

Enhancing Technology Clusters through University Collaboration¹

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Abstract:

Balochistan University of Information Technology and Management Sciences is active in Information Technology, Telecommunications and Electronics clusters. BUITMS have followed the collaborative approach to technology incubation and clustering. The major partners in IT clustering are the Higher Education Commission, Software Technology Parks, Pakistan Science Foundation, National Institute of Electronics, Central Telecommunications Research Labs, National Telecommunications Corporation, Pakistan Electronic Media Regulatory Authority and provincial and federal governments and the corporate sector. Few examples of our alliance with some of these partners are given below:

- Our work with the telecom partners includes the development of indigenous low cost digital exchanges to replace thousands of VHF radios across the country to increase the teledensity and spread of satellite phone PCOs for universal telecom service coverage in Balochistan.
- Balochistan is a very large area, very low population density and with very poor media coverage. Our collaborative work with Pakistan Electronic Media Regulatory Authority and NGOs active in the area includes setting-up campus and community radio stations for academic and entertainment purposes and use of cable TV for education, training and vocational skill development.
- Our partnership with the Software Technology Park is focused to finding innovative solutions to complex logics, tools, techniques, processing, and storage and communication problems. Development and spread of IT tools in local languages is another major initiative.
- We are also aligning with SUPARCO for remote sensing applications for mineral development in Balochistan.
- BUITMS is active in developing e-government applications for the provision of efficient public services delivery.
- BUITMS is very active in providing IT training to communities, particularly to women, children, school teachers and government employees to accelerate the use of IT and increase its quality and efficiency.

¹ The paper has been accepted, for detailed program, please see the Clusters 2003 website at <http://www.congresbcu.com/clusters2003udem/eng/defaulteng.htm>

BUITMS has established Balochistan Business Incubator – student run faculty guided business incubation center. The student run enterprise writes proposals for small technology projects, participates in competitive awarding process, wins and executes the projects. The students are guided at each stage by the seasoned faculty members and general cover is provided by the Computer & Emerging Sciences Expert Advisory Cell. C&ESEAS comprises faculty members active in providing advisory services to the provincial and federal government, public enterprise and industry. The clustering concept is fostered through the virtual networks running on Pakistan Education and Research Network whereas the Balochistan Educational Network is in the making.

Balochistan University of Information Technology and Management Sciences is in the process of building a high technology triangle – a 100 acre state of the art facility within its new campus is in the design phase where zones have been allocated to various high technology innovative businesses. At this triangle intellectual resources, space as well as venture capital from BUITMS Endowment Fund will be made available to young entrepreneurs interested in commercializing their research and innovative businesses to serve the country and serve the region. Full range of professional and business support services along with innovative financial schemes in association with Small & Medium Enterprise Development Authority are being worked out. We are also working to establish linkages with technology clusters in China and the Middle East and research collaboration with other universities.

From our experience we learnt that the young graduates must be trained and entrepreneurial thinking should be developed in them while they are in schools receiving their education. The focus of the universities should be to produce the job creators and young entrepreneurs and not the job seekers. Then they should be facilitated to get into business, particularly high technology businesses in and around campuses where the technical and research resources are readily available. The linkages between industry, academia, research institutions, research funding agencies and government institutions are extremely important for the clustering concept to flourish and must be strengthened. The recent advances in Info-communication Technologies provide a big helping hand to maintain these linkages and sustain the collaborative efforts².

Literature Review

Considerable amount of general literature is available on clusters and economic development and spread on issues from one extreme to another. However, literature on specific issues in cluster development and impact assessment is rather limited. When one tries to establish how clusters are defined and understood, the literature provides numerous definitions of clusters. Cluster, the result of improvements in the business environment, "is a geographically proximate group of interconnected companies and associated institutions in a

² [http://www.congresbcu.com/clusters2003udem/abs/S13-1Choudary\(Balochistan\).htm](http://www.congresbcu.com/clusters2003udem/abs/S13-1Choudary(Balochistan).htm)

particular field, linked by commonalities and complementarities" As the sum of its parts is of greater value than each individual company or institution, clusters create synergy³. According to Porter⁴, "clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field that are present in a nation or region. Clusters arise because they increase the productivity with which companies can compete. The development and upgrading of clusters is an important agenda for governments, companies, and other institutions. Cluster development initiatives are an important new direction in economic policy, building on earlier efforts in macroeconomic stabilization, privatization, market opening, and reducing the costs of doing business".

