

## Perspectives of Academia-Industrial Linkage in Pakistan: An Insight Story

AMBREEN GUL\* AND AFTAB AHMAD

National Academy of Young Scientists (NAYS) Pakistan, School of Biological Sciences, University of the Punjab, Lahore, Pakistan-54590.

### Abstract

West has made tremendous progress after industrial revolution. The industry in west was strengthened by academia-industry linkage. Now, there is great emphasis in east to bridge the academia and industry. Pakistan, among other Asian countries, is far behind in the development of this relationship. Commercialization of high technology products becomes possible through strong academia-industry linkage. This report highlights the importance of academia-industry linkage and the long-term effects, it imparts on the development of nations. Science and technology development in universities can only be made public by sharing information and promoting the industrial linkage. Biotechnology, pharmaceutical and information technology (IT) sectors are one such example, which can progress until the academicians belonging to these fields collaborate to industries and commercialize the new products in and out of the country. Beside others, China, India and Thailand are among Asian countries that worked hard to strengthen academia-industry linkages as compared to Pakistan, which improved their economy. National policies, in bridging the gap, are keystone for building the foundation of academia-industry relationship. Strategic measures for a strong and effective academia-industry linkage are outlined in this report.

**Keywords:** Academia-industrial linkage, Pakistan, National, Developing countries, Innovation, Technology, Higher education.

### Introduction

“Coming together is a beginning, keeping together is progress and working together is success” a saying of Henry Ford pinning towards a key to success of nations. Historical examples reveal that individualistic approach to strive for excellence can never be made true until the unity of forces into a bond. This quote applies to all fields equally. Individuals’ progress when they share, communities get strong when they collaborate and the nations survive through the concerted action of her communities.

Symbolically, the nations’ estrangement into three categories as underdeveloped, developing and the developed, owes to their progress in the field of science and technology (Iqbal, 2007). Under this criterion, one has to peer deep into the grounds that have build up progress in few, but left rest of the countries behind. West is the best example to look upon in terms of industrial revolution. The impacts of World War II posed on the British economy were:

- (a) Space for various industries,
- (b) The opportunities for the investors to promote them,
- (c) A concerted link between the industrialists and educationists to thrive for excellence.

Industrial revolution in Britain came into existence mainly because of the strong interaction between the two entities i.e. Industries and Academia, and it raced in the list of developed countries leaving behind the rest of the world. Almost all major revolutions in technological sector engross academicians at the back. Technological enterprises like Royal Mint, Trinity House and Xerox Company all had renowned scientists, Newton, Faraday and John Bardeen, accordingly, at their back (Murty, 2002). Developing countries can thrive for the status of developed world by acting on this old saying, “united we win, divided we fall”.

Fundamental approach to the lack of progress in Pakistan has been reviewed in this paper with

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\*Author for correspondence E-mail: [hrm@nays.com.pk](mailto:hrm@nays.com.pk)

special emphasis to the Academic-Industry Linkage. An understanding to the academia and industry approach towards innovation and technology development has been discussed. Many recommendations, for the sake of healthy and strong Pakistan, to develop an effective Academia-Industry linkage have been proposed.

### **A Case Study in Pakistan**

#### ***Biotechnology Industry:***

Since the past decade, the biotechnology in Pakistan has progressed largely. National centers and institutes have been established in many prominent public sector universities. Among them, National Institute of Biotechnology and Genetic Engineering (NIBGE) is the leading institute in the field of biotechnology accomplishing the biotechnology growth in major areas of research like Agriculture, Health, Environmental and Industrial Biotechnology. The basic mandate of this center is to promote the research combined with genetic engineering techniques to uncover the industrial problems and benefit the public by crafting dynamic and comprehensive solutions. In this perspective, endeavor progress to execute the development of agriculture biotechnology in the form of establishing and commercializing insects and pests resistant crops, drought and salt tolerant crops and organic fertilizers, etc., are underway.

