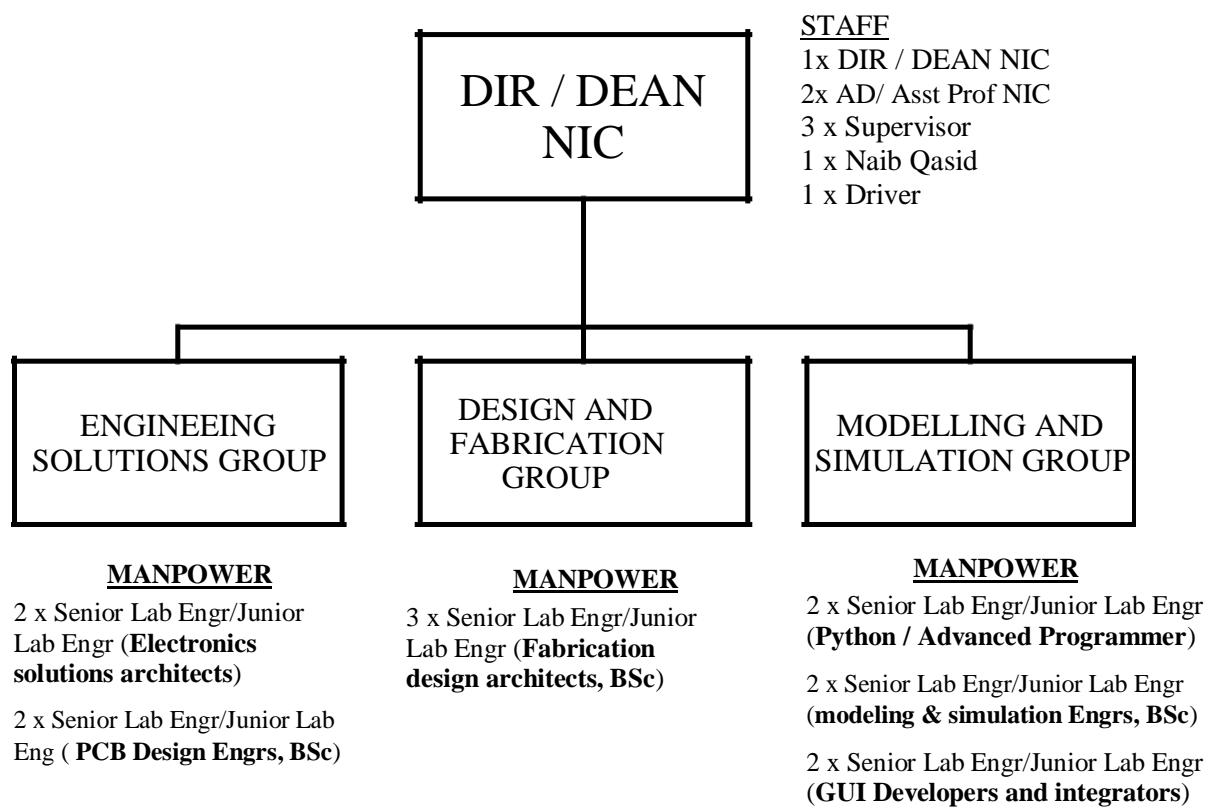
### **Salient of Initial NIC Plan**

35. Design and fabrication from the perspective of producing technology-based products, which have a market, and which can be produced locally is quite different from how research is traditionally viewed in academia. Industry in Pakistan is shy of adopting new technologies, due to cost effects and low short-term dividends. Less some isolated examples, industry harbouring advanced technologies are mainly confined to the military sector. In the backdrop of the current situation, where the nation is trying hard to come out of the dogma of huge trade deficit, fast track solutions which can compete in technological compliance and quality are direly needed. To achieve this an agile, skillful, efficient and dedicated outfit is needed. The skills desired from HR, in this case, are quite different from what is normally required from the perspective of formal educational and academic research skills. Skillful, dedicated staff, which is hired purely on competence level

and the ability to deliver, are ideal for such setup. They as a consequence will have to be paid for their acquired skills and deliverance of work of exceptional quality.