Clustering is a term that economists have borrowed from science to describe the growth of a significant concentration of innovative companies around a nucleus of R&D facilities, such as those provided by the universities or leading-edge government laboratories.

The analysis of the available definitions of technology clusters indicates that Porter's definition provides a reasonable foundation to analyze the clusters and development thought while the other definitions are based on the need of the researcher and are generally skewed to serve the purpose of the researcher and or analyst. There are many definitions which describe and analyze the industrial and economic clusters in isolation and not as system which has related entities as integrated part of the development system. Another important observation about other studies definitions is that the concepts of geographical concentration and synergy is not discretely present in the definitions but in the subsequent discussions. This led us to coin a definition of clusters general enough but sufficient to be used in any type of technology clusters that aspires to achieve the economic growth and general societal development. Thus our definition of technology clusters is that it is the concentration of businesses, academic institutions, research and development agencies, philanthropic organizations and regional/local government organizations including financial institutions active in some particular geographical area or is clustered around some development theme for individual and collective benefits to be drawn through synergetic impacts. Research Triangles, Technology Parks, Industrial Parks, Technology Corridor, Industrial Estates, Incubation Schemes are common examples of clustering approach. This definition of Technology Cluster offers a very significant potential for local and regional economic development initiatives in Balochistan. The Fruit & Vegetable Processing Clusters, Marble and Mineral Development Cluster, Aquaculture Cluster, Livestock and Dairy Development Cluster are few examples.

³ Porter M. E., On Competition, HBS Press, 1998

⁴ Porter M.E., Clusters of Innovation Initiatives: San Diego, New York 2001

Economic Theory of Clusters and Role of ICT

Establishment of clusters and role of Information and Communication Technology is a new paradigm in the economic growth in globally traded industries. The general departure from the industrial economy to the knowledge economy has made ITC a mandatory requirement for sustainable innovation and flexibility in adaptation of new ideas and approaches in fast paced businesses and ITC has become a key drivers of growth. Addressing the opportunities in an unplanned linear fashion in routine does not yield most optimal returns. However, addressing the opportunities in an opportunistic way is a key and ITC provides that capability to the firms. Formal and informal flows of knowledge, interdisciplinary and cross-fertilization of ideas, and opportunities for team entrepreneurial development is certainly adds synergetic impact which very conveniently can be achieved with the help of ITC. ITC can only make a difference in association with all other players, actors and ingredients, catalysts that play their part with their core competencies for overall national or regional economic development system. The core competencies in the different segments of the nations may be different.

It has generally been accepted that the economic geography as well as the technological developments both increase the economic growth but also increase inequality hence, a deliberate intervention in the economic geography is required for sustained economic growth without increasing inequality rather decreasing it and a balanced development in an area. Quah⁵ states, “many observers suspect economic growth to be inextricably associated with inequality: growth alone need not bring about unalloyed, uncontroversial increase in economic wellbeing because rising average income levels might come together with increasing disparities between rich and poor. Prominent theories on the source of economic growth reinforce these concerns. He sites Aghion and Howitt (1998), Grossman & Helpman (1991), Romer (1986, 1990) and David (1986) to support his argument.

From his initial position that clusters breed economic growth which interns breed inequality and phenomenon of technological lock-in Quah starts departing from the initial position when he states, “what makes ICT different from other intangibles is its disrespect for geographical distances” or when he states geographical clusters emerge to balance the trade-off between centripetal and centrifugal forces, ICT influences the balance between these forces”. He further states that ICT is not just a high technology; it is a high technology with peculiar properties. Like Quah, death of a distance and impact of Internet, and technology spill-over has been discussed by many other researchers but with a conclusion, “inequality has increased, however, there is a little evidence that recent ICT progress has been at all critical to this”.