Center for Excellence in Molecular Biology (CEMB) and Center for Applied Molecular Biology (CAMB) is another striking example to conduct the research at molecular level and, hence, endorse variety of biotechnological sectors like medical (interferon, stem cell regenerative medicine, diagnostic kits for HCV, HBV and TB), Agriculture (Bt Cotton, Disease free Gladiolus Corn) and gene characterization (gene sequencing, microarray). Development of interferon (IFN- $\alpha$ , IFN- $\beta$  and IFN- $\gamma$ ) and Insulin is a major breakthrough by CEMB ready for commercialization but is suffering the poor Governmental-industrial policies and rolling, like a ping-pong ball.

Similarly, many public sector universities have established biotechnology institutes, are working independently for the promotion of scientific innovations at the expense of Govt. budgetary, destined for higher education sector. Known examples include; Institute of

Biochemistry & Biotechnology (IBB) and School of Biological Sciences (SBS) at The Punjab University, Institute of Industrial Biotechnology at GC University Lahore, KIBGE at Karachi University, IBGE at University of Peshawar, HEJ Research Institute of Chemistry, etc.

Unfortunately, despite the existence of well-equipped institutes, biotechnology growth at national level is not coming up to expectations and requirement of the era. Productive capacity of the institutes is much less than their status, pinning towards a major lapse in implementation of unified national hold and targeted research work. Moreover, research activities in many of such institutes are repetitive or for the sake of piling up research papers. Regardless of the presence of so productive institutes, academia-industrial linkage in these institutes is very weak. The ground reality is that, industrial biotechnology only exists in the institutes, and the actual presence of biotechnology industry is next to none. Biotechnology bloom is closely linked to industry, and in the absence of any industry, it is worthless to spend a huge amount on the biotechnology research in institutes.

#### ***Pharmaceutical Industry:***

Pharmaceutical discipline, although evolved since Pakistan's independence in 1947, still is a progressive department and needs focus on applied research and development in medicine manufacturing and providing health care (Hadzovic, 1997). There exists more than 600 pharmaceutical companies in Pakistan and out of this 386 are true operating units (Aamir and Zaman, 2011). This sector is not only progressive but has more potential both in its research and development (R&D) and in national growth. The national companies fulfill almost 80% demand domestically while 20% relies on foreign export, largely from Switzerland (Aamir and Zaman, 2011).

Even though the greater expansion in number of pharmacies, meager amount is spent in its R&D sector. Industries, in Pakistan, lack interest and infrastructure for R&D, which forms the base of resource construction for developing nations. Only multinational Companies, consisting of 30 operational units, contribute if any, towards pharmaceutical R&D, while all other national units are paying much less attention to their

research. Apart from the pharmaceutical companies, universities in Pakistan, awarding the pharmacy degree, are far behind the practical approach in drug research.

If an academic institute accomplishes the development of drug, it's up scaling and commercialization, which are the industrial tasks, halts its accessibility to public. CEMB, for instance, has succeeded in the development of few major protein-based drugs, interferon and insulin. There is still a question about, who will do the rest of the tasks? There exists enormous potential in universities to expand the theoretical knowledge for practical capacity building and enhance the experience of young professionals to make innovations in pharmaceutical sciences by adopting various research projects in pharmacogenomics, pharmacokinetics, protein-based drug designing and new drug formulations. Moreover, out of 21 HEC recognized (Babar, 2006) pharmacy institutes (public and private) and 15 unrecognized pharmacy institutes, prospects for industrial linkage are not only encouraging but a whole batch of pharmacists can find practical approach to more than 600 industrial pharma units around the country.

Azhar et al. (2009) reported the challenges, a Pakistani pharmacist face, and their role as potential health care provider. An estimated 8102 pharmacists in the country only 5% are involved in R&D. Unfortunately, in Pakistan, pharma sector lacks infrastructure for R&D and many of the pharma industries only involved in manufacturing of ordinary drugs. Academia-Industrial linkage in this sector is not only poor, but needs to be established by bringing together both the industrialists and academicians.

