Technology Management in Higher Education

Manual for ORICs

Step by Step Operational Guidelines for Office of Research, Innovation and Commercialization (ORIC) in the Universities of Pakistan

by

South Asia Triple Helix Association (SATHA)

Developed by

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President's Message

South Asia Triple Helix Association (SATHA) has been established to spur research, innovation economic growth and regional competitiveness in the region to cope the challenges of growing population and poverty. Its primary purpose is to build University Industry Government (UIG) collaborations.

Technology Management in Higher Education is the key area to be focused for fostering UIG Linkages. This manual is about operational guidelines for ORICs/TTOs (Technology Transfer Offices).

The efforts by universities to improve Technology Management (TM) capabilities in ORICs do not occur in isolation. Each university needs to invest in capabilities development within an intricate linkage of information, skills and product exchange with the external environment, which includes other manufacturers, service firms, buyers and suppliers, consultants and a variety of institutions dealing in finance, skills and technology support. Effective TM development requires that the intensity and ease of interchange improve as each of the actors becomes more specialized in its own area of competence.

This manual on TM is an educational tool. It is meant to guide ORICs of universities. Because of the significant variations in the level of development and therefore, the managerial skills required to master the technologies, it is added that the educator has extrapolated and possibly adapted those topics in this manual to suit the local environment.

Summary

Higher Education Commission-HEC has taken a great initiative to establish technology offices in Pakistan called ORICs- office of research, innovation and commercialization. HEC is gradually strengthening these ORICs through financial and management empowerment. ORICs are made essential focal persons and activities like research grants are submitted through ORICs. ORICs receive 15% of each grant, training, foreign exposure visits and lot more needed to strengthen ORICs for the role of technology management and transfer. This operational manual is developed for ORICs to support them for running operations of ORICs successfully.

Pakistan is ranked among top countries in terms of its strengths and basic resources like population, geography, mineral resources etc. Pakistan ranked among least countries in terms of development indices and human life index. This simply indicates that the resources are not capitalized for the welfare of society using innovative knowledge. In contrast to it this has truly happened around Pakistan in neighboring countries where knowledge has helped improve human life.

ORIC offices in Higher Education are instrumental to fill above mentioned gap. The manual document describes in details various bottlenecks, operational issues, practical challenges and possible interventions to promote problem solving research in higher education of Pakistan.

Acknowledgement

The operational manual is based on five years extensive interaction of lead author with faculty and industry. The working of last five to six years include around 50 workshops on technology development, policies for problem solving research, innovation enabling environment in 100 plus universities of Pakistan. More than 1000 faculty members, scientists and industry people attended these workshops and gave valuable inputs on to how to effectively manage technology transfer process in the universities of Pakistan. The authors are thankful to all these participants for input.

We are especially thankful to PASTIC, SRC (Pvt) LTD and Pakistan Council for Science and Technology for collaborations and support for these interactive technology workshops.

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1. Fundamentals of ORIC Management

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

Source: The text about ORIC role (1.1) is taken from HEC Website

HEC aims at always motivating and facilitating the Higher Education Institutions (HEIs) to make research a top priority for a sustainable economic growth and future knowledge economy. For this purpose, a centre is being established in universities to serve as a pivotal point, encompassing all the research activities - from development of research proposal to the commercialization of research products - under a single umbrella.

1.2 Objectives of ORICs

The objective is to develop, expand, enhance and manage the university's research programs and to link research activities directly to the educational, social and economic priorities of the university and its broader community. 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.

For this ORIC wants to improve the environment for all research and scholarship 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
- Improve recruitment and retention of the top faculty
- Translating research for the public's benefit
- Improving and strengthening university-industry relationships
- Promoting entrepreneurship, technology-transfer and commercialisation activities which improve and support the economy
- Promoting and improve multi-disciplinary research initiatives

1.3 Role of ORIC

Office of Research Innovation and Commercialization is meant to manage intellectual assets from faculty and converting them into mind-blowing technologies giving benefits to the society. ORIC is meant for establishing collaborations between industry and academic researchers (faculty). ORIC may have the following roles:

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

[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)*

1.4 Technology Eco System and Role of ORICs in Pakistan

Pakistan has recently started its innovation eco system after the initiative of HEC. Innovation eco system includes technology capacity of the country, technology adoption of the country and conducive regulatory framework which drives both academic and industry to work for innovation. Higher education plays a major role in making sustainable future (Cortese, 2003). HEC has achieved only first step of science capacity in Pakistan. The amount of competent scientists along with reasonably good labs and laboratories exist in Pakistan now.

The innovation governance framework with technology friendly policies are still absent in Pakistan. This absence seriously hinders performance of ORICs and the scientists also. Technology from lab to market needs policy support to attract investment, needs protection at incubation period and extra incentives to grow up to viable and competitive level (Todeva, 2013). According to Evans (1997) "The character of business community can be reshaped by state policy". Technology without flexible supporting system faces death after short period of its birth.

Industry in Pakistan has bitter or no experience of working with local academia for technology development. Industry has complaints about the poor quality of graduates which pre-step of technology projects (Bok, 2009, p 208). There is a need of continuous interaction and drive to bring industry on board and initiate contract research.