The critical analysis of these works warrants an intervention and to us ITC is a candid intervention that can have a significant bearing that it can help economic

⁵ Quah Danny, “ITC Clusters in Development: Theory & Evidence”, *EIB Papers*, Volume 6, No 1, 2001.

growth and eliminate or at least reduce inequality in the economic growth. Michael Porter⁶ in his article contradicts this view and supports the locational advantage in competition yet in the background supports this position of ours. He suggests that clusters foster high levels of productivity and innovation and lays out the implications for competitive strategy and economic policy. Economic geography in an era of global competition poses a paradox. In theory, location should no longer be a source of competitive advantage. Open global markets, rapid transportation, and high-speed communications should allow any company to source any thing from any place at any time. But in practice, location remains central to competition. Today's economic map of the world is characterized by what Porter calls clusters: critical masses in one place of linked industries and institutions--from suppliers to universities to government agencies--that enjoy unusual competitive success in a particular field. The most famous examples are found in Silicon Valley and Hollywood, but clusters dot the world's landscape. Porter explains how clusters affect competition in three broad ways: first, by increasing the productivity of companies based in the area; second, by driving the direction and pace of innovation; and third, by stimulating the formation of new businesses within the cluster. Geographic, cultural, and institutional proximity provides companies with special access, closer relationships, better information, powerful incentives, and other advantages that are difficult to tap from a distance. The more complex, knowledge-based, and dynamic the world economy becomes, the more this is true. Competitive advantage lies increasingly in local things--knowledge, relationships, and motivation--that distant rivals cannot replicate. A very comprehensive discussion and critique is presented by Choudhary⁷ on the Porter's Index and what he call's Enhanced Industry Environment Fit Index and also provides a reasonable framework for the analysis of innovative products in competing markets.

The cluster theory of Porter and intervention requirement suggested and implied by Quah and others both support the formation of the Balochistan IT Cluster as it endeavors to support economic growth in Balochistan and reduction in inequality by using locational advantage in certain raw materials coupling with ICT for achieving the competitive advantage.

Role of Universities & R&D in Technology Clusters

A significant amount of work has been done on the role of research and innovation in the development of technology clusters and consequently on economic development. According to NRC⁸ a cluster develops when a pocket of innovative knowledge-based firms acts as a magnet, attracting other firms to invest and locate in the same area. These firms gain strength when supported by

⁶ Porter Michael E. "Clusters and the New Economics of Competition" *Harvard Business Review*, November-December 1998

⁷ Choudhary Muhammad A, Identification of Barriers to Market Growth for Computer Assisted Instruction Technologies, PhD Dissertation, George Washington University, Washington DC, Published by UMI Dissertation Information Service, Ann Arbor, Michigan, 1993.

⁸ <http://www.nrc-cnrc.gc.ca/doingbusiness/>

strong research institutions, a concentration of capital and business expertise as well as an appropriate environment in which innovation can flourish. Clustering is a long-term process and several key ingredients must be in place to ensure its ultimate success. The cluster process must be community-driven with a well-defined technology focus, active networks and committed local champions. Importantly, clusters need a science and technology anchor, usually a government research institution or a university, able to work with local companies, transfer technology and spin off new enterprises.

The stakeholder integration is an integral requirement and key to technology cluster development. Fuelled by innovation, the cluster becomes a hotbed of investment and technology transfer. Small companies spin off from the original R&D laboratory. Startups find the technical and financial support they need to establish a customer base for innovative products and services. The success of one company attracts another, and another—eventually building a critical mass of skilled people, expertise, capital and entrepreneurial drive. Such an environment helps create local jobs and fuels economic growth in a region. Overall, clusters contribute to a higher quality of life for the community, the region and the country.

It is very common in the west that the universities and research institutes act like nucleolus and have become central hubs for dynamic technology clusters in diverse areas of science and engineering. Communities such as silicon valley, Boston, Maryland technology corridor, Montreal, Ottawa and Saskatoon have seen the tremendous growth that can occur when industry leaders and researchers come together to identify needs and develop solutions that touch the lives of people in their sphere of influence. With stakeholder involvement in strategic planning, this local touch can quickly transform a small community into a dynamic network with global reach. As a result of the efforts of stakeholders and catalyzation of the governments, a large number of the technology clusters have emerged in almost all parts of the world: in USA & Canada⁹, Central & South America¹⁰, Middle East, Europe¹¹, China¹² and Asia during the last decade. The survey of the cluster development after the advent of the Internet has accelerated manifold. In soft sciences and research clusters are active beyond national boundaries.

