Technology Management in Higher Education

Manual for Offices of Research and Technology Commercialization

TTOs/ORICs

by

South Asia Triple Helix Association (SATHA)

Rahmat Ullah

Dr Mir Dost

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Summary

The Higher Education Commission (HEC) has taken a great initiative to establish technology offices, also known as the Office of Research, Innovation and Commercialization (ORIC) in Pakistan. The HEC is gradually strengthening ORICs through financial and management empowerment. These offices are operating as the central point of activities to initiate and submit research grants. In the return, the ORICs receive 15% of each grant for training, foreign exposure visits but a lot more is needed to strengthen them for playing due role in technology management and transfer. In this context, the purpose of this operational manual is to develop and store materials for ORICs that facilitates them to run research, innovation and commercialization operations.

Prior studies suggest that Pakistan ranks among the countries which top in terms of strengths and basic resources like population, geography, mineral resources and others. On the other hand, Pakistan ranks among the countries in terms of least development indices and human life index. It arguably indicates the weaknesses in the optimization of available human capital and financial resources that could potentially impact a welfare society and help to prosper the country in the bigger spectrum through innovation in science and technology. Globally, countries have been thriving through proper utilization of their resources, brought significant prosperity in their economy and facilitated their people.

It is firmly believed that ORICs in higher education are instruments for quality research, innovation and commercialization. Authors believe that this manual provides details of various bottlenecks, operational issues, practical challenges and possible interventions to promote problem solving research in higher education of Pakistan.

Acknowledgement

The operational manual is the result of extensive ten-year interaction of the lead author with academia and industry. The working of the last ten years includes around 50 workshops on technology development, policies for problem solving research, and innovation enabling environment in more than 100 universities of Pakistan. More than 1000 faculty members, scientists and industry people attended these workshops. They gave valuable inputs on how to manage effectively technology transfer process in Pakistan's universities. The authors are thankful to all these participants for their input.

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List of Abbreviations

Office of Research Innovation and Commercialization	ORIC
Technology Transfer Office	TTO
Intellectual Property	IP
Technology Management	TM
Higher Education Commission	HEC
Fast Moving Consumer Goods	FMCG
Trust Building Measures	TBM
Information Communication Technology	ICT
Research & Development	R&D
Technology Development Fund	TDF
National Research Program for Universities	NRPU
Job Description	JD
Intellectual Property Organization	IPO
Confidentiality Disclosure Agreement	CDA
Annual Confidential Report	ACR
Human Resource	HR
Head of Department	HoD
Terms of References	TORs

Chapter 01

1. Fundamentals of ORICs Management

1.1 Offices of Research Innovation and Commercialization (ORICs)[1]

The Higher Education Commission (HEC) aims to motivate and facilitate the Higher Education Institutions (HEIs) in terms of conducting quality research for a sustainable economic growth and future knowledge economy. For this purpose, ORICs are being established in universities to serve as pivotal points, encompassing all the research activities - from development of research proposal to the commercialization of research products, services, technologies or processes - under a single umbrella.

1.2 Objectives of ORICs

The main objective of ORICs is to develop, expand, enhance and manage the university's research programs and to link their research activities directly to the educational, social and economic priorities of the university and its broader community. Besides this, the ORIC is also responsible for assuring that the quality of research reflects the highest international standards and advances the stature of the university internationally.

In order to ensure such standard, the ORICs will have to bring improvements in the environment for all academic and scholarly research by:

- Supporting the strategic research directions and policies of universities
- Improving integration of research and education at all levels of the institution
- Increasing and diversifying external research funding
- Improving recruitment and retention of the top faculty members
- Translating research for the public's benefits
- Improving and strengthening university-industry linkages
- Promoting entrepreneurship, technology-transfer and commercialization activities which improve and support the economy
- Promoting and improving multi-disciplinary research initiatives

1.3 Role of ORIC

In principle, ORIC facilitates the management of the intellectual assets which mainly stem from faculty research and converts them into mind-blowing technologies giving benefits to the society. There is the significant importance of academia and industry linkages for innovation and experiential educational model development. In this context, ORIC facilitates the establishing of collaborations between industry and academic researchers (faculty). Specifically, ORIC may have the following roles and responsibilities:

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[1]*Source: (The above text is taken from HEC website*http://hec.gov.pk/english/services/universities/ORICs/Pages/default.aspx http://hec.gov.pk/english/services/universities/ORICs/Pages/Objectives.aspx*)*

- Identification and evaluation of potential ideas
- Collaboration with potential industry
- Development of research and technology
- Commercialization of technology

1.4 Technology Ecosystem and Role of ORICs in Pakistan

Pakistan has recently started its innovation ecosystem after the initiatives taken by the HEC. Innovation ecosystem refers to the technology capacity, technology adoption and conducive regulatory framework of the country which drives both academic and industry to work for innovation. The role of higher education is considered as an important factor in the development of sustainable future (Cortese, 2003). The HEC has achieved only the first step of science capacity in Pakistan. By now, there is an adequate amount of competent scientists along with reasonable number of labs and laboratories which exist in Pakistan.

Unfortunately, the innovation governance framework with technology friendly policies seems to be absent even until today in Pakistan. As a result, this is hampering the potential performance of ORICs and the scientists in particular. Well established research in the developed economies suggests that the technology from labs to the market requires the policy support that could attract investment, protection of incubation time period and extra incentives to grow up to viable and competitive level (Todeva, 2013). According to Evans (Evans, 1997) "The character of the business community can be reshaped by state policy." Simply, the technology without a flexible supporting system faces death after short period of its birth.

Industry in Pakistan has poor or no experience of working with local academia for technology development, and academia-industry linkages are crucially important. Both institutions need to have an adequate interaction and collaborations. The gap between both institutions is widening for certain reasons. For instance, it has been observed that the industry complains about the poor quality of graduates which is the pre-step of technology projects (Bok, 2009, p 208). Similar nature of opinion holds true for industry in terms of projects and due diligence collaboration with academia. In this context, there is an importance of quality networking; continuous interaction, and drive for bring industry-academia-public sector linkages and aligning it with research and development.

This gap requires a great deal of activities from the ORICs. These offices can take this as a blessing in disguise to solve the problems faced by the Pakistani innovation ecosystem. The ORICs can find certain innovative ways and means to support innovation in their institutions (Bercovitz & Feldman, 2006). For this, ORICs will have to be; responsive: realize the importance and urgency of problems and their solutions, dynamic: solving it with their full capabilities by using and utilizing their human capital and other resources available, and more importantly through efficient and out reaching to break the status quo and develop R&D collaborations.

The tested and certified solutions to these issues are triple bottom approach. In different words, the remedy lies only in strengthening of the ORICs and also empowering them to play

the role of catalyst between academia, industry and public sector. The academia has to respond to challenges of relevancy of curriculum, need based research and transfer of technology for economic impact (Lin, 2004). It requires the focus of the ORICs which should be to create the first few success stories where university research contributes in industry growth. In later stages, such trends will follow the initial success and flourish in terms of useful outcomes.

1.5 Technology Transfer Framework

The most critical component in innovation management is Technology Transfer Framework. In countries like Pakistan, it is highly ignored or misunderstood. The Technology Transfer Framework presents the role of each stakeholder along the development stages of technology transfer (Bercovitz & Feldman, 2006). The framework of technology transfers for ORICs has to loop through eleven steps between technology identification and successful commercialization of end outcomes. Figure 1 presents the framework for technology transfer.

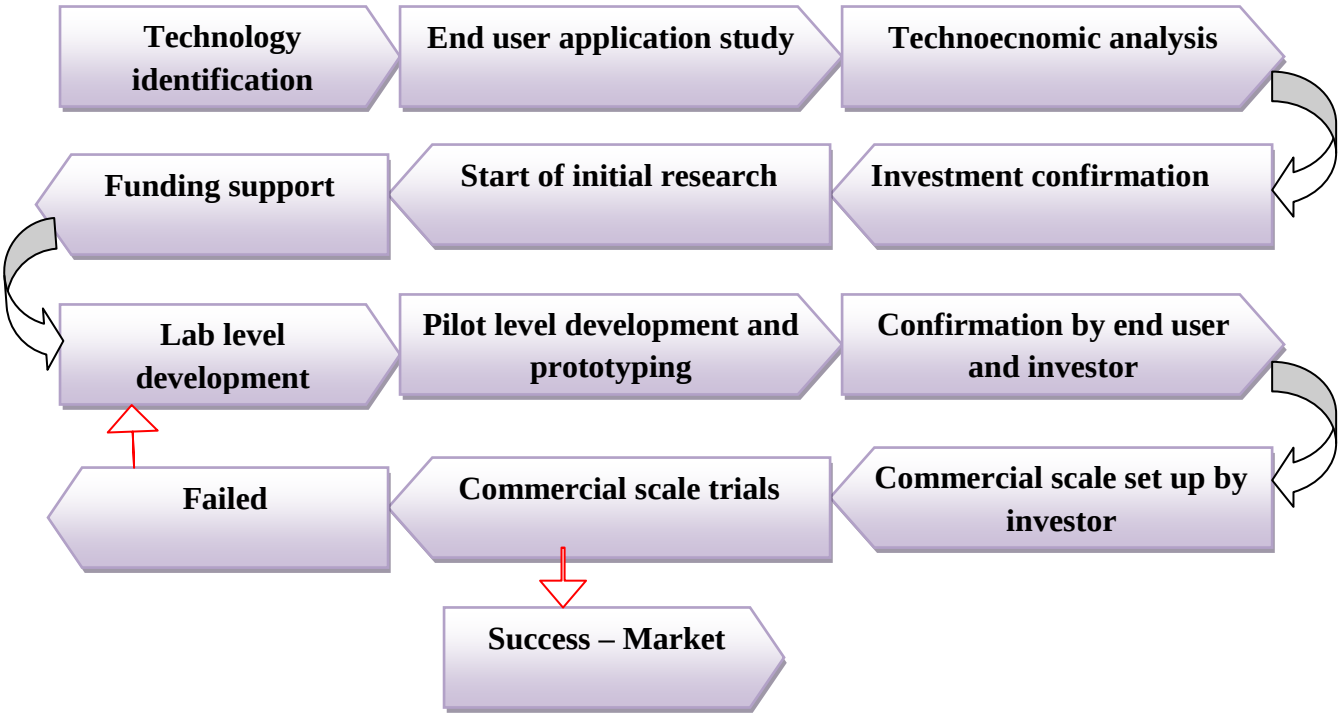

Figure 1: The Technology Transfer Framework for ORICs

The ORIC is responsible for driving the technology in all stages. It includes problems resolving at all stages, and creates trust and confidence of each stakeholder to move technology from all stages to success.

Technology business is time and need contingent. It is possible that demand for technology is viable in the start and turns out non-viable when technology is completed. There are a number of factors which affect the investment decision in technology like political and social condition of the country, competition in the market, testing facilities and availability of funds.