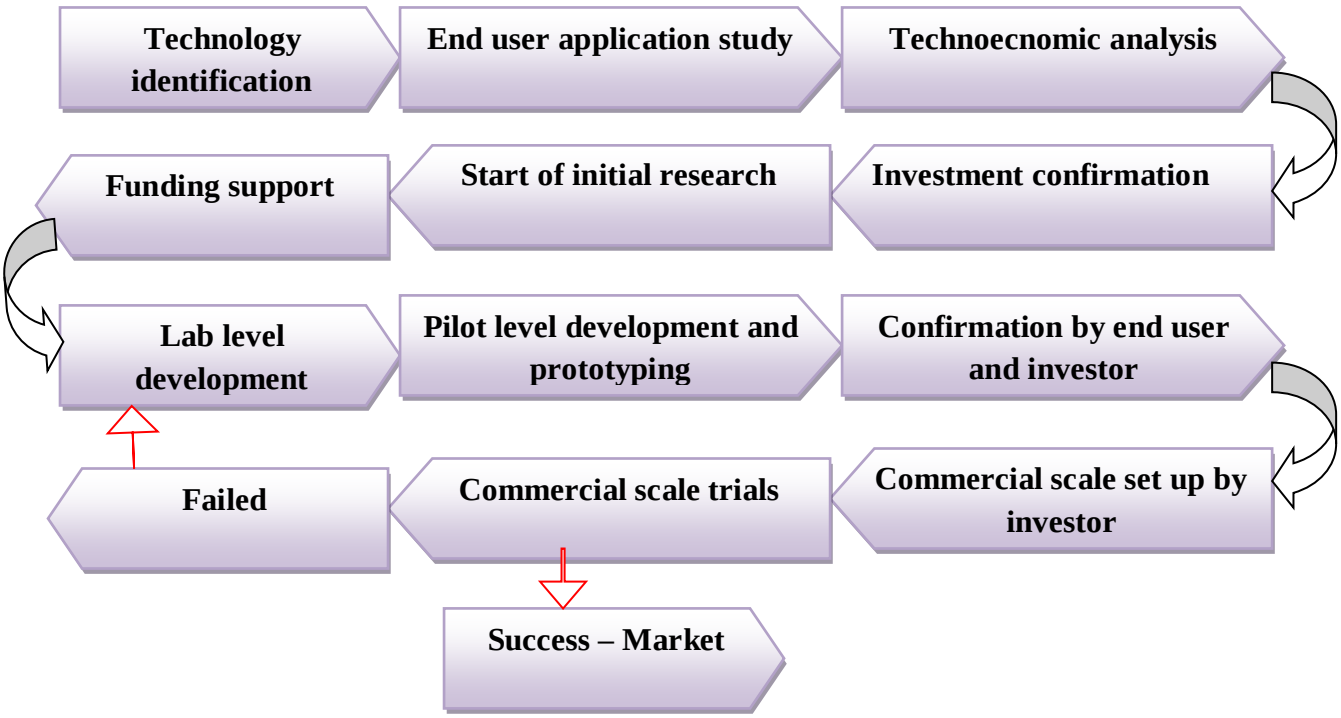
ORICs have great opportunity in form of above mentioned problems in Pakistani innovation eco system. ORICs by treating it as opportunity instead of problem can make turn around. ORICs can find innovative ways and means to support innovations in their institutions (Bercovitz & Feldman, 2006). ORICs need to be responsive, dynamic, efficient and outreaching to break the status quo and develop R&D collaborations.

The solution lies only in strengthening ORICs and empowering them to play a 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). The focus should be to create first few success stories where university research contributes in industry growth. Trend will follow the initial success and grow to produce more success.

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 present role of each stakeholder along the development stages of technology transfer (Bercovitz & Feldman, 2006).

Below is the technology transfer framework can be exorcised in ORICs.



ORIC is responsible to drive the technology in all stages, resolve problems of all stages and create trust and confidence of each stakeholder to move technology from all stages to success.

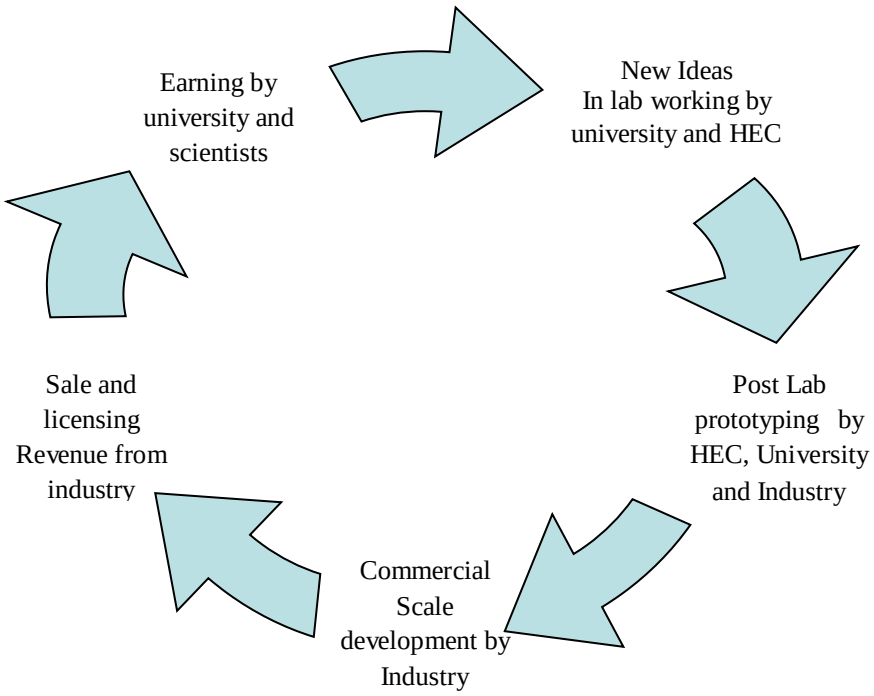
Technology business is time and need contingent. It is possible that demand of technology is viable in the start and turns out non-viable when technology is completed. There are number of factors affect the investment decision in technology like political and social condition of country, competition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

ORIC offices must plan how to promote contract research and revenue from technology sale. We propose that within three years, ORIC must start earning from industry through contract research or sale of technology.

Here is financial cycle across technology framework



Industry is always interested to invest in technology at its confirmation stage. Pakistani industry has no experience of doing joint R&D with scientist and making projects success. The effective method is to involve industry in R&D and technology development through state funding. The state funding must support upto prototyping level that is decision stage about technology viability. The viable project can be taken further by industry to develop commercial scale production.

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 on technology can pay to the university and scientists on mutually agreed upon terms.

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

1.7 Role of Players in Technology Development Stages

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

Role	**Scientists**	**Investors Industry**	**User Industry**	**ORIC**
• Technology identification	✓	✓	✓	✓
• End user application and confirmation			✓	✓
• Technoecnomic analysis	✓			✓
• Investment confirmation		✓		✓
• Start of research and development	✓			✓
• Funding and related support	✓	✓		✓
• Lab level development	✓			✓
• Patent filing	✓			✓
• Confirmation by end user	✓		✓	✓
• Pilot level development and testing	✓	✓		✓
• Confirmation by end user and investor		✓	✓	✓
• Commercial scale production		✓		✓
• Success or fail		✓		✓

1.8 Technology Selection

The 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 process followed by new products. In advance world academia and industry has similar level of working sage and efficiency research also gives good publications.