**Initial Scope**

36. NIC due to its task has to be divided into groups. Each section will be aware of the overall heading and requirements of the project in hand and will dedicate itself to the portion of the project(s) in progress. However, they will be quite resilient and immune to the hassle of loss of a group member or lack of immediate availability of resources. In projects, which are to be completed on a defined timeline, this is a basic requirement. In the local technical community where long-term research and development is seldom an option, failure, is seen as a stigma rather than a normal occurrence in the overall due process of product development. This, however, increases the HR and equipment requirement. The proposed basic structure of NIC, in light of afore, is tabulated below.



**ORGANIZATIONAL CHART AND MANPOWER NIC**

**Responsibilities**

37. The proposed tabulated manpower will be able to handle 2-3 innovative projects every six months depending upon the complexity and magnitude. Director NCII will be overall responsible to complete projects in time and must have technical skills and acumen to provide candid and lucid guidelines to every team member. He / She is a cosmopolitan engineer who is resourceful and must have delivered at least two national level projects. Foreign industrial experience is an added attribute, which is desired but not imperative. AD NIC is a non-technical post which will keep track of coordination with NORIIC, accreditation authorities, prepare Gantt charts for project timelines, keep a track of financial aspects and will carry out internal financial audit as well.



### **Administrative Structure within NUTECH**

38. NIC will operate under direct administrative control of the DoU. NIC will assist DoR office in filing of patents, preparing documentation for grant of funding and any other documentation. Preparing of technical documentation for testing and all documentation required by technical audit authorities will be prepared by NIC engineers. A record of completed technical documentation will be kept in DoU office and NORIIC office.

### **ICAT Term**

39. Planning and execution of ICAT term is the responsibility of respective departments as per procedure in practice. Financial support, technical resource allocation and identification of local trade and artisans, to help students complete their projects, will be managed by NIC. Innovations lab will be used to carry out design, fabrication and testing work. Wherever needed students will be given due support in fabrication of PCBs, CAD design and 3D printing. NIC staff will present their projects to students to inspire them to take on innovative ideas and to turn them into products. This will make ICAT term more productive and will let students understand different phases of product development. NIC is an incubation centre where students will always be welcome to share their ideas and to make or repair things. Students can think of different projects all year long, discuss with NIC staff and carry out fabrication work during the ICAT term. Funds for ICAT will be released out of R&D fund. Dir NIC will be responsible for disbursement of funds, collection of bills and further submission to treasurer's office.

### **Contributions of Faculty**

40. NUTECH cherishes a very able faculty having profound industrial experience. Faculty will be encouraged to bring project proposals, along with their commitment in academic programs. NIC will then initiate formal process so as to make the faculty member comfortable administratively and technically. Such projects will be executed under the umbrella of NIC. NIC will get requisite approval, allocate funds, technical resources and will also render technical advice, as needed. NIC will be responsible for coordinating with testing / regulatory authorities and will also provide blueprints for related paperwork. NIC assist faculty in their projects and remove any hurdles, as they progress.

### **Hiring of HR**

41. Due to nature of the mandate, hiring for NIC, will be skill based and criterion will be decided by Director NIC. Experience is not a pre-requisite and so is formal educational qualification.

### **R&D Funds**

42. Due to fast pace of innovations and development work and latency in public procurement processes a separate R&D fund is recommended to be created. The fund will be used to procure parts and services for ongoing projects. Monies from this account can only be drawn after due

approval of competent authority. NIC will keep record of all receipts and expenses and will be required to submit bills, as needed by treasurer's office, in a maximum of six months after the disbursement of cash on need basis. NIC is recommended to be an integral part of NUTECH. The staff for the lab will be sanctioned once the full scope of equipment and manpower needed, is realized. However, on much needed basis a sanction of *Rs 10.0 million is requested to jump-start NIC*.

### **NIC Asset Management**

43. All equipment and parts procured will remain property of NUTECH and be on the charge stock of NUTL office. This way money expended on tools and test equipment will not go to waste and will contribute towards making relevant technology labs. For example, after completion of NuVent and medical portable X-ray machine, NUTECH will have sufficient test equipment for the establishment of an electromedical lab where testing of medical ventilation systems and small sized medical imaging systems will take place. NUTECH can become the first university to train much needed electromedical technicians for the local medical industry and award a diploma / short course under NSDD.