Human efforts in R&D are never wasted and new applications are found in future time. The accumulated experience in technology development always pays back even in case of failure.

1.6 Economic Cycle of Technology Project

The ORICs must plan how to promote contract research and revenue from technology sale. This process potentially could help universities to become economically sustainable. The authors in this context propose that within three years' time period, ORICs must start earning from industry through contract research or sale of technology. Following Figure 2 presents the illustration as a process of economic cycle of technology projects.

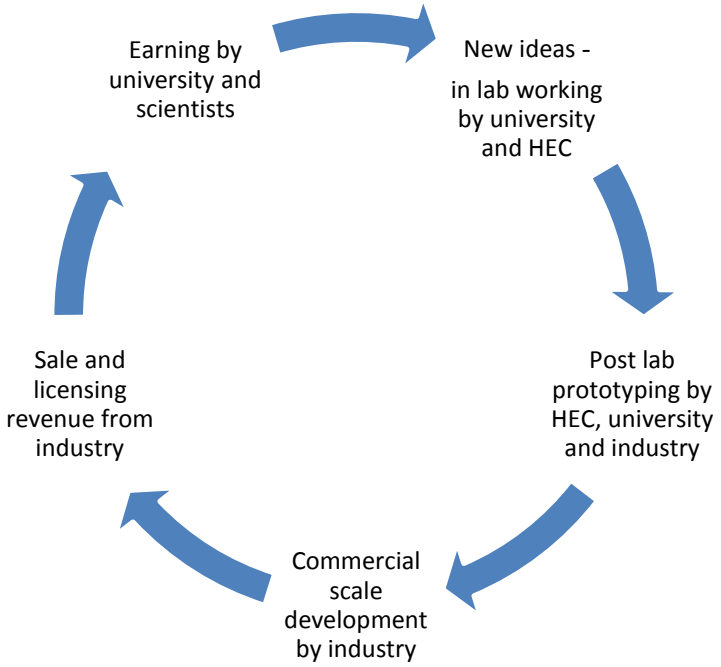

Figure 2: Financial Cycle across Technology Framework

The common perception is that the industry is always interested to invest in technology at its confirmation stages. In the context of Pakistani industry, it has no experience of doing joint R&D with scientists and making projects successful with networking and collaboration from academia. Among others, one of the effective methods is to involve industry in R&D and technology development through state funding (i.e., Higher Education Commission and others). The process must follow three steps:

Step 1: State funding must support up to prototyping level which is the decision stage about technology viability. The viable project can be taken further by industry to develop commercial scale production.

Step 2: Industry should be asked to pay cost or fee of technology once viability of project is confirmed. At this stage, if industry decides to invest in technology, it can pay the university and scientists on mutually agreed upon terms.

Step 3: Industry can be asked to support for consumables and chemicals during the lab and prototyping level of technology.

1.7 Role of the Players in Technology Development Stages

The common reason in technology failure is expecting scientists to do everything from idea generation to setting up a plant. The technology projects have roles of various players at different phases and stages. The clear understanding of these roles along with stages will lead to successful technology development. The ORICs have to be present along with industry and scientists in all the stages. The collaboration has to sustain in all phases between ORIC, scientist and industry. The focus areas are highlighted in the Table1 below. The initial planning upto confirmation level of what to do is part of ORICs focused job. The trail, experimentation, proving the concept and developing the solution is part of the researcher's job. The up-scaling at pilot and commercial level is primary job of industry.

Table 1: The Role of Various Players in the Technology Stages

Role	Scientists	Investor Industry	User Industry	ORIC
• Technology identification				✓
• End user application and confirmation				✓
• Technoecnomic analysis				✓
• Confirmation of funding, investment and related support				✓
• Start of research and development	✓			
• Extermination and meeting tech requirements	✓			
• Lab level development	✓			
• Patent filing	✓			
• Confirmation by end user				
• Pilot level development and testing		✓		
• Confirmation by the investor		✓		
• Product development		✓		
• Engineering and plant design/fabrication		✓		
• Commercial scale trails and product testing		✓		
• Production and marketing		✓		

1.8 Technology Selection

The academic scientists mostly intend to work on advanced ideas which attract high repute journals for publications. The industry and society demand improvement and efficiency in their current products and processes followed by new products. In an advance world, academia and industry have similar level of working and research efficiency also gives good publications.

The above stated argument hardly fits in the contexts of developing economies. For example, in a country like Pakistan, the industry is quite behind and usually works on old technologies. There is the chance that efficiency increase in factory production leads to good commercialization but is not worthy of good publications. This as a result might not attract significant number of research publishing aspiring academicians.

The ORICs can play a significant role. They need to devise a strategy that researchers are given both options and incentives for both objectives. The scientists may split their research works into publishing new ideas in the reputable academic journals and also solve current operational problems of industry and society.

The current status in the relationship between academia and industry in this country are on the stages of building trust. Both institutions will have to get closer and create the situation where both can have a win-win strategy. For instance, academia needs to add value in existing life of industry by proving academic capacity to deliver solutions to the prevailing problems. Academic contribution for trouble shooting and increase of productivity of industry will lead to good trust and planning for large breakthrough projects.

1.9 Technology Timelines

The technology business needs long term orientation and patience. It takes on average five years from idea to a product in the market. The authors describe it as two years for pre-project and three years for post-project, whereas third year is the zero year. It is also presented in the following Figure 3. According to the figure, the pre-project two years include identification, basic analysis, lab level research, funding and prototyping to some extent.

The zero year is the third year that includes lab testing, technical and economic feasibility, business plan, commercial trials and consumer and market reports. Around 2-3 years are needed after prototyping to make commercial production sustainable. This includes large scale plant design, good volume of sale and reasonable level of profit to ensure commercial viability of large scale production.

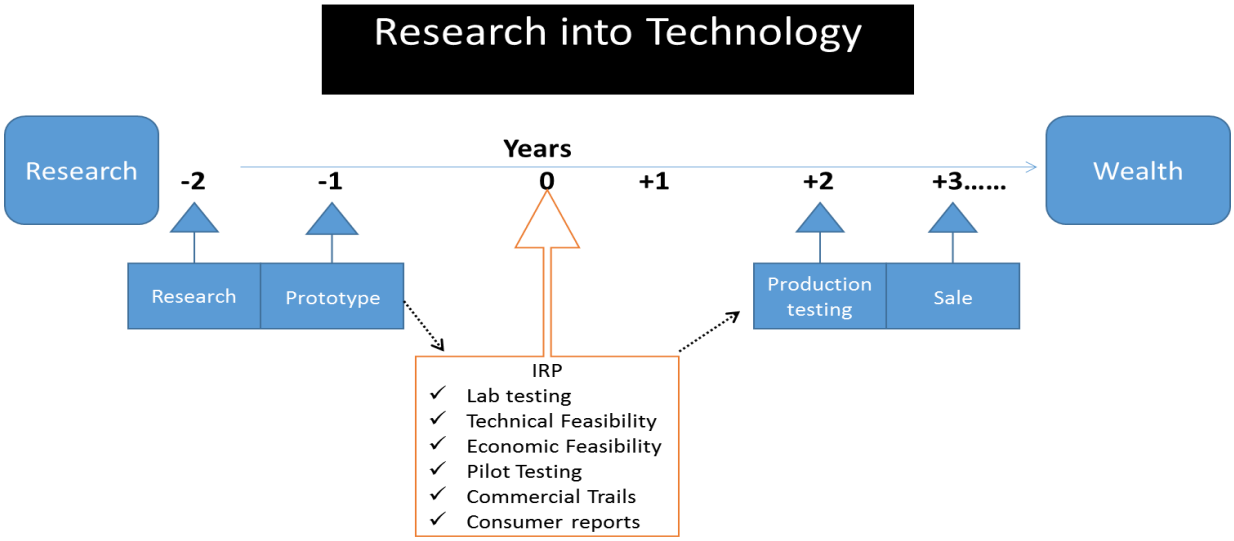

Figure 3: Timeline of Research into Technology

1.10 Planning Framework for ORICs

The ORICs need to develop their planning framework. It must be designed based on their priorities and preferences within the timeframe. With the passage of time, the process of planning improves and changes gradually as progress is achieved. These offices need to frame their basic areas of achievements and then devise key deliverables in those areas. There should be key performance indicators, key actions to be taken and anticipated impact on the university due to this planned working. The following Table 3 presents the detailed hierarchical framework functions and outcomes of fully functional ORICs. This framework might not be one size-fit for all ORICs. It is subject to the adjustments and provided requirements of each ORIC.

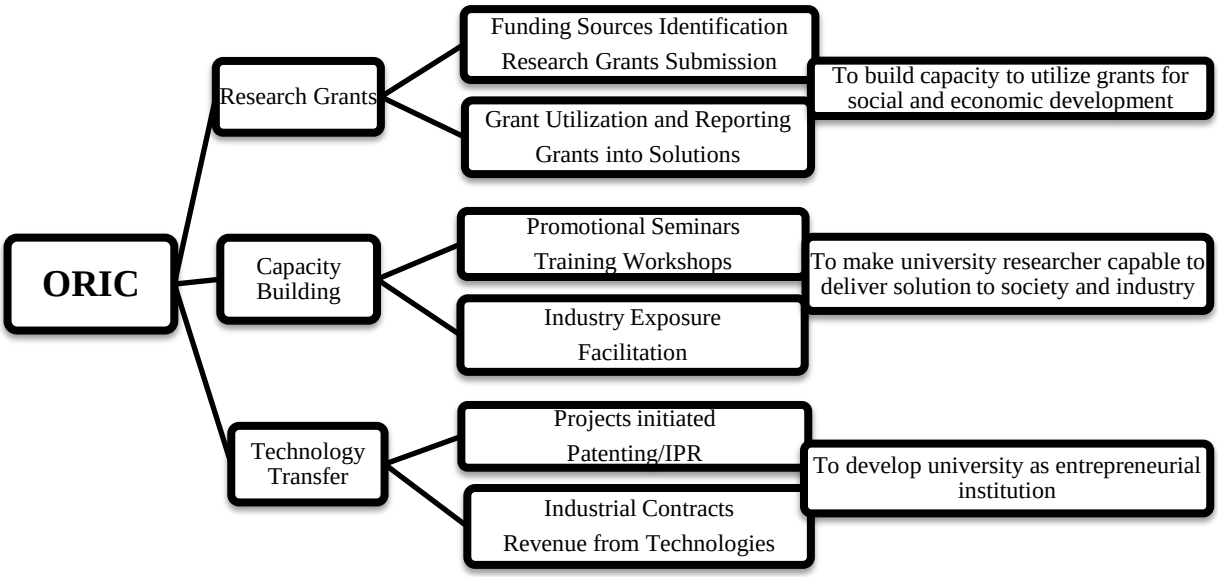

Figure 4: Aggregate Planning of the ORIC

Table 2 presents the stages of planning for actions and resources. This has three further steps to follow. It begins with the research grants, capacity building and university technology transfer. Action plan begins with the submission of project proposal submissions to the national and international funding institutions. The HEC and other donors invite proposals from faculty members who have interest to develop technology. These project proposals are funded by certain agencies with a certain amount for a certain period of time. ORIC must capitalize on this funding to convert them into socioeconomic development.