In country like Pakistan, the industry is quite behind and works on old technologies. There is the chance that efficiency increase in a factory production leads to good commercialization but not worthy of good publications.

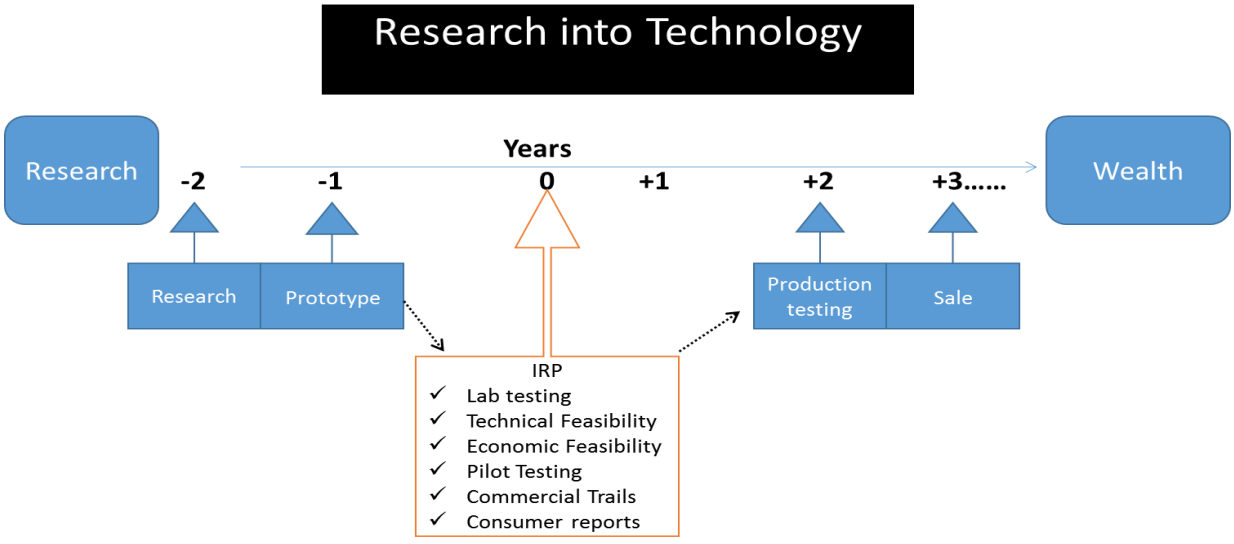
ORIC office needs to devise a strategy that researchers are given both options and incentives for both objectives. The scientists divide its research works to publish new ideas and also solve current operational problems of industry and society.

As we are on basic trust building stage, we need to add value in existing life of industry to prove academic capacity to deliver solutions. 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 Time Lines

The technology business needs long term orientation and patience. It takes on average five years from idea to product in market. We describe it as two years pre project and three years post project where is third year is the zero year. Pre project two years include identification, basic analysis, lab level research, funding and prototyping to some extent.

The zero year is third year that include 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.