### **Initial Implementation Plan**

44. Following critical areas have been identified for the implementation plan of NIC:-

- a. **Engagement of Industry**. Initially, most progressive and dynamic firms will be engaged to solve their critical industrial problems and sponsor fully funded projects. The firms will be engaged by NORIIC.
- b. **Tapping of Innovative Brains**. Undergraduate students to start their academic career with innovative approach right from the start. NUTECH has devised test methods (intelligence test, videos and models, etc.) to tap innovative brains in order to explore their potential for innovation. Candidates with innovative ideas, concepts will be given opportunity to complete their dream projects.
- c. **Innovation Hobby Shops (IHS)**. Selected students will work in their respective departmental innovation hobby shops with the objective to complete their novel project by utilizing all resources available in hobby shop, teaching labs and research labs of NUTECH.
- d. **System of Specialized Training**. NUTECH students (undergraduate level) will be required to study specific subjects particularly designed for the training of innovators, transformation of minds to produce novel products, innovate approach to solve problems, and creation of innovation in skills. These interdisciplinary subjects are critical for engineers and scientists to understand complexities of novel product development. These interdisciplinary subjects have been included in undergraduate programs as per following details:-

(1) **Learning Communities Program**

- (a) Human 2.0
- (b) City Science
- (c) Scalable Civic Action
- (d) Development Ventures
- (e) Revolutionary Ventures
- (f) Principles of Awareness
- (g) Learning Creative Learning
- (h) Projects in Creative Learning
- (i) News and Participatory Media
- (j) Research in Media Technology
- (k) How to Make (Almost) Anything
- (l) Teaching in Media Arts and Sciences
- (m) Independent Study in Media Arts and Sciences
- (n) AI for Impact: Solving Societal-Scale Problems
- (o) Practical Experience in Media Arts and Sciences
- (p) Independent Study in Media Arts and Sciences
- (q) Undergraduate Research in Media Arts and Sciences
- (r) Understanding and Designing Affordable Health Diagnostics
- (s) Designing and Deploying Affordable Health Diagnostics and Therapeutics
- (t) Rapid-Prototyping of Rapid-Prototyping Machines: How to Make Something that Makes (Almost) Anything

(2) **Industry Career Acceleration Program**

- (a) Mastering Innovation & Design-Thinking
- (b) Computational Camera and Photography
- (c) Mathematical Methods in Imaging
- (d) Mobile and Sensor Computing
- (e) Neurotechnology in Action
- (f) Principles of Neuroengineering
- (g) Mathematical Methods in Imaging
- (h) Computational Camera and Photography
- (i) Imaging Ventures: Cameras, Displays, and Visual Computing
- (j) Advanced Seminar: Affective Computing and Ethics
- (k) Organizations, Innovation, and Technology: Putting Ideas to Work
- (l) Digital Transformation, Value Creation, and Breakthrough Innovation

(3) **Technology Leadership Program**

Organizations across all industries are rapidly exploring and adopting digital technologies to adapt and remain competitive. Traditional business models and processes are being redefined by the application of transformational digital technologies in managing or driving disruption. Exponential technologies such as Artificial Intelligence, Machine Learning, Augmented Reality, Blockchain and Data Analytics etc. are changing the constraints on business growth for organizations. This is creating a new set of challenges and opportunities for global leaders.