Capacity building stage includes the arranging of seminars and workshops at departmental/faculty levels to inculcate research culture among rejuvenating researchers. This will require the limited resources that include fee for the training organization that develops and customizes trainings for institutional need. And in order to balance the research for technology outcomes and publication, there would be the importance of having an officer that takes care of the publication of the research outcomes. The financial support for these activities can be derived from the projects approved for the individual researchers. The details can be seen in the following Table 2. Keeping in view the importance of technology transfer

for the promotion of research and its outcomes, the third stage is to develop a strong technology transfer culture at university levels. At action plan stage, the ORICs need to promote the outreach and interaction that facilitates and encourages the new product/service development initiatives and outcomes. Besides this, the universities can also arrange similar nature of in-campus interaction to further strengthen the environment where idea generation by students and faculty becomes the routine in the university for viable outcomes. This process may require one full time technology manager and officers for support. Table 2 presents the details.

There is no doubt that these inputs have significant outcomes for the individuals, universities and the country in general. Due to the limitations, the authors of this manual restrict the outcomes only for universities. As presented in Table 3, the main positive outcome indicators are:

1. Revenue share of the universities goes up with contract research and the grants released against the submitted project proposals to the national and international funding institutions.

2. It facilitates and motivates the faculty members to get funding for their research and contribute for the technological outcomes and access to real time data for publication. Besides that, it assists them to get closer linkage to the industry and become the experiential researcher.

3. In the long run, this process will be useful for the universities to grow the entrepreneurial mind-sets in the universities. The outcomes in the shape of technology or services will contribute in problem solving of the industry and society. More importantly, the identification and management of the startups will start from the universities.

Table 2: ORIC Planning for Actions and Resources			
	Action Plan	**Resource**	**Time line (Rs Million PKR)**
Research Grants	Research Proposal Submission to national & international funding agencies	One full time funding officer supported by internee	X number for proposals for x amount per year
	PhD faculty will be awarded research grant for FYPs	Fixed budget to support initial working of research projects/proposals	One research grant to selected faculty members per year X number of minimum grants
Capacity Building	Departmental Wise Seminars & Workshops	One full time training officer supported by internee	X number of seminars and workshops quarterly
	Industry exposure Facilitation	Transportation- Hospitality for outsider guests	X number of visits to industry in a month and invited industry guests
Technology Transfer	Identification of viable technologies Feasibility studies IPR /patenting	1-2 full time marketing officers to support tech transfer between researcher and industry	X number of technologies to be shared in a year with industry X number of technologies were approved by industry and put in negotiation
	Industry interaction, negotiation, contract and selling of technology	Budget, transportation and other facilities to make proactive interaction and frequent exchange	X number of technologies are transferred in a year against y amount

Table 3: ORIC Planning for Performance Indicator and Impact

	Action Plan	Key Performance Indicator	Impact on University
Research Grants	Research Proposal Submission to national & international funding agencies	How much proposal submitted by each faculty How much proposals are won by each faculty	University Revenue share increase by contract research + research grants
	PhD faculty will be awarded research grant for FYPs	How much grants are applied internally How much grants are won How much internal grants are translated into outside funding proposals	
Capacity Building	Departmental Wise Seminars & Workshops	How may general seminar in each quarter of the year How many workshops in each quarter of the year	Motivation for technology research Information to drive industrial liaison and tech projects
	Industry exposure Facilitation	How much industry interaction, field visits and collaborations/MoUs	
Technology Transfer	Identification of viable technologies Feasibility studies IPR /patenting	The number of technologies in process given by industry .The time of conversion from idea given to faculty and results shared to industry for prototyping. Number of technologies finalized including academic results and feasibility study	Trust on university research and technology capability Good amount of revenue New ventures based on university technologies Increased university role in social and economic development
	Industry interaction, negotiation, contract and selling of technology	The number of projects put in piloting with industry The number of technologies converted into marketable products	

1.11 Infrastructure and Operations of the ORIC

The ORIC by design is dynamic, outreaching and interactive that inspires faculty and students for industry and community needed research. There is also a concern: what if these offices become bureaucratic in nature where faculty and students seldom make visits. In terms of infrastructure and seating arrangements, ORICs need to have adequate attraction and the culture to openly welcome the stakeholders. The authors suggest that the role model ORICs need to have the following facilities and responsibilities.

1.11.1 Open Environment

The seating arrangements for ORICs staff including head (director/in charge) must be in an open environment. The open environment always serves the purpose of interaction, fast communication, collaborative working and high efficiency. In different words, the offices must be in the position where faculty and other stakeholders may easily network and communicate with the ORIC officials.

1.11.2 Free Working Space

ORICs must have a kind of free working space where collaborators of the project can interact and brainstorm on certain complex problem solving activities. Unlike other projects, the nature of technology projects is collaborative, interactive and requires thoughts from individuals with diverse education, experience and backgrounds. These kinds of projects demand co-working space to ensure that individuals can have flexible working hours to produce quality outcomes.

1.11.3 Meeting Rooms

Quality ideas do not emerge in vacuums. Rather, they require a kind of space where people from different backgrounds sit together, share their ideas and solve their problems through interaction. In this purpose, the ORICs will have to ensure the availability of a meeting room that could provide space for people to meet.

1.11.4 Transportation

Movement of individuals requires having the facility of transportation. Therefore, ORICs will have to have the facility of transportation to execute their activities accordingly. These offices require going on frequent visits where they take the faculty and students to industry and bringing industry people to the university. Besides that, the staff of ORIC itself must go on field visits to the industry and other academic institutions. At minimum, ORIC at university level must have a vehicle (car) which is dedicated to it for frequent movement and on demand transportation facility for students and faculty visits.

1.11.5 Operational Budget

The offices are mostly inefficient due to the lack of operational budget and therefore become salary paying machines. The ORIC needs a dedicated budget for operations, promotions and marketing activities. The budget is needed to be flexible for printing of ORIC promotional materials, field visits, refreshment and other operational needs.

1.12 Human Resource of ORIC

There are no degree programs, diplomas, and short courses on technology management in Pakistan. This led to serious shortage of trained human resource on technology management and innovation management. Some universities tried to bring industry people in ORICs and found them ineffective due to their inability to effectively liaison with faculty. The experience of university professor as part time ORIC heads also needs revision due to workload of professors and lack of prior experience to deal with technology development process. With great concern, it has been identified that the ORIC operation staff is also not trained in technology management and transfer process nor have the same experience.

Therefore, for efficient and effective ORIC, there is the urgent need of a full time director having industry experience followed by academic working. The director must be dedicated and supported by infrastructure, financial and communication resources.

Director ORIC

The director ORIC must be an individual who may have spent early career in industry and then moved to academia. The minimum qualification must be Doctor of Philosophy (PhD) from a research reputable institution from abroad. This qualification combines three experiences in a person as 1) working in local industry, 2) teaching and research in academia and lastly, 3) exposure of advanced world technology process during PhD.

Marketing Person: The most prominent position in ORIC is a marketing person with science or engineering background at intermediate level. Minimum experience should be 3-5 years preferably with marketing in industrial goods followed by FMCG businesses.

The role of **Marketing Person** is to develop business plans for faculty research, find partnerships for research projects, explore new opportunities for contract research and sell technologies/patents of the university.

Administration Person: The ORIC must have an administrative position to handle operations. The person must have 1-2 year experience of working in industry preferably in service sector with master degree.

The role of **Administration Person** is to develop a very welcoming service orientation of ORIC. The admin officer is responsible to ensure that ORIC services reach desks of faculty with proactive, interactive, and dynamic working backed by responsible communication.

Finance Person: ORIC also needs a finance person to support financial planning of research proposals of faculty, quotation handling and financial planning for contract research with industry. The person must have 1-2 year experience of dealing with accounts, finance or investment operations**.**

The **Finance Person** is responsible to manage quotation for grant applications, do financial planning for projects, develop budgets for research works and ensure accurate financials in business plans and contract research.

Other Staff: ORIC needs for staff proposed by the HEC like IP manager, publication officer, support staff like research associates, assistants and support staff may vary according to the situation or HEC guidelines.

1.13 ORIC Committees

Academic: ORIC must have an academic committee represented by faculties and departments of the university. This committee would be responsible for academic matters like research ethics, proposal review, internal support, rewards and related initiatives to improve university internal performance.

Industry: ORIC must also have an industry committee of 10-15 industry people responsible for industry linkages, research partnerships, technology transfer and general industry interaction.