Balochistan IT Cluster

The notion of regional development is increasingly associated with widespread access to global information resources, development of advanced skills,

⁹ Ibid.

¹⁰ Quandt, Carlos (1997) “*The Emerging High-Technology Cluster of Companies, Brazil*” Prepared for International Development Research Center, Technopolis 97 Conference, Ottawa, Canada, September 9 – 12, 1997.

¹¹ Ibid.

¹² Harwit Eric, “High Technology Incubators: Fuel for China’s New Entrepreneurship”, The China Business Review, 2002.

continuous innovation and the diffusion of new technologies. These capabilities are essential to sustain local and international competitiveness' and build a knowledge based economy. At the same time, the development of high-tech clusters is seen as an instrument to link scientific and technological development objectives with regional development objectives. Successful clusters depend both on the private and public sector (usually universities and research institutions) which join efforts to create enabling and innovative environment and to build synergies among agents with complementary capabilities. In Balochistan, the regional development is certainly associated with the creation of mega projects like, Gawadar Port, Makran Coastal Highway, Mirani Dam, Sandik Metals Projects and other similar projects on one hand and entering into the supply chain for these projects by the local entities (both business, government and philanthropic) on the other. The development of such clusters is gradual and cumulative: over time, they build knowledge, skills, institutional support structure, specialized services, financing arrangements, infrastructure and collective norms of cooperation and mutual trust. Taking notice of the wealth and job creation potential of the successful clusters, national and regional governments worldwide have engaged in efforts to build and sustain the high technology clusters. Balochistan IT Cluster is an effort in this direction.

Balochistan IT Cluster is represented by the government departments, research institutions, universities, academic institutions other than universities, national and international non governmental organizations, national and international development institutions and

Objectives of Balochistan IT Cluster

1. Helping the IT industry to flourish in Pakistan by playing our part in Balochistan;
2. Development of enabling IT Environment (availability of HW, SW, manpower, adequacy of regulatory structure, tax & tariffs structure, business services, R&D, support services etc.) for the companies to base in Balochistan;
3. Promote IT Entrepreneurial Activities in Balochistan – initiating new businesses, pampering existing businesses;
4. Help produce top quality IT manpower in Balochistan;
5. Helping the government to use IT resources for the excellence in service delivery;
6. Strengthening the use of IT infrastructure for the benefit of the public;
7. Creation of IT Incubators in Balochistan; and
8. Creation of IT Park in Balochistan.

BUITMS Model of Cluster Development

We have very carefully studies the successful clusters around the globe and found that the most successful clusters are built upon teamwork, linkages and common purpose, and the benefits that the cluster yields to the members. BUITMS has

developed a process that encourages local strengths while leveraging BUITMS national and international capabilities and partnerships. By applying this proven approach in a number of communities in Balochistan the cluster endeavors that each members starts benefit by interacting with other members.

This process allows IT cluster to develop according to unique needs, opportunities and challenges of the stakeholders. The Balochistan IT Cluster formation passed through the following stages:

- **Initial Stakeholder/Member Interaction** - BUITMS initiated a consultative process between the potential beneficiaries i.e., academic institutions, industry groups, research institutions, NGOs, government departments. The consultative process, meetings and workshops allowed stakeholders to define the existing and potential technology base and identify local strengths and weaknesses in the areas of business, financing, research, and infrastructure and reinforced existing partnerships, and provided opportunities to establish networks.
- **BUITMS Led Round Tables** Attended predominantly by academic institutions, businesses, government, financial investors and other interest groups, these roundtables brought all the players together. The focus was what you expect from other cluster members and what other members can expect from you. The overall objective of the BUITMS was to reach consensus that there is a reason for the stakeholders to stay active and become more active in a value driven cluster. The roundtables also provided opportunity to the members to identify the potential partners, projects for collaboration, and fine tune the modus of interaction and timeframe based on the convenience and priorities of each others. The role of BUITMS is of a catalyst and an honest broker and where xxxx The long term objectives of the cluster were established, which are:
- **Develop an Action Plan** - BUITMS championed the cause of IT development in Balochistan. Critical tasks for the launch of the cluster were identified, the role of various partners based on the core competencies established. In addition to defining the vision and outlining a strategy for sector growth, the action plan had a provision for revolving the leadership role that will keep the interest levels up and meetings at various locations sway the feel for a dominant player. The long term objectives are expected to guide long-term development and delegates responsibilities to stakeholders.
- **Value Driven Growth Strategy** - BUITMS is providing and serving as portal for the cluster members and link them with each other and to national and international networks. Its clout in the national academic and research circles, world-class facilities, knowledge-sharing networks particularly Pakistan Education and Research Network, and infrastructure support systems in IT and business domain. BUITMS has