- (a) Tangible Interfaces
- (b) Leadership & Innovation
- (c) Asking How Space Enabled Designs Advance Justice and Development
- (d) Space Technology for the Development Leader
- (e) Revolutionary Ventures: How to Invent and Deploy Transformative Technologies
- (f) Independent Study in Media Arts and Sciences
- (g) Culture Awareness for Global Business
- (h) AI Strategies and Roadmap: Systems Engineering Approach to AI Development and Deployment
- (i) Machine Learning: From Data to Decisions
- (j) Inclusive Innovation: Designing for a Better World
- (k) Organizations, Innovation, and Technology: Putting Ideas to Work
- (l) Engineering Leadership for Emerging Leaders

(4) **Technology Research Experience Program**

- (a) Design-Driven Innovation
- (b) Human-Robot Interaction
- (c) The Invention Process: Invention in the Context of Innovation
- (d) Autism Theory and Technology
- (e) Project Realization in Cleanroom
- (f) Microfabricated Devices
- (g) Introduction to Microfabrication
- (h) Sensor Technologies for Interactive Environments
- (i) Evolution: Natural and Directed
- (j) The Physics of Information Technology
- (k) The Nature of Mathematical Modeling

- (l) Principles of Neuroengineering
- (m) Understanding & Predicting Technological Innovation: New Data and Theory

e. **NIC Research Groups (DTRGs & CTRGs)**. NUTECH Departmental Technology Research Groups (DTRGs) and Composite Technology Research Groups (CTRGs) will carry out interdisciplinary research and focus on innovations in all projects. Interdisciplinary research teams working in DTRGs and CTRGs will be integral part of NIC. Some of the multi-disciplinary research areas are enumerated below:-

- (1) Photonics
- (2) CT Science
- (3) Foot prosthesis
- (4) Agonist-antagonist
- (5) Effecting computing
- (6) Bio-mechatronics
- (7) Camera culture
- (8) Conformable decoders
- (9) Human dynamics
- (10) Life-long kindergarten
- (11) Molecular machines
- (12) Nano-cybernetic
- (13) Personal robots
- (14) Responsive environment
- (15) Sculpting evolution
- (16) Signal kinetics
- (17) Social machines
- (18) Space enabled
- (19) Tangible media
- (20) Viral communication
- (21) Signal & image processing
- (22) Intelligent dynamic communications
- (23) Ultrasonic engineering
- (24) Continuous manufacturing and crystallization
- (25) Microsystems and photonics

f. **NIC Focused Labs**. NIC will work with all five undergraduate departments (*Electrical engineering, Mechanical engineering, Civil engineering, Computer engineering, Computer Sciences*) and Focused Labs of NUTECH. Research teams working in these Labs

will be integral part of NIC to foster innovation culture. NUTECH undergraduates to serve as leaders in innovation, economy, skills, and confidence to develop and deliver breakthrough solutions to real-world problems. Research teams will be given opportunities for extensive collaborations with global research institutes thus enabling them to build expertise in the innovation process and exposure of evidence-based science of innovation. *NIC focused Labs* (to be developed in NUTECH in future) are as under:-

- (1) Biotechnology Lab
- (2) Nanotechnology Lab
- (3) Artificial intelligence Lab
- (4) Electro-Optical Systems Lab
- (5) Advanced manufacturing Lab
- (6) Modelling and simulation Lab
- (7) Micro- and nano-electronics Lab
- (8) Information and communications Lab
- (9) Sensors, photonics and electromagnetic applications Lab
- (10) Cyber Technology and Information Systems Lab

g. **NORIIC**. NORIIC to get projects of innovative nature from all stakeholders (internal, national and international). All these innovative projects have to be fully funded by either private industry or public sector department or directly funded by government. Funds are required to be utilized in the development of Labs, equipment for DTRGs and CTRGs, development of materials, systems, test rigs etc. The functions, responsibilities of NORIIC have already been approved in BOG, however, following functions are critical after development of product:-

- (1) **Patents**. The successful lab level project / product has to be patented before commercialization. NORIIC to ensure patenting of a product within six months after successful submission of patent documents. NUTECH will dedicate sufficient funds for the patenting of products.
- (2) **Commercialization and Internalization of Product**. NORIIC will initiate commercialization, Internationalization and transfer of technology of product according to NUTECH Standard Operating Procedure (SOP).

### **Summary**

45. After due approvals NIC will become the face of technical innovations for NUTECH. This tenacious group of committed and capable engineers, faculty and experts will try hard to break the shell of uncertainty and make a difference. NIC will enable NUTECH receive big dividends in the longer run through the creation, development and promotion of innovative emerging technologies in future.