Hierarchy of ORIC Human Resource

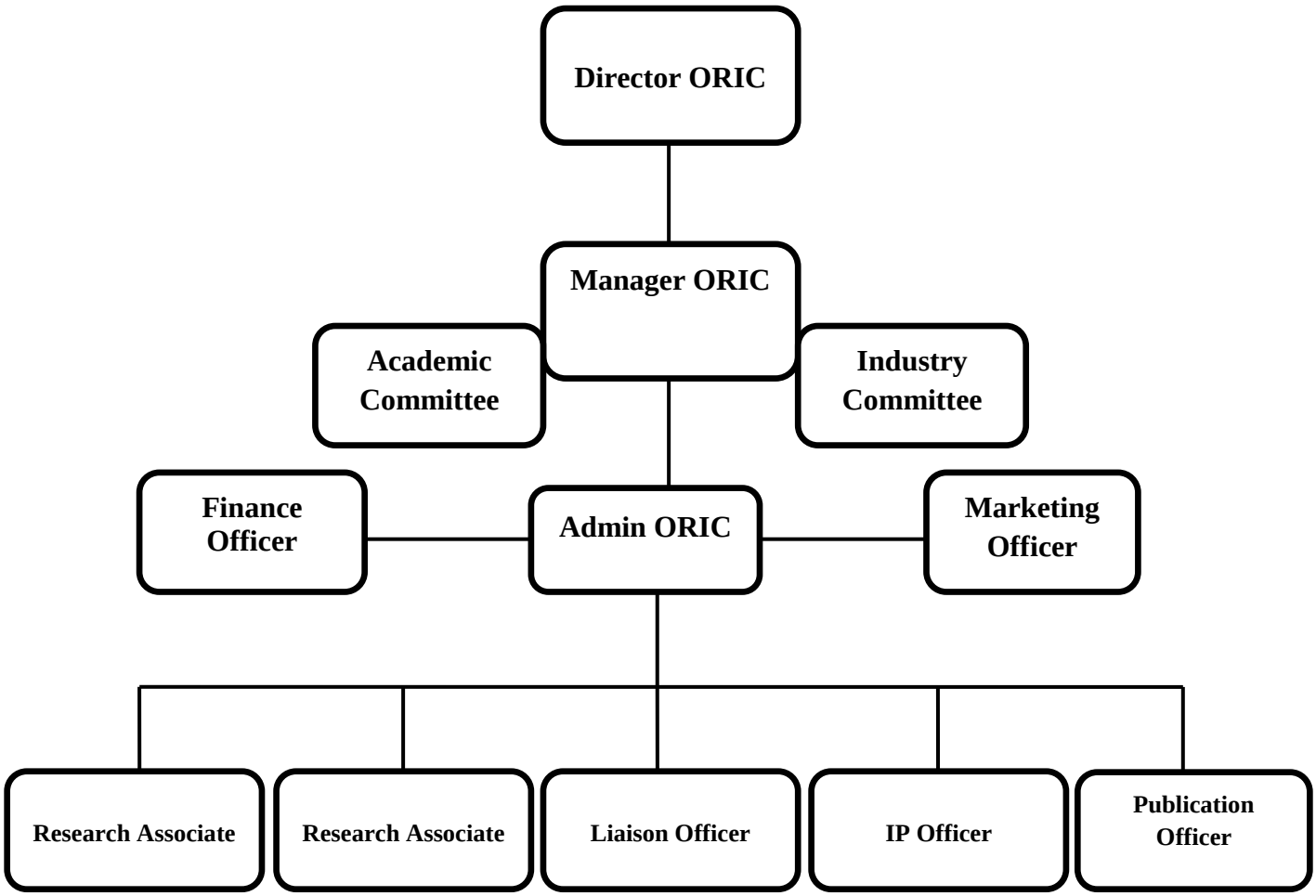

Figure 5: Hierarchy of the ORIC and Human Resource

1.14 Evaluation of ORICs

The ORICs should be assessed on individual and collective basis. Individual performance and evaluation refers to the assessment of ORIC staff. Each staff member should be judged every month on respective tasks and duties assigned (Appendix I: Monthly Progress Report).

The collective performance of ORIC refers to the overall performance of Technology Transfer Office. It should be judged on the number of measures taken to support technologies transfer to industry.

1.14.1 Yearly Assessment of Director ORIC

- How much new formal and informal collaborations are made?
- How much formal collaborations are actually initiated for joint working?
- Any strategy made to improve ORIC-University-Industry joint projects.
- Any internal plan implemented to improve ORIC performance.
- Any plan made or proposed to improve entrepreneurship culture in the university.
- Any plan or system introduced to improve faculty interest and incentives for applied research.
- Any plan or strategy introduced to improve university funding through research grants and industry contracts.

1.14.2 Yearly of Assessment of ORIC

- How many new university-industry collaborative projects are initiated?
- How many in process joint projects are completed on time?
- How many support activities are conducted to serve ORICs objectives?
- How many faculty and student visits to industry are arranged?
- How many industry visits to university for faculty interaction are arranged?
- How many new proposals are submitted to industry and donor agencies?
- How much increase in research/industry funding from the previous year?
- How many technologies are ventured or licensed out?

1.15 Incentives for ORIC Staff

The ORIC staff must be made the part of risk and rewards for quality outcomes. The conventional way of just paying salaries against their services can underpin non-performance of ORICs. Among others, ORIC's key staff includes marketing, administration, finance person and top management needs to be incentivized for:

- A share from ORIC earning from research grants/industry contracts
- Incentives to arrange maximum faculty interaction with industry
- Incentives to increase industry projects in faculty research
- The appraisal of ORIC staff must also include these variables

Chapter 02

2. Major Challenges of ORICs

2.1 Contribution in Economic Development

One of the biggest challenges for ORICs is to ensure significant economic contribution of the university. In recent times, Pakistan has experienced development in higher education that translated into good number of publications and citations. The poor quality of students' research leads to trust deficit between industry and academia instead of solving problems. This raises the serious question as to what measures ORICs will have to take to mitigate the widening trust gap between academia and industry.

Academia will have to take critical steps to glue the bondage of trust with industry. In this process, the role of ORICs is crucial in which they may reverse the situation of trust deficit and drive academia to translate their research into economic and social contribution. These offices may work on behalf of faculty members, incentives for faculty and students, entrepreneurial capability building of scientists, ease the technology transfer process, and manage intellectual property. In order to overcome these sort of situations, the ORICs will have to closely monitor the academic system of conducting research (i.e., research journal publication, rigor in thesis/dissertation write up), ensure the supervisory process (i.e., relevant field supervisor, expertise of supervisor must be relevant to the type of research being conducted, etc.,) and more importantly, there must be quality and rigorous research output from the students. This will contribute heavily to the country's social and economic prosperity.

2.2 Policy Factors

There is the dubious mechanism of measuring the outcomes of the researchers. Very often researchers and scientists raise the question as to why they need to solve industry problems whereas they are judged for teaching and publications. Due to such measurement, these academicians poorly demonstrate their interest to start and finalize their projects. The failure of the completion of the projects causes serious trust deficit. This requires serious attention. The ORICs need to work efficiently for the designing of the policies to address those key challenges and identify other grey areas. For this, these offices need to develop certain policies, devise incentive system and frame enabling environment for researchers and scientists to excel in the contract research. More importantly, the ORICs also need to advocate to Government and its institutions to devise policies in order to bring industry academia closer to each other.

2.3 Trust Gap

The trust gap widens when industry and faculty do not interact with each other. This is the biggest challenge to overcome to start collaborative joint projects. The poor quality of the projects done by academia causes industry to lose interest and trust. Academia must have

internal body to review the progress of industry projects and assume responsibility for taking measures in case of low performance. Industry seldom trusts for the second time if given projects are carelessly treated with no timely report, required support, dedicated time and significant attention to the projects deliverables (Bok, 2009, p 208). Regular interaction and exchange of ideas between faculty and industry minimize the trust gap.

2.4 Generation of Funds

The financial viability of ORICs is quite challenging for universities, especially of the private sector. The HEC arrangement of 15% on HEC funding for ORICs is very supportive and needs to be exploited by ORICs by submitting maximum grants proposal to HEC. The ORICs can achieve their financial empowerment and support marketing operations of faculty research through this fund. There are a number of other measures to generate funding for ORICs;

- Submitting proposals to other funding agencies
- Wining contract research from industry
- Getting consultancy projects from industry
- Getting training projects for faculty
- Participating independently in various open bids for projects

The ORIC needs to devise policy that ORIC will receive 15% share out of entire university revenue that comes through ORIC from external sources.

Chapter 03

3. Operational Guidelines for ORICs

3.1 Trust Building Measures – TBM

- **Problem Statement**

It was reportedly found that great trust deficit exists between knowledge producing academia and knowledge user industry. There are a number of efforts that were started for university industry linkages but ended up by increasing the trust gap. Now it is the right time for ORICs to take various measures to interact, collaborate and understand each other's contexts. Without spending significant time with each other, common understanding of issues is not developed. It is highly advised that each ORIC may plan initial 1-2 years for increasing industry interaction and building trust and confidence.

- **TBM Areas for ORICs Working**

- Participation of industry on academic boards/committee
- Participation of faculty in committees of business chambers and associations
- Exchange of scientist– business manager
- Aligning students thesis with industry issues
- General collaborations and community services
- Participation in seminars, networking dinners and interaction

Focus: ORICs must focus first to revive confidence and trust between faculty and outside market; industry and community. Therefore, ORICs must plan interaction and get-togethers where both sides sit together, understand each other, and exchange ideas and potentials.

3.1.1 Participation on Boards/Committee

Current State: It is the rare practice of a few universities/R&D organizations where department committees have related industry people on board. Same holds true for the committees of chambers and business association as they do not have permanent position for related scientists from academia.

ORIC Initiative: There is a need to make participation of industry-academia in each other's boards. ORIC may try to initiate the following in their institutions:

- Every university department to have 01 industry position in its committee
- The advanced study boards in universities must have 20% industry nominations
- The committees for curriculum, theses selection, theses review, etc., must have 02 permanent industrial nominations or for each meeting
- University liaison offices must ensure participation of HoDs /approved supervisors in various committees of business chambers and industry associations

3.1.2 Practical Exposure for Scientists

Current State: There is no trend of scientists to spend few days on industry floors to understand ongoing issues of businesses. This non-understanding has made the scientists irrelevant to the local industry and community. Businesses are the front end of market changes, grow on daily basis and adopt changes. Less exposure of scientists to these changes impedes collaboration as both are not on equal level of understanding and exposure.

ORIC Initiative: There is a need to make industry working part of the scientist's job who opts for applied research. ORICs may advocate the following:

- Each summer of the faculty to be spent in industry as part of university job
- Faculty to be encouraged and facilitated to have regular industry visit
- Faculty doing applied research needs to be given flexible teaching hours to adjust time for industry interaction
- Faculty be allowed and appreciated to choose Co PI (co-principal investigator) from industry
- Faculty be allowed and appraised to join committees/boards/teams of industry as volunteer, consultant or partner for commercial and noncommercial works
- Faculty may be allowed to work (during working days) in industry as collaboration in the projects of mutual agreement

3.1.3 Students Thesis on Industry Issues

Current State: The thesis/dissertations of the graduating students are not conducted on industry issues. The industry-student interaction stands at minimum level in all academic circles. This, as a result, has brought negative effects on students' job prospects and university relevancy with the environment. Thesis/dissertations can be instrumental for trust building if planned and conducted jointly.

ORIC Initiative: Thesis/dissertation of all level students (BS, MS and PhD) to be made instrumental for association with industry. The thesis and dissertations if linked with industry issues can provide job opportunity and good salary at start. The ORICs may consider the following initiatives:

- Industry person as mandatory co-supervisor to be part of thesis selection and evaluation process in industrial thesis
- Industrial research thesis must be on industry issue(s) and approved after industry recommendations
- The consumables and expenditure for industrial research thesis to be funded by industry
- Students need to be trained for industry liaison

3.1.4 General Community Services

Current State: There is an inadequate culture of planned collaborative efforts. The academic conferences are seldom attended by industry. Other events of universities are not planned for industry participation. There is less culture of community services by universities.

ORIC Initiative: There is a need to promote regular culture of community services in the university. This community service enables academia to learn how to interact with outside environment. The community services also improve university branding and create positive emotional bank account in the society. These community services will also open doors for industry participation in the university life.

ORIC may consider the following initiatives:

- The academic conferences may not be limited to industry sponsorship only
- There is need to include industry issues and problems in the academic conference
- There is need to invite industry in general university programs
- There must be various students' forums of community services headed by teachers to perform certain welfare services for the common man
- University may plan some social services in collaboration with local industry and society
- University may provide faculty and students to support social welfare initiatives taken by industry and community

3.2 Management of Research by ORIC

Problem Statement

One of the bottlenecks in research commercialization is expectations from scientists to commercialize the research. Doing science and commercializing science are two very different things. The commercialization is part of technology management that must be done by ORIC and independent technology institutes like Institute of Research Promotion-IRP. R&D management includes technology identification, business planning and commercialization by ORIC after scientific trials by the researchers. There is the need to develop enabling environment of management around science, and knowledge creation and its exploitation.