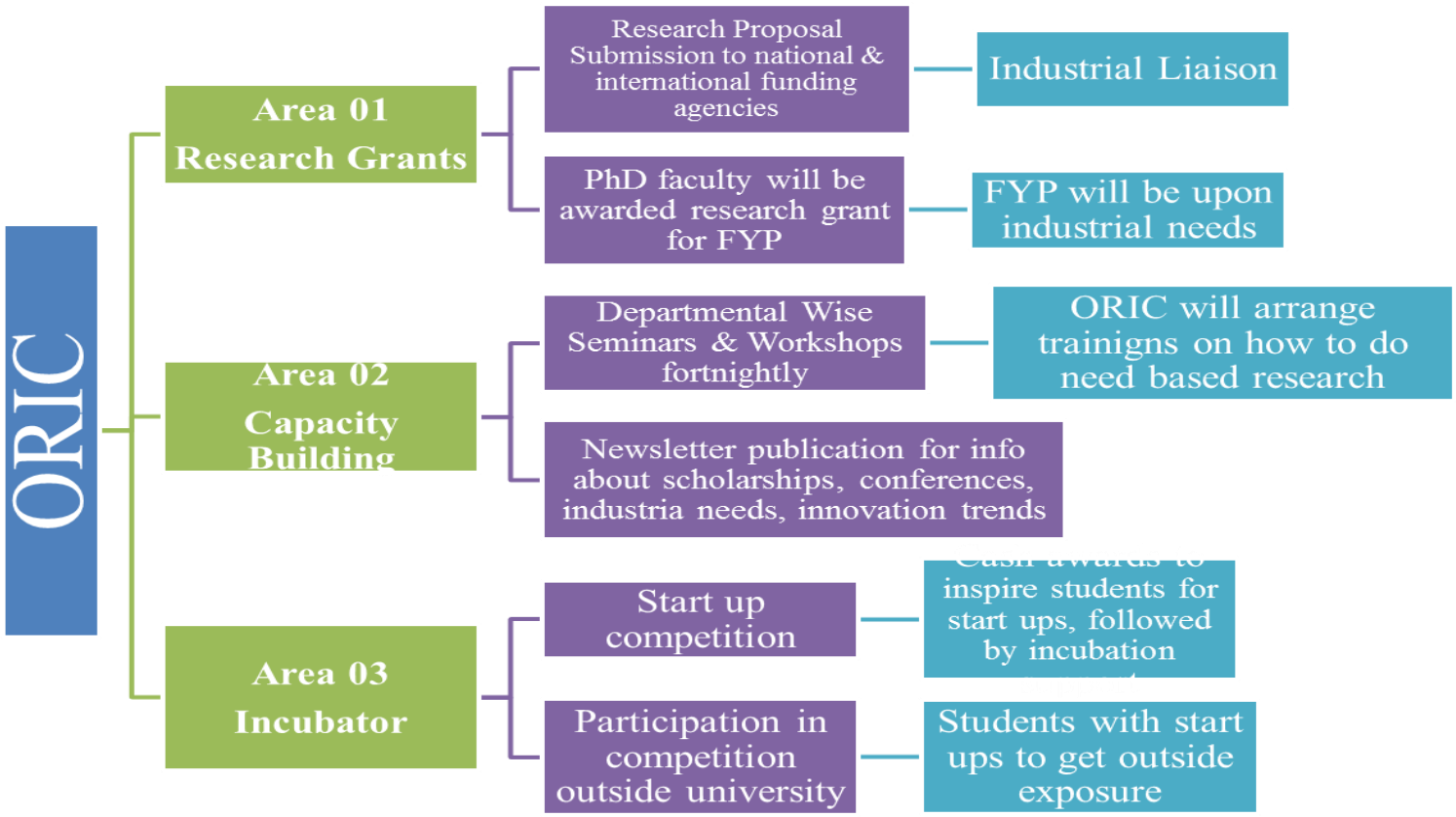


1.10 Planning Framework for ORICs

ORICs need to develop its planning framework based in their priorities and preferences in entrain time. This planning need to improve and change gradually as progress is achieved. The ORICs need to frame its basic areas of achievements and then devise key deliverables in that area. There should be key performance indicators, key actions to be taken and anticipated impact on the university due to this planned working.

The model planning framework is presented below which can be adjusted according to planning requirements of each ORIC.

Aggregate Level Planning for ORICs



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 per year
Capacity Building	Departmental Wise Seminars & Workshops	One full time training officer supported by internee	X number of seminars and workshops quarterly
	Newsletter publication for info about scholarships, conferences, industrial needs, innovation trends etc.	One publication officer	Monthly newsletter – weekly OIRC e news email
University - Incubator	Start-up competition	One full time incubation officer supported by internee	X number of startups registered each year in per incubation process X number of startups registered each year in incubation process
	Participation in competition outside university	Budget to support startup exposure visits and participation	X number of visits with x amount is given to each startup yearly

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 FYP	• 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
	Newsletter publication for info about scholarships, conferences, industrial needs, innovation trends etc.	• Is newsletter is of high quality in terms of contents and design • Is newsletter being read • Is there some queries based on newsletter information	
University - Incubator	Start-up competition	• How many students got pre incubation training • How many startups are incubated • How many startups are growing with time and sustainable	• Entrepreneurship culture promotion in university • Impact of business on society • Start-ups will be produced from university
	Participation in competition outside university	• How many startups are winning awards in competition as token of appreciation and quality of idea	

1.11 Infrastructure and Operations of ORIC

ORIC by design is a dynamic, outreaching and interactive office to inspire faculty and students for industry and community needed research. Sadly ORICs are bureaucratic kind of offices where faculty and students seldom make visits. In terms of infrastructure and seating arrangements, ORICs are not much attractive and open to welcome.

Open Environment: The seating arrangements for ORIC staff including head must be in open environment. The open environment always serves the purpose of interaction, fast communication, collaborative working and high efficiency.

Free Working Space: ORICs must have a kind of free working space where collaborators of the project can sit and do some works. The technology projects are always collaborative and need inputs of many people. These kinds of projects demand co working which to be provided ORICs where people can come freely and work for certain time.

Meeting Room: ORICs need a dedicated meeting room with seating capacity of around 30 people. There is need of interactive meetings, proposal presentations, briefings and investment seminars by industries.

Transportation: ORIC office working is totally halted without transportation facility. The working of ORIC requires frequent visits of faculty and students to industry and bringing industry people to the university. Lot of field visits are also needed by ORIC staff. Therefore, ORIC needs a dedicated car for frequent movement and on demand transportation facility for students and faculty visits.

Operational Budget: The offices are mostly inefficient due lack of operation budget and therefore become salaries paying machines. 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 course 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 found them ineffective due to inability to effectively liaison with faculty. The experience of university professor as part time ORIC heads also needs revision due to workload of professor and lack of prior experience to deal technology development process. ORIC operation staff is also not trained in technology management and transfer process nor have the same experience. ORIC team needs to be full time, dedicated and supported by infrastructure, financial and communication resources (Hülsbeck, Lehmann, & Starnecker, 2013).

Director ORIC

ORIC head needs to be a person who spent early career in industry and then moved to academia and did PhD from abroad. This qualification combines three experiences in a person as 1) working in local industry, 2) teaching and research in academia and exposure of advanced world technology process during PhD.

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

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

Administration Person: ORIC office must have an administration position to handle operations of ORIC. 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 office. The admin officer is responsible to ensure that ORIC services are reached to desks of faculty with proactive, interactive, dynamic and responsible communication.

Finance Persons: ORIC also needs a finance guy 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 Persons** 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.