the highest capacity to introduce technology clusters to the national and global markets.

- **Propagate and Disseminate Achievements** - Success breeds success. Publicizing significant achievements is a key to raising the cluster's profile and generating new opportunities for sustained growth. It also attracts new partners and new investments, thereby expanding core capabilities and making more funds available for future R&D.

BUITMS Clustering Initiatives across Balochistan/Pakistan

BUITMS clustering model allows the entrepreneurial spirit in local technical, business and academic community to benefit from synergetic strengths of other members: R&D expertise, scientific and technical information resources, and innovation assistance programs of the government and other development agencies. In the process, cluster is expected to provide a continued and sustained help to Balochistan based companies to benefit the most of its national and international networks.

Balochistan University of Information Technology and Management Sciences has initiated a project for the creation of consortium of libraries by automating the libraries in all the academic and research institutions in Balochistan. The first phase of the project has already started for linking the three public sector universities under the council of Vice Chancellors. Completion of this project will to allow the students of other public sector institutions who are members of the cluster to use its academic and research facilities of each other. The university also intends to start research on the SW development in Balochi language for use by various public sector agencies particularly in the institutions where there is public dealing and the systems which require interface with publics like police department, health and education department.

BUITMS has established Balochistan Business Incubator which is a student run, faculty guided business incubation center. The student run enterprise writes proposals for small technology projects, participates in competitive awarding process, wins and executes the projects. The students are guided at each stage by the seasoned faculty members and general cover is provided by the Computer & Emerging Sciences Expert Advisory Cell. C&ESEAS comprises faculty members active in providing advisory services to the provincial and federal government, public enterprise and industry. During the last year the incubator developed Library Information Management System, managed the university web site and is currently active in developing university's student records management information system.

The clustering concept will be further strengthened and fostered through the virtual networks running on Pakistan Education and Research Network (PERN) to connection to which is being provided to BUITMS. The Balochistan IT

Department is also working to establish Balochistan Educational Network (BEN) which is also in the making.

Balochistan Technology Park

Balochistan University of Information Technology is developing its new campus at a 400 acre plot in Chiltan Daman-e-Koh, adjacent to Hazarganji Wildlife Conservation Park where a large area is allocated for the Balochistan Research Triangle for development and commercialization of high technologies.

Advance In-vehicle Electronics - Telematics

One of the huge new emerging technologies that will provide a lot of commercial opportunities for IT companies comes from “Telematics.” Telematics are advanced in-vehicle communications and information technologies and services. Examples include wireless phones, navigation systems, satellite radio and Internet connectivity. It used to be these gadgets could only be ordered as options on high-end luxury vehicles. Now automakers are even offering telematics on lower cost models. The telematics systems can also include the option of voice-activated access to personalized Internet information, including news, stock quotes and weather. Some telematics features include Automatic Collision Notification, Emergency Assistance, Roadside Assistance, Infotainment Concierge (operator assisted or web based), Personal Information Management, Traffic Information, Hands-free Voice Control Services, Information Gateway, Speed Dial, Satellite Radio, Entertainment/Multimedia, Remote Diagnosis, Wireless Synchronization, and Vehicle Tracking. A joint research project with the help of M/s Toyota Pakistan, M/s Atlas Honda, and M/s Hinopak Limited is being developed to further the research and development in telematics.

Bioinformatics & Nanotechnology

Bioinformatics merges recent advances in molecular biology and genetics with advanced computer science technology. The goal is increased understanding of the complex web of interactions linking the individual components of a living cell to the integrated behavior of the whole organism. The Balochistan University of Information Technology has submitted a research grant to HEC for the up gradation of the existing Center of Biotechnology and Informatics to Institute of Biotechnology and Informatics. The interdisciplinary program will offer graduate education and supports pilot research studies in Bioinformatics.