3.2.1 Technology Management – Role of ORIC

Current State: There is substantial focus on technology development through lab works in the country. On the other hand, there is significantly less focus on technology management support of these trials. Technology managers with capability to support operational part of trials are not found in the university labs. Furthermore, in most of the universities, ORIC positions are filled with the staff with no industrial experience.

ORIC Initiative: ORIC needs to back up technology projects with management support and resolving issues. Technology management may include:

- Operational budgets to keep labs working
- Labs to be offered for commercial testing
- Professional management to be added in labs
- University labs to be given decentralized authorities to directors to commercialize testing
- Support for administrative, logistics and other management issues must be priority issues in universities

The second part of technology management is driving research for commercialization. ORIC can work as driving force between academia and industry. The tasks may include:

- Project identification for FYPs and research grants
- Industry liaison and partnership for funded and non-funded research
- Facilitation in small problems
- Project planning
- Financial viability analysis
- Commercialization support and industry interaction

The salary and incentive of ORIC staff must be linked with revenue earned from technology sale

- The ORICs need to be strengthened as technology managers in the universities

- The ORICs must be rewarded for technology sale in terms of money and promotion/increments
- Technology earnings may be shared as some share for ORIC staff out of earning from industry

3.2.2 Management of Infrastructure and Facilities– Role of ORIC

Current State: Inadequate infrastructure support is hampering the progress in applied and basic research in many universities in Pakistan. These infrastructural items include small instruments, tools, chemicals, fuel, tests, information availability and repairing. This, as a result, is causing both delay and suffering of the projects.

ORIC Initiative: The challenges specific to applied research demand very facilitating environment for scientists. Easy access to infrastructural support and logistics will help scientists to dedicate attention for solution of the problem. The ORICs may consider the followings as enabling factors:

- There is the need for dedicated research facilitation center in every ORIC/University
- The facilitation center should arrange transportation, logistics, small tools, instruments, chemicals, related information from market, etc.
- There should be significant budget available for facilitation center
- There should be easy access budget for repairing and maintenance of equipment
- There is the need of mobilization support for frequent industry visits

3.2.3 Capacity Building for Applied Research

Current State: Two very critical capacities are needed for applied research. One is the capability to do need based research and second ability is to commercialize and exploit research. This leads to starting and establishing a relevant and effective ORIC. Despite that, there is a dire need of some serious efforts to build capacity of academia and industry for applied research. Currently, scientists are not trained to solve problems of local industry through commercial research. Universities as a whole and ORICs are not well trained for the role of technology management. Industry is not well trained to exploit university knowledge. Industry is also not trained well for the adoption and implementation of university given research of initial level.

ORIC Initiative: There is need for significant attention and resources on building capacity of academia involved in conducting applied research. The following measures may be considered by the ORICs to build the capability of the researchers for applied research that potentially assists the development of academia-industry linkages for commercial outcomes:

- Foreign scientists having 10 years plus relevant experiences to be invited to train scientists on various aspects of conducting technology driven research.
- The scientist opting for applied research must attend one annual workshop on technology management
- ORIC officers to be trained on aspects of technology management
- ORIC staff must attend few online courses on technology management

- Faculty to be involved initially in short troubleshooting projects to build confidence
- ORICs may launch special training for industry managers on how to adopt university research

3.2.4 Quality Assurance Mechanics in the University

Current State: It is observed that the universities in the country lack internal mechanism of quality assurance process for projects given by the industry and the society. Eventually, the industry loses interest when it finds that there is no one to take responsibility for their given projects. Industry mostly demands committed research work on time with progress report and networking. Such things are not assured from academia side as they work free from any such limits.

ORICs Initiative

There is the need of mutual understanding and collaborative efforts between academia and ORICs to ensure quality assurance mechanisms in universities. In this context, the role of academia should be to strengthen the working environment of the ORICs and support their role in projects accepted from industry. The ORICs must become responsible for timely results and reporting. There should be the mechanism at the departmental levels where there should be a specific committee that approves and tracks down the progress of each project. In case of delays, the department and ORIC must be able to take some constructive measures to ensure the continuation of the projects for useful outcomes.

Based on the above, the authors suggest that ORIC may take the following measures to ensure quality assurance mechanisms.

- Take a focal person from each department for effective departmental communication
- Ask departments to make their committees for project management
- This committee should decide projects, review quality, and track progress
- The committee may take necessary action in case of projects delay
- Industry may meet this committee to see mechanism of assured delivery
- This system to be put on ORIC’s website so people build trust on processes of ORICs

3.3 Incentives for Problem Solving Research

Problem Statement

The indicators of research output in Pakistan started from HEC initiatives. There is significant progress in research publications, PhD scientists, universities up gradation, lab set ups and offering of PhD programs in the country. The efforts for commercialization of research are started now by setting up ORICs in the universities.

The incentive system for academics is shifting from only teaching, paper publication and administration services to patenting and commercialization of patents.

Problem solving research is an adoptive research which solves existing problems of society and industry.

3.3.1 Incentive System for Applied Research

Current State: The entire system of academic incentives is based on teaching, research publications and performing given tasks by institutional heads. Scientists try to fulfill these three important aspects as priority. Most of the young scientists trained for scientific discoveries are busy in administrative works which is alarming for education and research outcomes. In recent times, the HEC has made a great transformation by including industry interaction, contract research and patents in annual appraisal of universities for ranking. This will create a constructive competition among the academic institutions to facilitate and expedite their research for commercial purposes.

ORIC Initiative: In this context, the ORICs will have to play an important role very smartly here. They have to add faculty burden of contract research by reducing their non-teaching loads. ORICs have to work with HR and leadership of the university to spare scientists from non-scholarly load of the faculty.

The office of the ORIC may consider the following:

- Commercialization of research to be considered as output indicators reflected by earnings from industry
- 70% earnings from research from industry may go to scientists while 30% to the university/ORIC of the university
- University earning of Rs. 0.5 million may be considered as equal to one research paper
- The regular industry researchers having earning from industry must be given off from administrative work
- The regular industry researchers having 01 million university earning per year must be given 50% off from teaching load
- Around two years as grace period to be given to researchers aiming to develop themselves as applied researchers

- Annual Confidential Report (ACR)/ Faculty appraisal form must include the following components:

    - Teaching in classroom settings
    - Publications in recognized journals
    - Administration
    - Industry interaction
    - Contracts signed with industry
    - Thesis supervised on industry problems
    - Technology sold to industry
    - Community service
    - Conferences and workshops

3.3.2 Financial Support for Applied Research

The Current State: Currently, the focus of research funds is mixed as few funds like NRPU demand novelty and advancement in knowledge whereas Technology Development Fund (TDF) demands prototyping. The TDF is tied up with applied nature of work for developing solutions of industry problems. The grants release system is very active. Similarly, ICT R&D Fund is also very active and progressive for applied research.

ORIC Initiative: The ORIC has very strong role here to direct its faculty towards technology development funds of the HEC and ICT R&D for industry research. The basic ideas need to be referred to NRPU funding. The ORIC must engage industry and scientists for quick funding and to keep projects on tracks.

The ORIC may consider the following:

- Conduct a baseline study about potential and viability of research
- The university funds may be allocated on the base line studies, lab trials and pilot level testing

The ORIC shall approve the research projects that must fulfill the following criteria:

- Must have demand for commercial scale plant
- Must have reasonable price level
- Must have doable processes of development/synthesis
- Must have raw materials price less than 50% of product price
- Must have easy supply of raw materials
- Must have consent by investor and end user for commercialization

The ORIC may also initiate small grants from university to support prefunding stage of industry projects. Following may be considered by ORICs/universities:

- Rs 500,000-1000,000/- for each scientist per year who chooses applied research
- Rs 200,000 for a PhD student working on some industry issue
- Rs 100,000 for MS/MSc student working on some industry issue

Institutional internal funding needs to be allocated for applied research. The review and funds release process must be completed in three months on average.

The release of funds is a major hurdle in applied research. The funds need to be made easily accessible and without hurdles of official hierarchies. A research grant for applied research should be decided within three months.

The review process of applied research should include industry collaboration, scientists' expertise, institutional facilities and review about methodology, ethics and any misconduct.

The procurement faces much hurdle in public sector funding. There should be an officer in ORIC who may deal with all procurement issues and financial reporting. However, it would be very important to involve the scientists in the research and development related practices rather than involving them in the irrelevant administrative activities.

3.4 Assessment of Problem Solving Research

Problem Statement

The entire burden of research commercialization is placed on the researcher who has almost minimum role in the entire process. It means that the entire institution needs to be assessed for research commercialization. This approach will bring a supporting ecosystem for impact making research. This will also lead to a good enabling environment for applied research.

3.4.1 Performance of Applied Researcher

Current State: Performance of scientists is not linked with commercial output of their research. This performance indicator is neither part of selection, recruitment, promotion nor part of regular performance evaluation and reporting.

ORIC Initiative: There is the need for applied research to be considered as an essential performance indicator during recruitments, selection and performance reporting process.

The ORIC may advocate for the following:

- Industry research and problem solving is made part of scientists' annual assessment
- The annual assessment forms must include weight for industry solution just like paper publications
- Appraisals and promotion criteria include weight for commercial research just like paper publication
- Selection process includes weight for commercial research just like paper publications
- The equivalent could be defined as Rs. 0.5 million research revenue for institution stands for one research paper
- Various cash rewards may be announced for various levels of industrial contract research
- Some competitions schemes may be planned to reward scientists for bringing industry funding and contract research
- Filing of patents and sale of patents must be given high reward

3.4.2 Performance of Head of Applied Researcher

Current State: No department head in the universities is held responsible for applied and problem solving research. Head is neither asked nor accountable for how many technologies are transferred to industry by scientists working under him nor incentivized. This, as a result, is leaving others unaccountable for searching and working on the research projects.

ORIC Initiative: The ORICs must remain in touch with the head of the departments and deans of the faculties. This will smooth the coordination and communication between academia and ORIC to disseminate useful information instantly. It is because the provision of enabling environment will make the head of department accountable and responsible. The ORIC also makes the heads responsible for sharing the potential risks and rewards for commercial research.

Authors suggest the following as possible considerations in this regard:

- Job description of a HoD must include commercial research output by fellow scientists
- The HoD must be incentivized and appraised to bring 20% of its department revenue from industry research
- Increment of HoDs should include 20% weight of earning from commercial research in the department
- Head performance reporting form must include number of technologies commercialized

3.4.3 Performance of Dean in the University

Current State: The deans in the universities are not held responsible for applied and problem solving research process. Dean is neither asked nor accountable for industry liaison, contract research, commercialization of research and technology transfer.

ORIC Initiative: The enabling environment is provided by the Dean. The Dean needs to share risk and reward for commercial research.