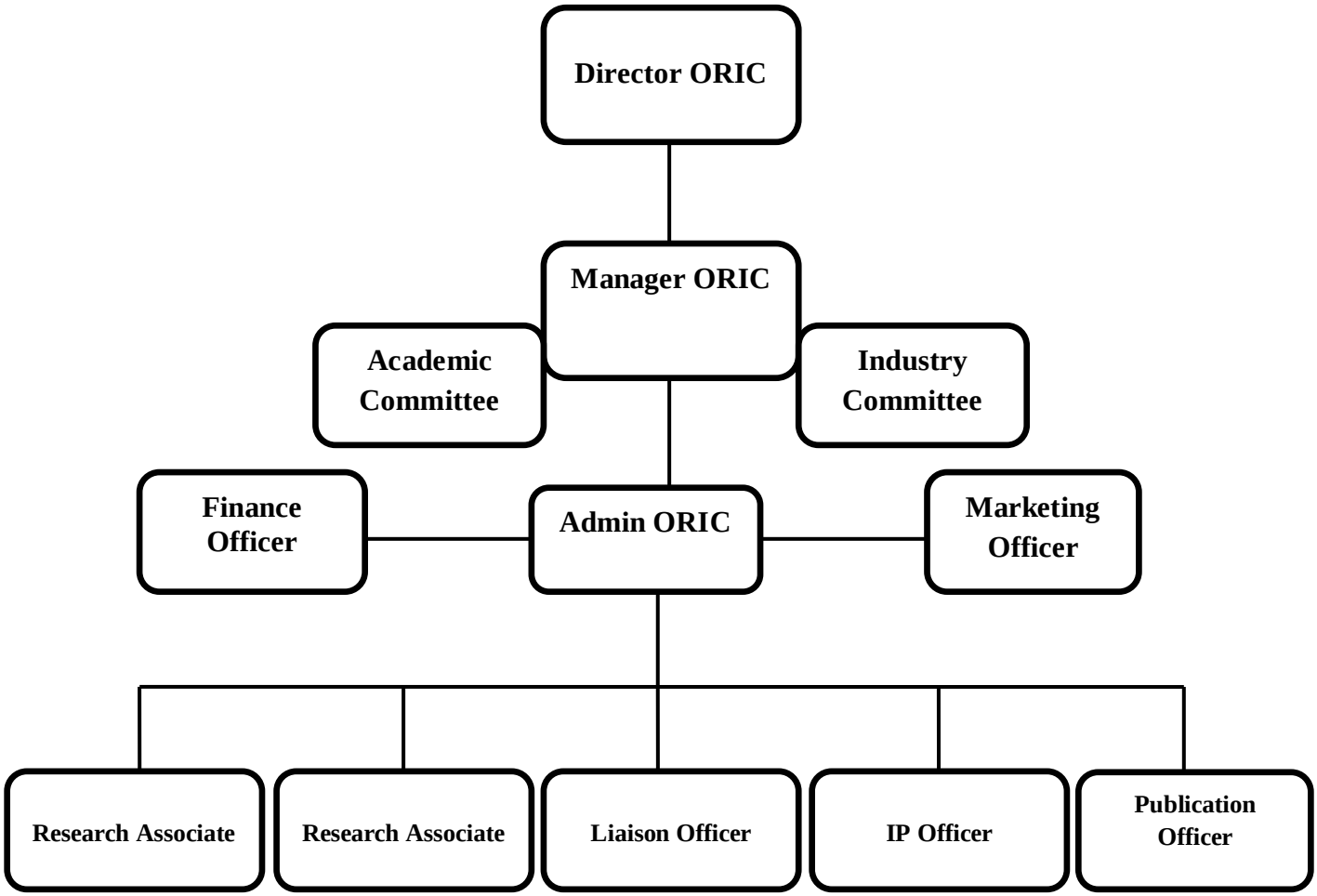
Other Staff: ORIC needs for staff proposed by HEC like IP manager, publication officer, support staff like research associates, assistants and support staff may vary according to situation or HEC guidelines.

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



1.14 Evaluation of ORICs

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).

Collective performance of ORIC refers to the overall performance of Technology Transfer Office. It should be judged as 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 students visits to industry are arranged
- How many industry visits to university for faculty interaction are arranged
- How much 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

ORIC staff must be made part of risk and reward of ORICs. Mare salaries for allocated time spending in office will underpin non-performance of ORICs. ORIC key staff like 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

2. Major Challenges of ORICs

2.1 Contribution in Economic Development

One of the biggest challenges of ORICs is significant economic contribution of the university. Pakistan has recent experience of development in higher education that translated into good number of publications and citation. The poor quality of students' research leads to trust deficit between industry and academia instead of solving problems.

How ORIC will reverse the situation of trust deficit and drive academia to translate their research into economic and social contribution. ORICs may need to work on faculty belief, incentives for faculty and students, entrepreneurial capability of scientists, technology transfer process, and management of intellectual property. In order to overcome, the academic system of thesis conduct and the supervisory process must ensure good quality and rigorous research output from the students thus heavily contributing to country's economy.

2.2 Policy Factors

Scientists always question why we should solve industry problems whereas we judged annually for teaching and publication. Scientists lose interest in the start or mid of the projects which cause failure and serious trust deficit. There is a dire need to cope up with this challenge. ORICs need to work efficiently for the policies addressing they why challenge and other grey areas. ORCIs need to develop conducive policies, devise incentive system and frame enabling environment for scientists to excel in contract research. ORICs also need to advocate to Government to device policies in order to bring industry academia closer to each other.

2.3 Trust Gap

The trust gap widens when industry and faculty does not interact with each other. This is the biggest challenge to overcome to start collaborative joint projects. The poor quality of projects done by academia cause the industry loses interest and trust. Academia must have internal body to review the progress of industry projects and responsible for taking measures in case of low performance. Industry seldom trusts 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 Funds Generation

The financial viability of ORICs is quite challenging for universities especially of 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. ORICs can achieve its financial empowerment and support marketing operations of faculty research through this fund. There are number of other measures to generate funding for ORIC;

- 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

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

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 number of efforts started for university industry linkages but ended up by increasing the trust gap. Now ORICs need to take various measures to interact, collaborate and understand each other's context. 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
- Students thesis on 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 to gather where both side of people sit together, understand each other's and exchange ideas and potentials.

3.1.1 Participation on Boards/Committee

Current State: It is a rare practice in few universities/R&D organizations where department committees have related industry people on board. It is also very rare that committees of chambers and business association have permanent position for related scientists from academia.

ORIC Initiative: There is a need to make participation of industry-academia in boards of each other's. ORIC may try to initiate followings 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 like for curriculum, theses selection, theses review etc must have 02 industrial nominations permanent 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 scientist irrelevant to the local industry/community. Businesses are the front end of market changes, grow on daily basis and adopt changes. Less exposure of scientists to these changes impede the collaboration as both are not on equal level of understanding and exposure.

ORIC Initiative: There is a need to make industry working as part of scientist job who opt for applied research. ORICs may fight for followings:

- 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 from academia, 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 theses of graduates are not conducted on industry issues. The industry-student interaction stands at minimum level in all academic circles. This has negative effects on students' job prospects and university relevancy with the environment. Thesis can be instrumental for trust building if planned and conducted jointly.

ORIC Initiative: Thesis of all level students (BS, MS and PhD) to be made instrumental for association with industry. The thesis if linked with industry issue can provide job opportunity and good salary at start. ORIC may consider 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 and approved after industry recommendations
- The consumables /expenditure for industrial research thesis to be funded by industry
- Students needs to be trained for industry liaison

3.1.4 General Community Services

Current State: – There is less 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 following initiatives:

- The academic conferences may not be limited to industry sponsorship only.
- There is need to to include industry issues and problems in the academic conference.
- There is need to invite industry on general university programs.
- There must be various students' forums of community services headed by teachers to perform certain welfare services for 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. Commercialization is part of technology management must be done by ORIC independent institute like IRP. R&D management includes technology identification by, business planning and commercialization by ORIC after scientific trials by researchers. We need to develop enabling environment of management around science and knowledge creation to exploit it.