#### **Telecommunication Industry:**

Colossal development in telecommunication in the current decade has not only made essential the establishment of telecommunication institutes in universities but also the development of specialized telecom industries in Pakistan. Keeping in view the progress in this sector in developed world, Pakistan is struggling hard, at the educational and industrial level, to keep pace with the advancement in developed world. Although small enterprises, in this sector, have chased their way through progress, but there is a huge gap in the linkage of these organizations to the universities. For instance, CARE (Center for

Advanced Research in Engineering) Pvt Ltd, Elixir Technologies Pakistan Pvt. Ltd, Aerocar Transaction Machines, Avanza Solutions Pvt Ltd, CureMD Pakistan, Knowledge Platform, CASE (Center for Advanced Studies in Engineering) and Myooffstreet.com are some of the leading companies in this sector. The setup of Arfa Software Technology Park (ASTP) by government of Punjab is very good initiative to provide place for academia-industry linkage and investment in IT sector.

University institutes have been established to produce highly qualified professionals. In this regard, CASE affiliated with University of Engineering and Technology Taxila, COMSATS Islamabad, SEECS-NUST Karachi, FAST-NUST Lahore and computer science departments in many public and private sector universities, not only offering graduate and post graduate courses (B.Sc. Hons, MS, Ph.D) but highly qualified expert professionals are emerging out of them.

Both science and technology are like the two arms of a person, one assists each other in one way or the other, but coexistence of each other makes the ultimate smooth survival and any lapse in the concerted action creates huge distances, not only in developmental progress, but also in long-term existence. Similar is the case with institutions and the industries. Former are destined for more elaborate comprehensive sort of research keeping in mind every pros and cons of basic and applied research while the later have been evolved for more objective, developed and mass production for benefitting the humanity in continuous way. Mutualistic behavior of the two is necessary, not only to save the resources but to avoid replication. This can only be achieved through a proper academia-industry linkage where both partners can be benefitted from each other.

#### **Comparison of University-Industry linkage with countries like China, India and Thailand**

Pakistan has been a good producer and exporter for a range of products accounting largely from agriculture sector. Leather and textile industries are one of the Pakistan's major export contributors. Industrial sector in Pakistan is lagging behind the requirements of the era in terms of its both infrastructure and skilled work force. Mostly industries operate at minimal labor, often with few graduates or highly qualified

skilled professionals, and are private sector entities, with very poor R&D centers and academia linkage. Pakistan, compared to its Asian counterparts, is far behind in academia-industry linkage. By looking upon the emergence of progressive countries in 21<sup>st</sup> century, ensure us the backing of academic support to industrial sector, which ultimately excels in their production and foreign exports competing with other leading counterparts.

India, for instance, is coming up progressively in the fields of IT, science, engineering and biotechnology apart from its agricultural commodities. The reason behind this is the cohort action of its industrialists with academicians as well as the governmental legislations as the driving force. India realized the importance of academia and industry soon after independence and succeeded in developing good academia-industry linkage. It not only promoted the establishment of industries but designed policies to flourish the Indian industry by blocking the imports of international goods as a market competitor of local made. Indian Institute of Technology (IIT), for instance, the best example to illustrate the phenomenon, has a strong linkage strategy with industry through Industrial Consultancy & Sponsored Research (IC&SR) Centre (Murty, 2002).

It produces graduates skilled for industry and works on projects to solve for industrial problems, provides consultancy to industry and, in turn, gets sponsors from the industry for its high-tech research. Council of Scientific and Industrial Research has an outstanding performance in Academia-Industry linkage. Indian Government has established strategies for promoting Academia-Industry linkages in India for its IT, biotechnology, engineering and agriculture sectors. In fact, India has developed sound base for biotechnology sector by setting up academia-industry linkage in various institutes for biotechnology and IT (Basant & Chandra, 2007). With a global market share of 3.6% in 2010, IT service is perpetually booming Indian technology.

Thailand's academia-industry linkage is not very well established according to a report published by Brimble and Donor in 2007, but in-fact much ahead of Pakistan. To name a few, Thai's shrimp, sugar, textile, automotive, electronics have earned rankings among World's

quality producer, by amalgamation of industries and academia. These sectors are contributing to its export have well established and strong academia-industry linkages. The realization of this initiative came up due in time by the lack of functional R&D and academic assistance, a fact to trigger industrialist to communicate and find expert guidance from the universities and for the academicians to excel in their career by pursuing the problem based solutions of industrial concern.