Following to be considered in this regard:

- JD of a Dean must include commercial research output by his faculty
- The Dean must be appraised for collaborations, partnerships, linkages and development of faculty
- The dean may be appraised for bringing20% of its school/institute revenue from industry research
- Increment of Dean should be based on earning from commercial research

3.4.4 Performance of ORICs for Applied Research

Current State: The ORICs in the universities are not challenged to promote applied and problem solving research. The ORIC is not much facilitated and therefore neither asked for how many technologies are transferred to industry by scientists of the institutions.

ORIC Initiative: The enabling environment may be provided to the ORICs. This will help them to share the potential risks and rewards for commercial research. In the context, the authors suggest the following to be considered:

- The ORIC may be provided with marketing professionals who have profound industry experience to liaison with industry
- The ORIC may be granted independence with budgets to facilitate research projects without delays and procurement issues
- The operational budget of the ORIC needs to be flexible to do extensive mobilization and university-industry interaction

- The ORIC may be given 15% of industry research earning against its commercialization services
- Increments of ORIC may be linked with 1) activities of university –industry interaction and 2) research based earnings
- The ORIC must be given independent transport and other logistics facility to promote interactions and liaison
- The performance of ORIC officials (Director and Managers) must be monitored against industry interaction, industry funding, patents and research publication

Chapter 04

4. Commercialization of Technology

Problem Statement

In recent times, the research commercialization capacity of Pakistani universities has just begun from scratch. The corresponding industry capacity to adopt and use the university research is also in a weak position. Therefore, technology is not presented in the terms and language of businesses.

The solution

The ORICs need to build capacity of presenting technology and research output in form of well-crafted business plans. There must be human resource in ORICs who understand industry mechanics and also able to translate university research into business and production. The extensive liaison of ORICs and faculty with industry can narrows down this gap and could help to present research in the business format.

The technology needs to be presented in a promising way to bring good returns to investment.

4.1. Promising Market for Technology Projects

The ORIC team in collaboration with scientists needs to analyze the size and volume of the market in which technology or solution is being offered. The size of market or potential sale volume must justify the production. The small market size can be compensated with planning to export to the regional markets and advanced world.

The market growth also needs to be considered as declining market does not justify the investment. The investment needs minimum five years market growth to ensure healthy returns by capturing good market share. The technology diffusion capacity of the market is also a proxy indicator of success of new technologies. Very traditional or commodity markets present less margin for new technologies due to low profit margin.

Following check list may be considered:

- Is market size enough to set up the plant?
- Does the market present healthy profit margin?
- Does the market accept new technologies?
- Is there export potential in the market?
- Can new investor get reasonable share in the sale?
- Does the market present growing trend?
- Does this technology have future prospect in market?
- Are there alternatives that exist in the market which are better and have low cost?
- Are there alternatives coming in the market which can kill this product?

4.2. Promising Production for Technology Projects

All the technologies and highly cited patents do not guarantee ultimate smooth production. There are 7-10 sciences and technologies combined to make a production process. A good chemical formulation may not be supported by material sheet of required vassal. Electronic and IT may not support that level of automation required in the plant. The civil infrastructure may be too costly to go for production. Therefore, ORIC teams in collaboration with scientists, need to plan production possibilities by considering such parameters and prerequisites.

The following check list may be considered:

- Is technology reproducible at pilot and then large scale?
- Is required machinery available in local and international market?
- Are testing facilities available and accessible for technology?
- Can technology meet required STM standards?
- Can production meet local production standards and regulatory requirements?
- Can production quality match the quality of market product?
- Is production heavily dependent on few uncertain things like imported raw material, human skills, etc. which can cause failure in the future?

4.3. Promising Financial Planning for Technology Projects

The financial planning of a project is very critical and fundamental in investment decision making. The investor always looks at the opportunity cost of invested capital. The technology must offer more financial output than the opportunities exist in the market. The investor likes to see how much has to be invested, how investment will return back, what are profit margins and most important how much risk is involved. Investor also wants to see the security of its basic investment in case of failure.

The following check list may be considered:

- What is the capital cost of the project?
- What is the level of risk in investment?
- What is the payback period?
- What is the breakeven point in sale?
- Does the breakeven point in sale achievable in market share?
- What are the projected cash flows?
- Are the profit margins reasonable to accommodate unseen cost?
- Can the cost be further reduced in future?

4.4. Promising Management for Technology Projects

The factors of technological success and failure do not always depend on the product's quality and cost. Many times, the management assigned to implement technology is responsible for project failure. This mostly happens in the case of ICT where technology implementation causes technology failure. The ORICs and the scientists need to take care of the team doing collaboration with projects and dealing on behalf of the investor.

The following check list may be considered:

- Is the team competent enough to implement technology project?
- Does the team have related experience and qualification?
- Does the team have orientation of how technology projects are implemented?
- Is enough training given to the team responsible for implementation?
- Is enough training given to end users?
- Does the investor have enough courage to invest in new technologies?
- Does the company have experience at large to invest in new technologies?
- Do the company and the team have the capability of selling innovative products?
- Does the company have related infrastructure and resources?

Chapter 05

5. IP Policy for Applied Research

Problem Statement

The Intellectual Property (IP) is a highly misunderstood concept in Pakistan in terms of ownership and inventor rights. The scientists mostly are afraid of IP and feel insecure by adopting patenting way of technology protection and disclosure. The ORIC also intends to enforce IP policy which includes a set of rules and regulations to control the scientists from earning through IP commercialization.

Proposed Solution

The ORICs need to conduct the series of workshops and trainings to make faculty and students understand the true sense of IP, its protection and commercialization.

The smart IP policy may include:

- IP Policy, Objective and Scope
- Definition of IP, the Inventor and Ownership
- Types of Protection Modes
- Commercialization and Monetization of IP
- Effective IP Contract and Negotiation
- Distribution of Income
- Other Rewards
- Applied Projects

5.1 Objective and Scope

To provide enabling environment in the university for ideas to become innovative solutions and generate socioeconomic value for inventors, institution, investors and associates working for it.

IP Policy scope covers services and facilitation of IP Management for faculty, investors, and institutions.

5.2 IP Related Terms

5.2.1 Definition of IP

IP Stands for Intellectual Property claimed by an inventor. IP can be in numerous forms like a product, process, writing, formula, technique, model, equation or anything claimed as output of exercise carried out by researcher or group of researchers.

IP Policy follows the spirit of country (Pakistan) law for invention. The invention in IP Policy is defined as "Anything new to the world or new to the local market contributing in the knowledge by presenting a potential solution to the problem that exists."

IP Policy also recognizes research work of faculty and students that is non-patentable but has economic potential and can be commercialized.

5.2.2 The Inventor

IP Policy of the university recognizes the inventor as someone associated with the institution as part or full time employee who uses significant university resources in the process of research work. The inventor is the one who by employing his or her intellectual capability, creates a potential solution for the problem which exists.

5.2.3 Contract Research

The contract Research is defined as "a contract by the institution researcher with a client to solve some problem or perform certain tasks within decided period for decided rewards. The researcher may employ university students and other researchers to honor the contract as per ToRs. The contract has to be formal duly authorized by competent body of the institution."

5.2.4 Research Grants

The research grant is defined as "the project conducted by the university researcher for a donor or funding agencies for prescribed research targets against a research grant. The source of grants is public money or donor fund for certain development and research objectives. The outcome of grant based research needs to be generalized for public. The IP if created as outcome of research grants will be owned by the institution."

5.2.5 Local Patent

The local patent is filed in the IPO office of Pakistan to gain protection of an idea or technology having commercial impact in the market of Pakistan.

5.2.6 International Patent

The international patent is filed in the foreign country where technology has commercial potential and therefore needs to be protected.

5.2.7 Ownership of IP

IP Policy recognizes the contribution of the inventor of the intellectual property and offers intellectual credit to the inventor. The researcher/s will be known as Inventor of IP/Creator of IP.

University will be the owner of the IP and exercise its ownership through ORIC. The University will invest significant resources in establishing IP through pilots and surveys, patenting, protection, selling patent and ensuring maximum economic returns out of the patent. The University needs to own patent invented by its scientists to generate good economic returns for the scientists and also for itself.

5.2.8 Types of IP Protection Modes

There are many varieties of tools developed to protect IP of the scientists. This may include utility patent, design patent, copy right, trademarks and others. The scientists may visit the website of IPO Pakistan or consult the experts to finalize protection mode for their IP.

5.2.9 Commercialization and Monetization of IP

The ORIC of the university will invest its resources to support IP creation, IP management, IP commercialization and due financial and non-financial rewards to the researcher and institution.

- Significant resources of the university will be involved during the process of research
- The ORIC of the university will help researchers in getting funding from external resources
- The ORIC of the university will invest in patenting and commercialization
- The ORIC of the university will invest in protection, management and legal fight for invention

The researcher and the ORIC of the university will enter into a non-disclosure agreement and write all kinds of rules, rights, duties and rewards.

The ORIC will approach users of patent for market test and will ensure that the investor should earn good money from the sale. The ORIC will approach the investor and license out the patent for commercial exploitation.

5.2.10 Effective Negotiation of IP

IP negotiation is the most critical negotiation. It requires technology, law and marketing expertise. It is always advisable that IP lawyer is consulted and made part of the negotiation team. Technology maturity is fundamental in winning negotiation.

- The initial level technology with no promised rate of returns yields very less revenue. The technology with consumer and commercial trials, where the buyer is ready to purchase the product yields very high amount of money.

- The second component of the winning edge is economic analysis of IP. The details of market size, break-even analysis, payback period and projected cash flows give a strong edge in IP negotiation.

5.2.11 Contract of IP

Contract of IP is very technical and needs expertise related to law, science and marketing. Contract must be made or consulted by IP attorney. The pre contract interaction must also include sign of confidentiality disclosure agreement (CDA). The CDA gives a legal way to brief about technology and its potential business aspects. Model CDA form is attached in the appendix.

The final contract must be made between the institution which owns IP and the buyer who wants to commercialize IP. The witnesses and legal consultants should also be part of the

contract. The contract should include promise of existing developed technology based on current performance. The contract should not include guarantee of to be tested results. Initial contract is preferred to be non-exclusive as technology is not at matured level of maximum revenue. Exclusive contract is preferred to be made when economic fruits of technology are assured and maximum IP value is being paid.

Model contract form is attached.

5.2.12 Promoting Research Grants

The research grants are very much essential to create IPs in the universities. These grants help scientists to plan and conduct very rigorous research and produce need based and novel solutions. These large research projects have higher likelihood of producing patents and quality publications. ORIC must facilitate maximum grants applications and provide incentives for winning research grants.

Model incentives are proposed in upcoming section of annual appraisal and cash awards.

5.2.13 Promoting Patents Filing

ORICs need to promote culture of patents filing in the university. The most critical aspect in this regard is faculty belief and perception towards patents. This requires lot of education and orientation sessions with faculty to make them understand the importance of patents. There must be good incentives for patents filing, patents rewards and patents commercialization

Model incentives are proposed in upcoming section of annual appraisal and cash awards

5.2.14 Applied Projects

The culture of applied projects is very crucial to create maximum IPs in the university. The faculty and students have industrial exposure; market needs and understanding about market competition are in better position to do breakthrough research. The ORIC must bring maximum industry projects of applied nature for faculty and students. These projects would be a kind of Pre-IP projects. The faculty involved in such short industry driven projects will be able to plan and develop saleable potential patented technologies.