3.2.1 Technology Management – Role of ORIC

Current State: There is substantial focus on technology development through lab works in the country. There is significantly less focus on technology management support of these trails. Technology managers with capability to support operational part of trails are not found in the university labs. Further, in most of 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. The 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
- Support for administrative, logistics and other management issues must be a 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

- ORIC offices need to be strengthened as technology managers in universities
- ORIC office 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: Among the reasons of failure in applied research is lack of infrastructure support. Lot of problems related to small instruments, tools, chemicals, fuel, tests, information availability and repairing make the projects delayed and suffer**.**

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

- There is need of dedicated facilitation centre in every ORIC/University
- The facilitation centre should arrange transportation, logistics, small tools, instruments, chemicals, related information from market etc
- There should be significant budget for facilitation centre
- There should be easy to access budget to get repairing and maintenance of equipment
- There is 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 as ability to do need based research and ability to commercialize and exploit research by making business out of it. Very serious efforts are needed to build capacity of academia and industry for applied research. The scientists are not trained to solve problems of local industry through commercial research. Universities as whole and ORIC offices 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 adoption and implementation of university given research of initial level.

ORIC Initiative: There is need of significant attention and resources on building capacity of academia involved in conducting applied research

Following measures may be considered by ORICs

- Foreign scientists having 10 years plus relevant experiences to be invited to train scientists on various aspects of doing technology driven research.
- The scientist opting 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 is to be involved initially in short trouble shooting 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 University

Current State: The universities lack internal mechanism of quality assurance for projects given by industry and society. Industry lose interest when find that there is no one to take responsibility of their given projects. Industry mostly demands committed research work on time with progress report and next working. Such things are not assured from academia side as they work free of any such limits.

ORICs Initiative

Academia needs to strengthen ORICs and its role in projects given by industry. ORICs need to be made responsible for timely results and reporting. The department also should have a committee which approve and track progress of each project. In case of delays, the department and ORIC must be able to take some corrective measures.

ORIC may take following measures

- Take a focal person from each department for effective department communication
- Ask departments to make their committees for projects 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 website so people build trust on processes of ORICs

3.3 Incentives for Problem Solving Research

Problem Statement

Indicators of research output in Pakistan starts from HEC initiative. We see 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 ORIC offices in the universities.

The incentive system for academics is shifting from only teaching, paper publication and administration service 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 doing given tasks by institutional heads. Scientists try to fulfill these three important aspects as priority. Most of young scientists trained for scientific discoveries are busy in administrative works. HEC is making a great transformation as included industry interaction, contract research and patents in annual appraisal of universities used for ranking.

ORIC Initiative: ORICs need to play 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.

ORIC may consider the followings:

- 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 university/ORIC office of 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 administration 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 ACR/ Faculty appraisal form must include components like:

  - Teaching
  - Publications
  - 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, focus of research funds is mixed as few funds like NRPU demands novelty and advancement in knowledge whereas Technology Development Fund (TDF) demands prototyping. The TDF is tied up with applied nature neither of work for developing solution of industry problem. The grants release system is also very active.

ORIC Initiative: ORIC has very strong role here to direct its faculty towards technology development fund of HEC for industry research. The basis ideas need to be referred to NRPU funding. ORIC office needs to engage industry and scientists for quick funding and to keep projects on tracks.

ORIC may consider followings:

- There is always appreciated that a base line study is conducted about potential and viability of research.
- The fund may be allocated for base line studies, lab trails and pilot level testing

The ORIC approved projects must fulfill 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 be consented by investor and end user for commercialization

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

- Rs. 500,000-1000,000/- for each scientist per year who choose 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 averagely.

The release of funds is 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 needs to 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 is much hurdle in public sector funding. There should be an officer in ORIC who deal with all procurements issues and financial reporting. Scientists must be spared from consuming valuable time in clerical services.

3.4 Assessment of Problem Solving Research

Problem Statement

The entire burden of research commercialization is put on researcher which has almost minimum role in the entire process. It means that entire institution needs to be assessed for research commercialization. This approach will bring a supporting eco system for impact making research. This will also leads 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 need that applied research be considered as essential performance indicator during recruitments/selection and performance reporting.

OIRC may advocate for followings:

- 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/promotion criteria includes 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 bring 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 universities is held responsible for applied/problem solving research. Head is neither asked nor accountable for how many technologies are transferred to industry by scientists working under him nor incentivized.

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

Followings to be considered in this regard

- JD 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/problem solving research. 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.

Followings 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 bringing 20% of its school/institute revenue from industry research
- Increment of Dean should be based earning from commercial research

3.4.4 Performance of ORICs for Applied Research

Current State: ORICs in universities are not challenged to promote applied/problem solving research. 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 is provided by the ORICs so ORIC needs to share risk and reward for commercial research. Followings to be considered in this regard

- ORIC office given marketing professionals with industry experience to liaison with industry
- ORIC may be given independence with budgets to facilitate research projects without delays and procurement issues
- The operational budget of ORIC needs to be flexible to do extensive mobilization and university-industry interaction
- 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
- ORIC office 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 and industry funding.

3.5 Commercialization of Technology

Problem Statement

The commercialization capacity in the universities of Pakistan is just started scratching the surface. The corresponding industry capacity to adopt and use university research also backs this weakness. Therefore, technology is not presented in the terms and language of businesses.

The solution

The ORICs need to build capacity of presenting technology or research output in form of business plan. There must be human resource in ORICs who understand industry mechanics and able to translate university research into business and production. The extensive liaison of ORICs and faculty with industry also minuses gap and help to present research in business format.

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

3.5.1 Promising Market for Technology Projects

ORICa team in collaboration with scientists needs to analyze the size and volume of 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 in regional markets or advanced world.

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

Following check list may be considered:

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

3.5.2 Promising Production for Technology Projects

All the technologies or highly cited patents does not mean ready for production. There are 7-10 various 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.

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 are available and accessible for the technology
- Can technology meets required STM standards
- Can production meet local production or regulatory requirements/standards?
- 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 future?

3.5.3 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 to be invested capital. The technology must offer more financial output than the opportunities exist in the market. The investor like 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.