Thailand's biotechnology based revival of shrimp and sugar industry are leading examples of academia-industry linkage. Thai's reemergence of shrimp industry in 1990 and onward after 1980s collapse explicitly highlights the importance of academia-industry linkages. The core point in this success lies in strong academia-industry linkage and then establishment of two centers, Centex Shrimp (Centre of Excellence for Shrimp Molecular Biology and Biotechnology) for research work and Shrimp Biotechnology Business Unit (SBBU), to commercialize R&D results.

Similarly, Thai's automotive firms are Asia's largest automotive parts manufacturers and nine out of ten are among world's top ten automotive parts producers. Thailand's textile institute (THTI), similarly, has 66 initiatives in supply chain management, garment, fabric design, dyeing, printing and IT with explicit linkage to universities in term of basic R&D for product development, waste management and good manufacturing practices according to US department of Health. Hard Disk Drives by the Thai's manufacturers expand the example of academia-industry linkages, adding to the success of Thailand's foreign export. Seagate is standalone to build effective long term academia-industry linkages in R&D field and successful relationship to academia.

China, among other Asian counterparts, not only holds strong belief on academia industry linkage strategy but leading in this strategic game. China is the world's greatest nation and is the second power after United States. Its accelerated growth in science and technology over the last two decade is not the only effort of academic or the industrial innovations, but the combined setting up of goal oriented progress alongwith the Government reforms in S&T have devoted much to this accelerated boom in China's economy.

China has empowered its R&D institutes, research funding and academia-industry linkages through profound policy based administration in 1985's S&T reform. The result, we see, is its success, not only in Asian markets, but also in global market share. Strong academia-industry linkages exist across China's universities since 1950's as the university-affiliated industries were the driving force for the development of this tie. Success stories of Chinese academia-industry linkages are countless to be outlined here but this is not overnight turn up of worst with the best. China is striving to excel in the race of developing nations since its independence in 1949 and policy based reforms were came into act in 1985.

Malaysia and Singapore are another good example of Asian successors. Both of the countries have realized the importance of academia-industry linkages and implemented them in their niche products like electronics, engineering and petrochemicals. Singapore reached the height of industrial development by the 1990, however, academia-industry collaboration was realized much ahead of 1990. Biotechnology has given top priority in Singapore and many pharmaceutical companies set up manufacturing plants there. The economic growth rate of Singapore is fastest in the world, 17.9% during the first half of 2010. Malaysia's case is much different from Singapore but it is much ahead in term of academia-industry ties than Pakistan. On the other hand, it is the only Islamic country, contributing 86.5% of total high technology exports, such as microchips and microelectronics, which is remarkable.

### **Challenges to Pakistan**

In Asian community, Pakistan is far behind in the race of product development and its export in international markets. Major challenge is non-involvement of Government in the development of Science &Technology (S&T). Moreover, if by chance, an initiative is taken, its implementation suffers poor administration and improper execution halts its beneficial outcomes, making worse the overall condition. Higher education and S&T, very important sectors in developing a nation, seriously suffers the budget allocations, and if allocated, often cut-down in the funding, makes the conditions worse. According to a report of a comparison of higher education budget

allocation of 132 countries of the world, Pakistan is at 125<sup>th</sup> number.

National development is impossible to grow without the interests of political Government and major reforms in higher education and S&T. The first and foremost challenge to the development of industries is harsh policies in term of tax incentive, international marketing and national utilization of the product. Many other factors, causing significant downfall of industrial growth since the start of 2000, are energy crisis, leading to decreased production and quality production. Another challenge to industries is the consumer psychology drawn more towards the imported products. This point towards the overall repute of Pakistani products due to lack of quality assurance system (Quality control checkpoints and R&D based innovation strategy), improper policies for in-house product development and poor marketing practices.

Regarding the promotion and establishment of industries, Government of Pakistan lacks such interests. It does not provide support or incentive for up gradation of already existing industries (such as agriculture, textile, leather), or the establishment of new high-tech industries (biotechnology, information technology, automotive). Universities and public research institutes trouble even more in high-tech R&D. Apart from the power outages, existing for hours, acquisition of equipment and chemicals imported from international markets is also troublesome. Institutes pay a huge sum in the form of taxes, an interesting cycle to pay back the Government fund for scientific development, on the purchase of equipment and chemicals back to Government.