The university should announce some cash awards on these Pre-IP projects also to do baseline studies. These projects also result into small solutions to industry which inspire trust and build confidence of industry on academic works.

Form for applied project is attached.

General Guidelines for Applied Projects

- Project may be identified by ORIC, scientist, industry or by any source
- Project needs to be assessed by marketing officer of ORIC
- Project must solve some current problem, improve economics or add value in social life
- Project ToRs needs to be clear in terms of role, payments, time and deliverables

- Initial proposal and final draft needs to be submitted to ORIC
- Project must add to university-industry long term collaboration
- Project technology like source code, design, process, etc., needs to be submitted to ORIC
- Project technology will be the property of the university
- ORIC will work for further commercialization of these projects
- Scientist will be credited as inventor of technology and get share from financial proceeds if any as per policy of the university

5.2.15 Distribution of Income

The researcher will receive share of income generated through commercialization of research output. The expenses, revenue, income and such details will be determined and explained in each contract of technology sale. The distribution of income may vary for each institution and in each case. The following model distribution is proposed:

Proposed Income Distribution	
Income Level (of Entire Project)	**Income Share**
• For net income less than PKR 50,000/-	• 100% share for researchers and team
• For net income more than PKR 50,000/million and less than 02 million	• 40% for university • 60% for researcher and team
• For net income PKR 02-03 million	• 30% for university • 70% for researchers and team
• For net income PKR 03 million and above	• 20% for university • 80% for researchers and team

TORs of Income Distribution

- The same ratio applied for consultancy, trainings and proceeds comes from earning through faculty and students input
- The university share means 15% for ORIC and rest will be accounted for department of the researchers
- The issues related to research team, work scope, labs, equipment, etc., has to be dealt at the department level
- The research contract has to be approved by ORIC in the beginning and closing
- The university's ORIC will be the final authority for all the contingencies, decisions, policy revisions and approvals

5.2.16 Annual Appraisal for Applied Research

The applied research will remain an undo able wish-list unless made part of annual appraisal (ACR) and promotion systems. The increments and rewards for impact making research must

be in HR policy of the university. Following incentives in % may be incorporated assuming total 100% performance making total 100 points.

Proposed Incentive points in annual appraisal out of total 100 points	
Award Criteria in Annual Appraisal	Weight in points
• Contract research with zero to PKR 50000/- funding	01 point (each project)
• Contract research from PKR 50000/- up to 01 million funding	03 point
• Contract research from above PKR 01 million	05 points
• Winning Research Grant from PKR 01 million funding upto 05 million	05 points
• Winning Research Grant from PKR 05 million Fund upto10 million	10 points
• Winning Research Grant above 10 million	15 points
• Local Patent Filing (Approved by IPO Pakistan for examination)	03 points
• Patent Filing in USA, EU, etc. (Approved by IPO for examination)	05 points
• Local Patent Grant	10 points
• USA Patent Grant	15 points
• Sale of Patent	05 points + Income Sharing

5.2.17 Cash Rewards for Doing Applied Research

The university may consider announcing cash awards for pre commercialization works to inspire scientists. There is good amount of struggle involved in developing technology from idea to saleable commercially viable IP. The scientists may be encouraged in this stage through following proposed cash awards per project.

Proposed Cash Awards	
Award Criteria	**Cash Award**
• Contract research with zero funding through ORIC	Rs 25,000/- each
• Local Patent Grant	Rs 100,000/-
• USA Patent Grant	Rs 200,000/-

• Sale of Patent	Share in Income

5.3 Framework of IP Policy

IP Policy Framework is presented to universities for developing their own IP policy according to needs and circumstances. IP policy is not fit-for-all instrument to adjust in every situation. Every university first needs to determine the level of innovation and development stage and design IP policy to correspond it. The institutional culture, environment and acceptance must also be considered while making IP policy. The most important aspect of IP policy is its implementation. The leadership of the university must ensure that significant efforts are made for policy advocacy and implementation.

<table>
<tr><th colspan="3">The Environment for IP Policy</th></tr>
<tr><td colspan="3">• Institutional history of patenting
• Intuitional history of IP commercialization
• The perception and attitude of the scientists
• Culture and social values
• Legal framework and law enforcement</td></tr>
<tr><th>The Planning of IP Policy</th><th>The Salient Features of IP Policy</th><th>Implementation of IP Policy</th></tr>
<tr><td>• What problems should be addressed?
• What are the issues to be prioritized?
• Who will be the custodian office for IP policy?
• Which team is responsible for implementation and revision?
• Who should take benefit from this IP policy?</td><td>• Objective and scope
• The coverage- IP types
• IP cycle – from identification to maintenance
• IP/Patent filing
• Ownership of IP
• Contract and negotiation
• IP policy for students, scientist and industry
• Incentive system to promote patenting
• IP commercialization and monetization
• Distribution of royalties and revenue</td><td>• Advocacy for IP policy
• Phases of policy implementation
• Improving patenting and industry linkages
• Contingency planning
• Disputes handling</td></tr>
<tr><th colspan="3">Evaluation of Policy Effectiveness</th></tr>
<tr><td colspan="3">• What is acceptance level of IP policy?
• How much increase in IPs/patents?
• How much increase in industry contract?
• How much increase in technology transfer?
• How much increase in revenue for the faculty?
• How much increase in revenue for the institution?
• How much increase in funding and research grants?</td></tr>
<tr><td colspan="3"></td></tr>
</table>

6. Case Studies

Case Study01

Personal Profile

- Name: Dr Abul Hussam
- Born: Kushtia, Bangladesh
- Nationality: Bangladeshi, American
- Institutional Affiliation: George Mason University, Georgetown University, Case Western Reserve University
- Alma mater: University of Dhaka, University of Pittsburgh

Problem Background

Naturally occurring arsenic in nature is found to be polluting groundwater at higher concentrations, especially in the areas with deep tube-wells. The presence of arsenic pollution is a menace in Bangladesh where 61 districts out of 64 have crossed the permissible limit and have caused chronic arsenic poisoning to about 77 million people. Environmental activists and government and academic institutions have been putting efforts on developing an easy to use and market cost-efficient technology for safe water.

Solution

Adversity of the situation was addressed remarkably by Dr Abul Hussam, a Bangladeshi chemist at George Mason University, USA. He developed a cost effective, simple and zero energy input system for arsenic removal from water. From 2001 to 2010, about a million Bangladeshis have been benefiting from this "SONO" filtration system.

Research and Development

Dr Hassam graduated from University of Dhaka, Bangladesh, in the field of Chemistry and earned PhD in Analytical Chemistry from University of Pittsburgh, USA. He had great understanding on Automated Electrochemical methods for Water Toxicity Analysis; which triggered his mind for development of a method to combat the arsenic pollution in Bangladesh during the 1990s. He established an automated lab in heavily arsenic polluted area "Kushtia" of Bangladesh with the help of his brother and began screening water samples from tube-wells of different areas. Side by side he worked on developing filtration system to provide safe drinking water. It took him two years to produce a marketable version of the prototype of a system utilizing zero energy, cheap raw material and long-term process efficiency.

Dr Hussam devised a very easy, two-step filtration process using a composite iron matrix along with wood charcoal, river sand, and brick chips. The first step removed arsenic and the second step removed all other fine particles, producing safe potable water.

The invention was patented as "Arsenic Removal Filter" (Patent No. 1003935, 2002) by Dr Hussam in Bangladesh along with two international patent applications which have been made under the Patent Cooperation Treaty (PCT).

Economic Impact

The licensed NGO has commercially produced about 160,000 SONO filters up till 2010 being used in Bangladesh as well as in India and Nepal.

Scholarly Impact

- More than 100 scientific publications and conference proceedings
- Awarded highest engineering prize, the 2007 Grainger Challenge Prize for Sustainability from the US National Academy of Engineering (NAE) for the SONO arsenic filter
- Reclaimed in TIME Magazine, Global Heroes of the Environment 2007
- The Outstanding American by Choice, awarded by US Citizenship and Immigrations Services in 2008
- Distinguished Alumni Award for "Creativity, Leadership, and Accomplishments" by the Department of Chemistry, University of Pittsburgh
- Director, Center for Clean Water and Sustainable Technologies, George Mason University
- Professor, Department of Chemistry and Biochemistry, George Mason University
- Visiting Research Scholar at Georgetown University and Case Western Reserve University

Case Study 02

Personal Profile

- Name: Dr Maurice Iwu
- Born: April 21, 1950 in Umuezeala, Nigeria
- Nationality: Nigerian
- Institutional Affiliation: University of Nigeria, University of Oxford, Ohio State University
- Alma mater: Master and PhD in Pharmacy from University of Bradford (1978)

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Problem Background

Nigeria, since its independence in 1960, has been striving to build a stable economy. Although its GDP is a bit higher than other countries in the fast-developing Sub-Saharan region but it is of little use. Unemployment, illiteracy, poverty, poor health and sanitation, self-production of neglected goods, and no initiatives for industrialization are menaces which hamper its shift of status from underdeveloped, to developing and developed nations.

There was a dire need to promote national resources, and develop linkages at local and international levels for their optimal exploitation and utilization. To support the economy of Nigeria, new business venture creation was a necessity.

Solution

The pain of the nation was felt by a patriot named Dr Maurice IWU. In 1992, he developed a non-profit, non-governmental platform (NGO) as Bio resources Development and Conservation Programme (BDCP). Its role is to collaborate with local and foreign partners on traditional health practices, medicinal plant varieties and their effective utilization. By doing so, it aims to proliferate and support Nigeria's biological and human resources.

In the global pharmaceutical market, hundreds of these are plant derived and 75% of these herbs are from tropical forests in Africa and South America. The program was the discovery and commercialization of herbal medicines which originated from the knowledge and information obtained from THPs (Traditional Health Practitioners).

BDCP has worked with the Nigerian Government and pharmaceutical companies, and has developed a database of traditional healers' remedies. This puts anyone who is willing to conduct further research or commercialize the remedy, under liability to give due credit and benefits equitably with all stakeholders.

Research and Development

To unify Nigeria's repertoire of biodiversity with pharmaceutical industry, the major challenge was to develop trustworthy relationship among government, business sector and local traditional healers. The local healers had been safeguarding the functions and potential of local herbs since centuries and been transferring generation via generation as a closely guarded secret.

To gain trust of the local community, the protocol to work with them was clearly defined with total transparency. They were given upper hand as the bearer of ancient traditional practices and motivated to disclose the information. They were assured of their strengthened position and share from the benefits derived from the collaborations.