Following check list may be considered:

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

3.5.4 Promising Management for Technology Projects

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

Following check list may be considered:

- Is team competent enough to implement technology project
- Does team has related experience and qualification
- Does team has orientation how technology projects are implemented
- Does enough training is given to implanting team
- Does enough training is given to end users
- Does investor has enough courage to invest in new technologies
- Doe company has experience at large to invest in new technologies
- Does company and team has capability of selling innovative products
- Does company has related infrastructure and resources

4. IP Policy for Applied Research

Problem Statement

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

Proposed Solution

ORIC offices need to conduct series of workshops and trainings to make faculty and students understand the true sense of IP, its protection and its 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

4.1 Objective and Scope

To provide enabling environment in University for ideas to become innovative solutions and generates 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 institution

4.2 IP Related Terms

4.2.1 Definition of IP

IP Stands for Intellectual Property claimed by any researcher of the University. 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 exists”.

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

4.2.2 The Inventor

IP Policy of the University recognizes Inventor as someone associated with University as part or full time employee and 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 exists.

4.2.3 Contract Research

The contract Research defined as "a contract by the university 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 through authorized body of the university".

4.2.4 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 university".

4.2.5 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.

4.2.6 International Patent

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

4.2.7 Ownership of IP

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

4.2.8 Types of IP Protection Modes

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

4.2.9 Commercialization and Monetization of IP

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

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

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

4.2.10 Effective Negotiation of IP

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

- The initial level technology with not promised rate of returns yields very less revenue. The technology with consumer and commercial trials, where buyer is ready to purchase product yields very high amount of money.

- The second component of 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.

4.2.11 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.

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

4.2.12 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 a patents and quality publications. ORIC must facilitate maximum grants application and provide incentives for winning research grants.

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

4.2.13 Promoting Patents Filing

ORICs need to promote culture of patents filing in the university. The most critical aspect in the 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

4.2.14 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. 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.

University should announce some cash awards on these Pre-IP projects also to do a 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

- Projects may be identified by ORIC, scientist, industry or 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 property of 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 University's ORIC policy

4.2.15 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, training and proceeds come from earning through faculty and students input.
- The University share means 15% for ORIC office 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 department level.
- The research contract has to be approved by ORIC in the start and closing
- ORIC office of the university will be final authority for all the contingencies, decisions, policy revisions and approvals.

4.2.16 Annual Appraisal for Applied Research

The applied research will remain an undoable wish-list unless made part of annual appraisal (ACR) and promotion systems. The increments and rewards for impact making research must by 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/- upto 01 million funding	03 point

• Contract research from above PKR 01 million	05 points
• Winning Research Grant from PKR 01 million funding up to 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 point
• 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

4.2.17 Cash Rewards for Doing Applied Research

The University may consider announcing cash awards for pre commercialization works to inspire scientists. There is god among of struggle involved in developing technology from idea to saleable commercially viable IP. The scientists may encourage 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. 25000/- each
• Local Patent Grant	Rs. 100,000/-
• USA Patent Grant	Rs. 200,000/-
• Sale of Patent	Share in income

5. Case Studies

Case Study 1

Dr. Hussam
Arsenic Removal Filter" (Patent No. 1003935, 2002)

Abul Hussam
Born: Kushtia, Bangladesh
Nationality: American
Institutions: George Mason University, Georgetown University, Case Western Reserve University
Education: PhD (Chemistry)
Alma mater: University of Dhaka, University of Pittsburgh

Dr. Hassam graduated from University of Dhaka, Bangladesh in the field of chemistry and earned PhD in analytical chemistry from University of Pittsburgh in the United States. 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 at a 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 have been made under the Patent Cooperation Treaty (PCT).