Private sector and public sector are the two different entities' working under their own modules. Political Government lacks any legislation to bridge the gap between the two, promote interaction and cooperation. These policies weaken the academia-industry linkage and the perpetual downsizing of development. However, to overcome the rotting problem, there is still a hope for both of these sectors to nourish and establish but in form of commensalism, as outlined in forthcoming section. By carefully looking upon the administrative structure of Government of Pakistan, one can notice the presence of so many ministries, who are sitting only for the sake of gathering salaries, but with no

practical implementation of their job. As a ray of hope Higher Education Commission (HEC) and Pakistan Science Foundation (PSF), alongwith other similar organization, have taken initiatives to promote academia-industry linkages.

### **Recommendations for a Good Academia-Industrial Linkage**

Academia-industry collaboration across Pakistan is very pathetic both from university and from industrial perspective. Moreover, strategic Governmental policies to develop an effective linkage across various institutes/industries in Pakistan are also lacking. Political contemplation for academia-industry linkage is of major concern, besides realization of its importance to industrialists and academicians. Therefore, the proposed strategy for academia-industry linkages is explained hereafter.

#### **1) Government Policy:**

Government should act to initialize the linkage program between enterprise and universities.

- National policy for academia-industry linkage is obligatory to strengthen scientific developments. Government of Pakistan needs a national S&T reform policy for developing S&T culture in the country, like China, where policy reform took place in 1985 after which knowledge-based economy flourished there.
- Higher education institute like universities should be given some form of independent governance to collaborate to private enterprises. Professors in the universities should also be encouraged to promote the academia-industry linkage.
- Government budget for higher education should be tripled from the existing amount (1.8% GDP) to 6% of its GDP. Pakistan access to higher education is 7.8% as of 2011 figure and it ranks at bottom 6<sup>th</sup> position in its spending on education sector.
- Funding allocation must be on priority areas of research as per demand of the country and a simultaneous encouragement of industrial sector for additional funding to that project. Approval of the project should be under stringent conditions to initiate the ties of academia and industry. Policies for the public research institutes must be to ensure the development of commercializable product.

- Taxation system should be revised specially for S&T and high-tech industries. Special relief on national development projects in research institutes and industries not only boosts-up the process of progress but also helps to flourish the product development both by industries and universities.
- Creation of a "National Innovation System" is required as a driving force for the development of S&T and high-tech research under which patenting and licensing regulation should be devised. Patenting policies and product licensing play a very important role in technology transfer from universities to industries keeping intact the Intellectual Property Rights for both the partners and promote academia-industry collaborations.
- Technology Incubation Centers, Science Parks should be put up within the universities to translate the ideas into marketable product and promote the collaboration of industries and Academia. Since, these centers provide an important hub for consultancy and knowledge sharing to industrialists. Government needs to speed up the process of establishing these centers and invest money on priority basis.

#### **2) Higher Education Policy:**

HEC is a keystone in generating scholars and scientists in high-tech research. HEC, in-fact, playing the lead role in promotion of higher education in Pakistan. HEC has already given the mandate to promote the academia-industry linkage in universities. Regarding the funding of research projects, it should approve the funding of the projects that endow the development of commercial products, with a condition for establishing the academia-industry linkage. This can greatly reduce the redundancy of the research besides promoting academia-industry linkage.

#### **3) Socialized Science:**

Knowledge-based economies develop by sharing information and knowledge transfer. In order to develop the scientific and research culture across Pakistan, it is important to socialize the scientific activities, in form of conferences, seminars, symposia, workshops and small trainings. These provide the important platform for sharing of information to other members of

the community. Young students can benefit by knowing the trends in the latest research work and then plan their own study projects. Industrial communities get to know about the plethora of research progress across different universities, which assist in the collaboration as per their product development. Development only takes place by sharing information, but if one wishes to keep the information and secrets of his/her study to oneself, nobody would get to know the innovation and no hands would join to promote its innovation.

#### **4) University Strengthening:**

Growth of academia-industry linkage requires the strong foundations and policy making. Technology transfer policies and patenting rights could bump up the collaboration more effectively. One important mandate of this linkage is university strengthening policy by the collaborating industries. Many measures can be devised and taken as a signed agreement or MoU between partners. Universities can be empowered by several ways.