First and foremost was the capacity development of THPs so that they effectively communicate and represent their interests during mutual cooperation exercises with national and international scientists. For that, Shaman Pharmaceuticals Inc. USA (Shaman PI) founded by Lisa Conte (a scientist - drug manufacturer) and African branch of International Cooperative Biodiversity Groups (Africa ICBG) and various departments of Nigerian government were taken on board by BDCP. African ICBG is an organization which works for biodiversity conservation and sustainable economic growth and drug discoveries. This resulted in benefits-sharing agreement between THPs, Nigerian scientists and the pharmaceutical company in 1991.

Once the agreement, procedure and protocols were discussed and agreed upon, the R&D on local flora started with taxonomic studies of pharmaceutically active native herbs under the guidance of THPs. They were being interviewed for disclosure of medicinal importance, recipes and formulations which were used as traditional cure. It benefited bi-directionally; the THPs got new and advanced information of the herbs and partners got identified exact varieties having medicinal potential instead of screening huge numbers otherwise.

Once the plant species were identified, taxonomically pharmacopeia (a list of medicinal drugs with their effects and usage directions) were developed. Species were then transferred to high-tech laboratories in Shaman PI's R&D facility in the USA to investigate further. The varieties having promising results were processed to study the active compound (which actually alters biological system upon intake). The drugs were manufactured by Shaman PI using these active ingredients and the profit sharing went with all stakeholders.

Apart from profitable ventures, at initial levels, "access fees" was paid to THPs by Shaman PI. It was to get access to the traditional repertoire of medicines via THPs and also for facilitation in plant specimen collections and other on ground helps. These short-term payments to THPs were managed by an independent organization established by BDCP called the Fund for Integrated Rural Development and Traditional Medicine (the Fund). These agreements were legal and based on the Convention on Biodiversity (CBD), a global treaty sponsored by the United Nations (UN) to deal with biodiversity and the equitable sharing of benefits.

Apart from financial support in the form of "The Fund", Shaman PI also financed development of local R&D facilities at Nigeria. It also helped THPs to set up their small-scale ventures for selling herbal medicinal cures.

Apart from Shaman PI, BDCP also partnered with organizations around the world to explore and share the R&D facilities for biological samples analysis. It included universities from UK, USA, Cameroon, South Africa.

With the vision to promote indigenous resources of Nigeria, BDCP developed into a platform to offer facilities of vast data (pharmacopeia), plant collection; fractionation; ethnobiological surveying and economic value assessment; environmental conservation; ethnobotanical trainings for THPs and scientists.

Economic Impact

BDCP understood the importance of IP assets. It filed various patents on drugs manufacturing with Shaman PI and other partners to United States Patent and Trademark Office (USPTO), and also secured international markets by filing international patent applications via the Patent Cooperation Treaty (PCT) System.

Due to unfavorable global economic climate in the late 2000s, the collaboration between Shaman PI and BDCP ended. Not only that, Shaman PI failed to pass FDA phase III clinical trials of its most promising drugs. However, the founder of Shaman PI, Dr Lisa Conte spent US $650,000 and successfully bought IP assets of the company (co-owned by BDCP as well).

She used these assets as a key to get into new licensing agreements and raised more than US $85 million. Then she established new pharmaceutical manufacturing company "Napo Pharmaceuticals Inc. (Napo)" in San Francisco, USA. She also secured licensing agreements with other globally recognized marketing firms for sale in USA, Asia, Europe and Japan.

BFCP set up two successful spin-offs, Axxon Biopharm Inc. (Axxon), Maryland, USA, and Intercedd Health Products (IHP), Nsukka, Nigeria. These two ventures are based on production and marketing of natural pharmaceutical products. The former specially markets the R&D products of International Center for Ethnomedicine and Drug Development (InterCEDD) by BDCP.

BDCP celebrates annual two-day exhibition called "HerbFest" to promote biotechnological business ventures and investment opportunities through seminars and displays of commercially viable products derived from plants.

Scholarly Impact

- Published more than 100 research articles
- Author of four books
- Senior Research Associate at the Division of Experimental Therapeutics of Walter Reed Army Institute of Research, Washington D.C.
- WHO Visiting Scholar to Dyson Perrins Laboratory, University of Oxford (1980)
- Fulbright Senior Scholar, Ohio State University
- Won the US National Research International Prize for Ethonobiolology in 1999.
- Professor of Pharmacognosy at the University of Nigeria, Nsukka (1984–1993)
- Member, Board of Directors, Axxon Biopharm Inc.
- Member, Board of Inter CEDD, Fund for Integrated Rural Development and Traditional Medicine, and Center for Economic and Social Justice
- United Nation's Lead Consultant for the development of Nigeria's National Biodiversity Strategy and Action Plan

7. Appendix I

Monthly Progress Report of ORIC Staff

Employee Name_____ Employee Code_____

Designation_____ Month_____

Major Tasks Assigned:

- a
- b
- c

Major Tasks Completed:

- a
- b
- c

Comments by Head ORIC:

Rating	**Needs Improvement**	**Average**	**Good**	**Very Good**	**Excellent**
	1	**2**	**3**	**4**	**5**

Remarks by Head ORIC:

8. Appendix II

Confidentiality Disclosure Agreement (CDA)

XYZ understands the importance of maintaining confidentiality of Technology ABC by our associated scientist ABC and agrees to protect it. It is here by stated that technology as mentioned below belongs to and is owned by XYZ whereas as recipient of information will work under the below mentioned rules according to law.

Whereas:

The recipient is XYZ

The discloser is ABC referred as the scientist

The technology is "XYZ"

Whereas rules are:

- The technology is owned by the scientist fully who is responsible for reporting, use of raw materials and any other resource used to develop this technology
- ABC receives the information of technology for doing pilot study, identifying commercial potential, assessing technical potential and evaluating possibilities of commercialization
- ABC will make no claim of expense in case of technology not proceeding for commercialization through any reason
- The scientist and XYZ will enter into a separate commercialization agreement in case both agree to proceed for commercialization

The recipient hereby agreed to abide by the rules set in this agreement. The recipient agreed not to disclose, misuse or use information for the purposes other than stated in the agreement or stated in the written consent.

The agreement hereby states the consent of both parties as recipient and discloser to enter into confidentiality disclosure agreement. Any modification, revision, or amendment is subject to written consent duly signed by both parties.

The agreement carries neither clause against law of the state nor any other aspect of technology.

Any contingency with respect to agreement will be referred to third party constituted by mutual consent

Both parties have read the contents of agreement, fully understood and voluntarily agreed to sign the deal as set by written rules herein.

The Recipient	The Scientist
Signature ----------	Signature ----------
Date----------	Date----------

9. Appendix III

Form for Applied Project

Office of Research Innovation and Commercialization (ORIC)
University Name ……
Address……

For Official Use Only
Reff:
Date:

Project Registration Form

Scientist Information
Scientist Name _____
School _____Campus _____
Department _____
Cell _____ Email _____
Project Information
Project Name_____
Start of Project (Date) _____Expected Project Completion (Date) _____
Project Scope_____
Project Objective_____
1) _____
2) _____
3) _____
Contribution/Value Addition/Innovation_____
Partner Industry Information
Partner Industry:
Contact Person: Cell: Email
Signature

Scientist	**Industry Representative**
Name _____	Name _____
Signature _____	Signature _____
ORIC Marketing Officer	ORIC Manager
Name _____	Name _____
Signature _____	Signature _____

Project Description
Role of Scientist
Role of Industry
Role of ORIC
Project Deliverables
Others

10. Bibliography

Technology Transfer Manuals

https://www.autm.net/AUTMMain/media/ThirdEditionPDFs/V2/AUTM_TTP_V2_Full.pdf

https://www.innovationpolicyplatform.org/sites/default/files/rdf_imported_documents/TechnologyTransferOffices.pdf

https://www.hw.ac.uk/documents/IP_Handbook.pdf

https://otl.stanford.edu/documents/OTLinventorsguide.pdf

List of Funding Agencies

http://www.irp.edu.pk/rd-events/fund-your-research/

Some International TTOs around the World

https://research.ncsu.edu/otcnv/

http://tto.montana.edu/

http://case.edu/research/faculty-staff/tto/

https://www.umass.edu/tto/

http://www.cu.edu/technology-transfer-office

https://www.marsdd.com/mars-library/commercializing-your-innovation-what-to-expect-from-your-tech-transfer-office/

Some IP Policy Links

https://www.enterprise.cam.ac.uk/our-services/academics-researchers-and-students/commercialise-your-research/intellectual-property/

https://policy.usc.edu/files/2014/02/intellectual_property.pdf

http://www.imperial.ac.uk/research-and-innovation/research-office/ip/ip-policy/

http://research.ufl.edu/otl/wp-content/uploads/UF-IP-Policy-Updated.pdf

https://www.uspto.gov/intellectual-property-ip-policy

https://www.cmu.edu/policies/administrative-and-governance/intellectual-property.html

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12. Authors' Profile

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Secretary General, South Asia Triple Helix Association (SATHA)
Chief Coordinator, Institute of Research Promotion (IRP)
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Rahmat Ullah is a research scholar in management with specialized focus on innovation and technology development. He moved into management profession by setting up own enterprise, managing marketing and doing sales for national firms. After management and business administration education, he joined research organization IRP to promote R&D culture in Pakistan. He has published his research papers in academic journals and also presented them in national and international conferences. He has diversified experience of providing training, managing survey projects, developing online portals, initiating academic publishing and executing funded projects of development nature.

Rahmat has the credit of introducing a number of research software in Pakistan, developing above 30 training modules of research methods and training research scholars in Pakistan and abroad. He is also the focal person for university-industry linkages where he successfully launched a collaborative R&D promotion program with state-run R&D organizations, chambers of commerce and industries, business associations and industrial groups all over Pakistan. He has managed a large number of development technologies and initiated many industries-driven projects in the universities of Pakistan.

Rahmat also got training in health and hospital management, developed medical unit, and served the development sector in social development and poverty alleviation. He has blended experience of failures and success in initiating startups, scaling up to national level ventures, and making them financially viable. Rahmat is a regular trainer in research methods, and consultant for innovation and technology development for academia, industry, and R&D organizations. Currently, he serves the Institute of Research Promotion as Chief Coordinator, manages UMT-ORIC, and General Secretary, South Asia Triple Helix Association.

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Dr Mir Dost is a PhD in Entrepreneurship and Innovation Management from Asian Institute of Technology (AIT), Thailand. Dr Dost is serving as an Assistant Professor, Director for the Office of Research, Innovation and Commercialization (ORIC), and Head of the Department of Finance and Management Sciences (F&MS) at LUAWMS. Dr Dost's empirical research focuses on the areas of entrepreneurship, knowledge management, innovation management and process innovation. His research papers are published in the international journals i.e., Journal of Intellectual Capital, Journal of Engineering and Technology Management. Dr Dost has presented his work in the top tier conferences, i.e., Academy of Management (AOM) in 2016 at USA, and International Society for Professional Innovation Management (ISPIM) in March 2017 at Toronto, Canada.