Computers, staff support, a classroom and new research laboratories have been planned. Bioinformatics incorporates many disciplines and specialties and requires a unique cross-training environment. Trained scientists in this area are essential to accomplishing our goal of discovering and developing novel drugs from gene to target to patient in the next decade. The opportunity to do this collaboratively with the University will benefit all of us immediately.

Nanomaterials are complex synthetic molecules that are hundreds of times smaller than the cells of our bodies. The processes to generate manipulate and deploy these substances, called nanotechnology, represent an area holding significant promise for health care and biotechnology in the 21st century. The name nanotechnology comes from the size of these materials, as these compounds are only nanometers (1/1,000,000,000 of a meter) in diameter. Consequently, nanostructures are similar in size to biologic molecules such as proteins. These materials can be made from polymers, carbohydrates or lipids, leading to a great variety of functional and physical characteristics. This structural versatility allows for the development of new industrial applications and artificial assembles that are miniaturized to a previously inaccessible size.

This area is now viewed as one of the last major technological frontiers to be explored. The impact this technology could have on communications, information storage and materials sciences will undoubtedly have a significant comparable to that of the “nuclear revolution” of the 1930s or the “molecular revolution” in the biologic sciences in the 1960s. These non-biologic applications offer limitless opportunities for miniaturization for information storage and communications. At the same time, understanding the principles of nanotechnology may provide insights into critical biologic systems related to disease control, correction of genetic disorder and longevity.

The study of biologic applications of nanotechnology will be important to the future of medical science. Medical applications of nanomaterials include the use of nanomaterials to resolve ultra-structural problems in cells and will revolutionize health care in much the same way that materials science changed medicine 30 years ago with the introduction of synthetic heart valves, nylon arteries and artificial joints. The correction of structural problems caused by genetic defects related to diseases as diverse as muscular dystrophy, heart failure and cystic fibrosis are only a few of the possible medical advances from these compounds.

Recent improvements in materials science technology have enabled researchers to create “custom designed” nanomaterials to suit specific biomedical purposes and to produce them in massive quantities. These materials are hypothesized to be able to repair or replace normal biologic components of cells. A remarkable range of human afflictions could be addressed by new therapies developed with these materials. Nanomaterials could protect the body from infections and accelerate wound healing. These synthetic substances also could carry drugs and genes into cells, ameliorating the defects that cause diabetes, high blood pressure and arteriosclerosis.

Center for Biotechnology and Informatics at BUITMS has initiated a comprehensive research program on the development and discovery of drugs in conjunction with the relevant advance scientific developments in the Information Technology as well as in the molecular sciences including DNA technology, metabolism and chemistry of natural compounds. This modern approach

requires participation of all the stake holders but more specially the researchers in the above mentioned fields and vigilant futuristic multinational pharmaceutical companies looking forward to collaboration for the development of their programs. The center for Biotechnology and Informatics embarks upon learning from nature in its manifestation for the designs of sub-cellular regulatory mechanisms, cellular interactions and communication systems, genes and their control, sub-cellular molecular information pools and exploring mechanisms of modifications in the metabolism. We can offer our services in the Information Technology related soft ware development and also essential training required for molecular and drug metabolism studies. Moreover for molecular studies we have collaboration with H.E.J. Research Institute, Karachi and would also develop collaboration with Center of Excellence in Molecular Biology, the Punjab University, Lahore. The center is also working to establish links with the pharmaceutical industry as well.

We can develop collaborative research projects on the products of the multinationals on the similar lines as it is being conducted on their behalf elsewhere in the world. Our advantage is that we have the expertise as well as natural pool of chemicals in the herbs of Balochistan and we know many herbs used by the people of Pakistan from centuries which have not been studied scientifically. In fact the research projects have already been submitted to various donors and capacity is being enhanced to initiate new projects.

Future Clusters Prospectus in Balochistan

Although the current cluster is focusing the IT, Telecommunications and Electronics sectors the future holds significant potential. With existing strengths in key sectors and growing interest from national and global investors, Balochistan resource base is poised to make a powerful entrance into the global knowledge-based economy.

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