Case Study 2

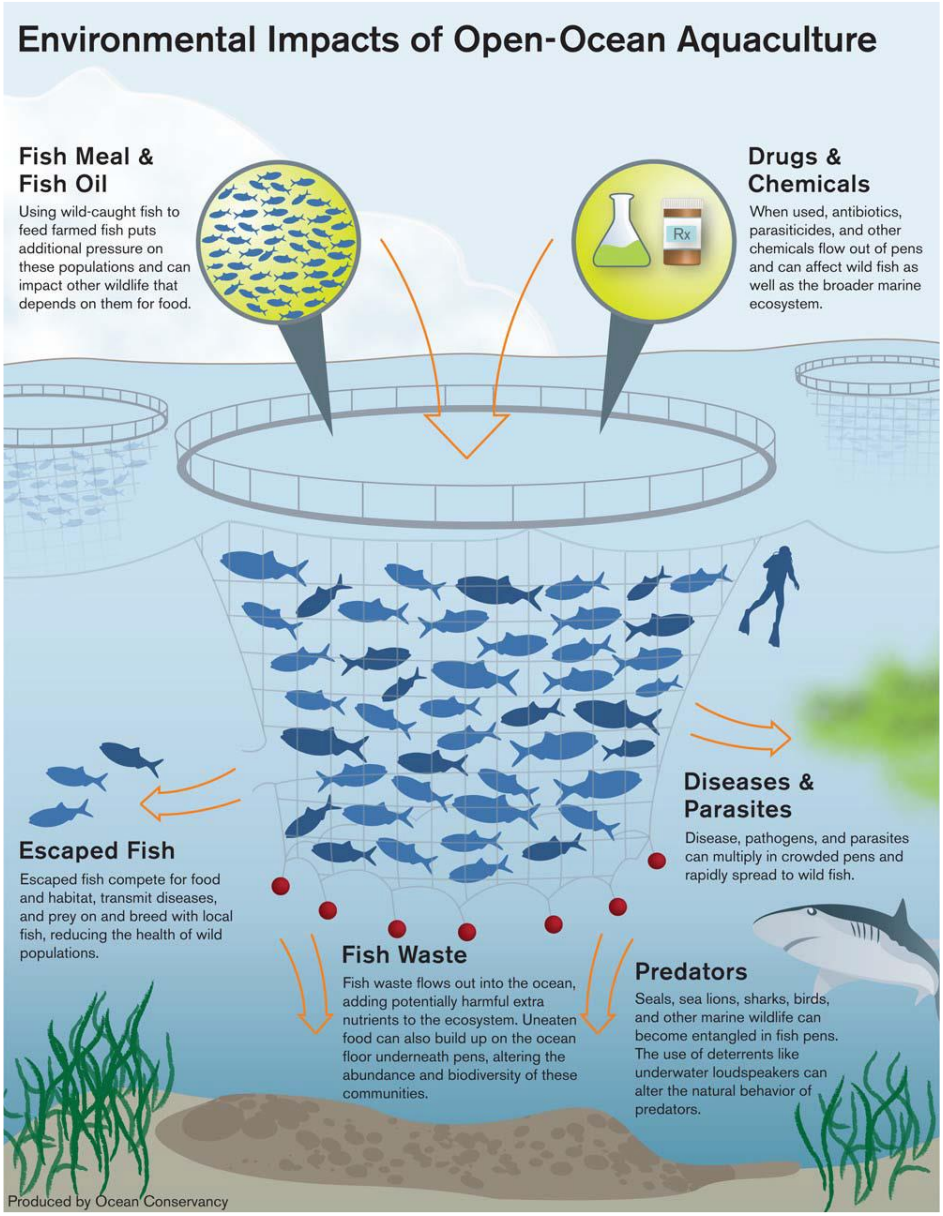
Prof. Dr. Hoang Trong Yem

Dr. Yem and his team successfully developed zeolite from mud which is abundant in Veitnam. It took them a year and about 500 failed experiments which paved the way for development of 14 different types of zeolites. Now, zeolite crystals are added into suitable products and used to clean water used in agriculture industry, livestock etc. Most happy by the success is not only the research team, but the farmers.

The IP division of university took this project to mark the new avenues of profitable research. the IP Division registered four trademarks for four different kinds of zeolite: "Bk-z4a," "Bk-

z13x," "Bk-zsr," and "Bk-zcr". Each trademark has the name of the zeolite in Vietnamese and is accompanied by the University's logo.

The technology was successfully commercialized in the form of a production plant in the Economic Zone of Dinh Vu, by 2011 output was valued at seven billion Vietnamese Dong (VND), or approximately US $335,000, annually. Due to ever increasing demand of zeolite, it was expected to reach in $115 million in 2011.



6. Appendix I

Monthly Progress Report of ORIC Staff

Employee's Name: Employee Code:

Designation: Month:

Major Tasks Assigned:

- a
- b
- c

Major Tasks Completed:

- a
- b
- c

Comments by Head ORIC:

Rating : 1—2—3—4—5

Remarks by ORIC Head:

7. Appendix II

Confidentiality Disclosure Agreement - CDA

XYZ understands the importance of maintaining confidentiality of Technology ABC by our associated scientist ABC and agreed to protect it. It is here by stated that technology as mentioned below belongs to and owned by whereas XYZ 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 and responsible for reporting, use of raw materials and any other resource used to develop this technology
- ABC receives the information of technology for 1) doing pilot study, 2) identifying commercial potential, 3) assessing technical potential and 4) evaluating possibilities of commercialization.
- ABC will makes 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 of both agreed to proceed for commercialization

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

8. Appendix III

FORM P-1A

THE PATENTS ORDINANCE, 2000
Application for patent when the true and first
Inventor is NOT a party to the application
(section 13(1))(rule 8(1))

We,

Office of Research, Innovation and Commercialization (ORIC),
University Name

hereby declare:-

(i) that I (or we) am/are in possession of an invention for "_____"

(ii) that I (or we) claim to be the assignee of _____ who claim(s) and is (are) believed to be the true and first inventor(s) thereof;

(iii) that the invention is not in use in Pakistan by any other person;

(iv) that the specification filed with this application is and any amended specification which may hereafter be filed in this behalf will be true of the invention to which this application relates;

(v) that following are particulars of my (or our) application.

Description:	5 pages
Claim(s):	6 claims
Abstract:	1 page
Drawing(s):	9 Sheets

Address for service in Pakistan:

_____

_____

I (or we) humbly pray that a patent may be granted to me (or us) for the said invention.

Dated this: ____ day of: ___ 2017

Signature: _____
Name:
Designation:

To:-
The Controller of Patents,
The Patent Office,
KARACHI.

ENDORSEMENT BY INVENTOR (S)

I (or we) _____

referred to on the reverse of this document as claiming to be the true and first inventor(s) agree that the said application shall be made without my (or our) name(s) as (an) applicant(s) for a patent.

Dated this: ___ day of: ____ 2017

1. Signature: _____
   Name:
   Designation: Inventor

2. Signature:_____
   Name**:**
   Designation: Inventor

Names addresses and signatures of two witnesses:

1. _____

2._____

9. Appendix IV

FORM P-28

PATENTS ORDINANCE, 2000
Form for authorization to agent.
(Section 81) (rule 55)

IN THE MATTER OF: **"**_____**"**

I (or We)

_____

_____

hereby authorize:

_____

_____

to act as my (or our) Agent and to perform the functions, acts and deeds deemed permissible by the Ordinance and the Rules and to receive all notices, requisitions and communications until further notice.

And I (or we) revoke the previous authority given by me (or us) in this matter.

Dated this: ___ day of: _____ 2017

Signature: _____
Name:
Designation:

To:-

The Controller of Patents,

The Patent Office,

KARACHI.

10. Appendix V

Form for Applied Project

For Official Use Only
Reff:
Date:

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

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

Project Description
Role of Scientist Role of Industry Role of ORIC

Project Deliverables   Others

11. Bibliography

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

12. References

Bercovitz, J., & Feldman, M. (2006). Entpreprenerial universities and technology transfer: A conceptual framework for understanding knowledge-based economic development. *The Journal of Technology Transfer, 31*(1), 175-188.

Bok, D. (2009, p 208). *Universities in the marketplace: The commercialization of higher education*: Princeton University Press.

Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for higher education, 31*(3), 15-22.

Evans, P. (1997). State structures, government-business relations, and economic transformation. *Business and the state in developing countries*, 63-87.

Hülsbeck, M., Lehmann, E. E., & Starnecker, A. (2013). Performance of technology transfer offices in Germany. *The Journal of Technology Transfer, 38*(3), 199-215.

Lin, T.-C. (2004). The role of higher education in economic development: an empirical study of Taiwan case. *Journal of Asian Economics, 15*(2), 355-371.

Todeva, E. (2013). Governance of innovation and intermediation in Triple Helix interactions. *Industry and Higher Education, 27*(4), 263-278.