- In the first instance, information sharing by universities and industrial involvement in the form of financial support to the partnering university not only enhances its research capacity but also reduces its dependency on government budgets.
- Graduate and postgraduate students of the universities should attain professional training from collaborating industry, in the form of internship, as part of their study program. In turn, the graduate courses should also include the courses of industrial concern, such as, entrepreneurship, business and marketing products, special science discipline subjects etc.
- Establishment of product specific R&D units within university, containing sophisticated equipment, further boosts up the academic capacity of innovation and product development. This R&D unit involves the scientific activities of scientists to excel in their career and a product of industrial concern. Postgraduate students of universities must be involved in this R&D activity, which produces skilled professional graduates, who after completion of the project can move to industry.

- Sponsored industrial collaboration is an effective way to strengthen university. In this way, universities can spend more on R&D projects. Setting-up liaison offices within university bridges the gap between academia and industry and can promote academia-industry linkages. An added advantage of this liaison centre is to help to commercialize and market the products made by the universities.

#### **5) Industrial Strengthening:**

Another mandate for academia-industry linkage policy is to strengthen the industry. Industries, in Pakistan, are facing many problems, which compromise the product price as well as international sale market.

- Encouragement of industries for knowledge-based product development, innovation strategy based on scientific research and sharing of industrial problems to the academicians for finding appropriate solution.
- Forcing industries to establish in-house R&D units or university R&D units, where professors and scholars engage in research activities. Industrial strengthening requires consultancy, scientific guidance and its R&D improvement. Besides, collaborating the academic R&D units, in-house R&D centers, not only, strengthen the industrial performance but also can keep update the quality of the product.
- Academicians and scientist can be hired as consultant to train special people required for industrial R&D centers. Major drawback of Pakistan industrial sector is its lack of interest in R&D. Industrialists, usually, avoid spending the extra costs to maintain these centers, limiting the product quality and hence further improvements. On these grounds, awareness of R&D should be realized to industrialists and offer them the services of academicians, in this regard.
- Employment candidature should include young motivated and highly qualified graduates. Industry can call for interview and select young graduates who will be paid by industry for their higher education but they will work on projects that will benefit that industry. After completion of degree, the students will work in industries that have paid for their higher education.

- The researchers who have done applied projects (insulin, interferon, solar panel etc.) should come forward and develop small industry and, later, they can expand it. If it is not possible for a single young researcher then a small group of young researchers can go for one industry. This will result in rapid development. Government should also provide interest free loan for such activities. There should be intensive training for researchers in research centers so they could learn and understand true science. The quality of work should be very high and reproducible. There is also trend of research from A-B-C...A-B-C in developing countries, which is repeated again and again, this trend should be changed from A-B-C.....Z.

#### **6) Model industries:**

Model industries can be established with strong academia-industry linkage. A transparent report should be prepared on development and progress of industry and academia with this collaboration and should be presented in the annual meetings. If the model proves successful then many other industries will follow this model. Industries can be bound to collaborate with research lab and give at least 2% of their income for research purpose. In return, trained scientists will give solution to the industrial problems. Experts should be sent to developed countries that have good linkage program to study and analyze their model and then that model should be translated according to local needs and requirement and implemented in developing countries.

#### **7) Mobilization of activities:**

Development of strong academia-industry linkage requires the national mobilization of scientific activities, their advantage to public and a realization of enterprise development. Creative programs and short documentaries, by the HEC of Pakistan, can play hence noteworthy effect on deriving the development of academia-industry evolution. Universities, through HEC funding, organize the gathering platform for scientists and industrialists for creating trustworthy environment between the two. Seminars,

conferences, workshops, short-term trainings can, therefore, play a significant role in information sharing. Specially, invited-industrialists on these occasions can be more effectively involved in industrial collaboration. Exhibitions at universities are another more effective way to build academia-industry linkage by attracting industrialists to the scientific developments. Process development at academic level can be leased to industry in a good way by showing their product.

By adopting the above strategies, both academia and industry can nurture each other and flourish in the race of developing nations just like the *Trichonympha* living in the gut of termites.

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