Institution-wise Feasibility for Establishment of Inter-Disciplinary Postgraduate Engineering Program in Southern Punjab

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Abstract **-** Southern Punjab region has remained largely deprived after 68 years of independence when it comes to higher education in engineering & technology or development of industrial research culture. Due to political, socio-economic, cultural, and geographical reasons more than 60 million people living in this region have faced lack of opportunities to higher education in engineering and professional development. In this paper a feasibility study is conducted for possible establishment of a postgraduate level inter-disciplinary engineering program in Southern Punjab region to fill this gap. A successful inter-disciplinary engineering management program at *University of Ottawa* is adopted as a model. The institutions of higher learning in Southern Punjab are evaluated for their preparedness to institute such a program on a matrix of indicators. The study determines that establishment of such program will allow engineers, architects and town planners from multiple disciplines to acquire higher education and develop managerial and entrepreneurial skills in close proximity to their homes. The study concludes that such a program is feasible, highly desired and can be launched with minimum additional financial and human resources.

Keywords: Engineering Management, Feasibility, Evaluation Matrix

I. Southern Punjab: Background & Statistics

Southern Punjab is the home ofover one-third of the population of Pakistan. Southern Punjab region does not have well-defined geographical boundaries, but may be defined in terms of the Seraiki belt, i.e., the region where Seraiki is spoken as the mother tongue. Unofficially, the lower 3 divisions of Punjab, i.e., Multan, Bahawalpur, and Dera Ghazi Khan are considered Southern Punjab. These divisions comprise of 11 districts with a total area of 99,572 sq. km (48.5% of the total area of Punjab Province). This shows that area wise the southern Punjab region is almost half of the Punjab province [i]. In addition, southern parts of Sahiwal and Sargodha divisions are included in the Seraiki Belt.

Punjab province inhabits more than 56% ofcountry's population. Almost, 36% of its rural inhabitants are poor, 2nd highest among the provinces of Pakistan. The Seraiki belt can be easily categorized as the underprivileged part of Punjab based on several development or welfare indicators. As compared to rural parts of Sindh province where the incidence of

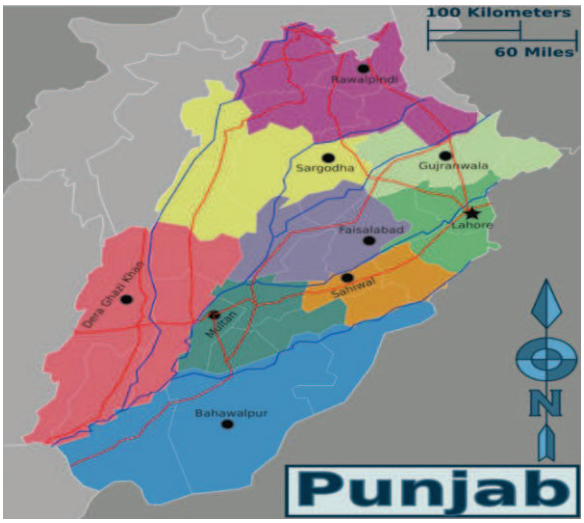

Fig. 1. Map of Punjab province (Division-wise)

poverty is 31-35%; rural Southern Punjab has a higher level of poverty documented up to 50% [ii]. Other studies [iii] place poverty in Southern Punjab at40%, which is at par with rural Khyber Pakhtunkhwa and Balochistanprovinces. Three districts of Punjab (Lodhran, Muzaffargarh and Rajanpur from Southern region of province) show least recorded literacy rate (30.23% and below) in the survey. Whereas remaining eight districts of South Punjab have lower level (30.23-45%) of literacy rate [iv] compared to districts located in Northern regions of Punjab.

Southern Punjab hostsseveral high-tech and process industries including power generation, fertilizer manufacturing plants, crude and edible oil refineries, textile spinning and weaving units, uranium, minerals, oil & gas reserves, nuclear power plants,

sugar and ghee mills, tobacco manufacturing facilities and cement industries. Despite recent initiatives from Federal and Provincial governments for improving higher education in the region, only two post graduate engineering programs in Electrical and Civil Engineering are available [v, vi] with very limited intake for engineers to improve their technological skills in this industrially rich but educationally deprived region that was a hub of knowledge, tradition and civilization for several centuries. This has resulted in lack of sustainable development, absence of industry-academia linkage, and non-availability of multi-disciplinary programs to incubate entrepreneurial activities and solve technical and managerial problems of the local industry.

In the year 2014-15, Punjab government distributed Rs. 48.31 billion, more than twice as compared toprevious year's funding, for 532 development projects for education (325 under process& 207 new schemes), which included Rs.14.05 billion for higher education**.** Although, Northern Punjab performed well on education indicators, Southern Punjab continued to lag behind due to poor planning and lack of execution. Home to one third of country's population, South Punjab has only two public sector universities (general category) and one recently established federally chartered degree awarding institute dedicated for engineering and technology education. A couple of Federal Institutes have established campuses in Southern Punjab; however, they only provide limited opportunities for higher education and research in the engineering field.

II. Higher Education as Precursor to Development

"Education is better safeguard of liberty than a standing army" is a legendary quote of Sir Edward Everett (1794-1865), Governor of Massachusetts state in USA and President of Harvard University [vii]. It has become a universal human right anda vital component to grab opportunities and gain empowerment [viii]. Higher Education is the key to sustainable development in a society asthis hasan impact on productivity effects and reduced income inequality [ix]. There is a substantial positive correlation between economic productivity and education. Life Satisfaction Index and Material Wealth Index also identify Higher Education as Indicator of Prosperity in Life [xxvii].

Education is the most significant instrument for human resource development.When individuals are educated, their living standards improve as they gain access to productive ventures, which eventually improves in their livelihoods [x]. Education melts away ignorance and fundamentalism in society, leading to a critical mind combined with knowledge, wisdom and tolerance, thus preventing corruption, crime and environmental damage in society [xxvii].

Higher incomes are associated with higher level of education. US Census Bureau reports higher earnings ratio of people with higher qualification Fig. 2. The purpose of education is not only to impart knowledge and skills which enables the recipients to perform as agents for economic and social change in the community, but also to increase the substantial impacts on ideologies, ambitions and rationales, which are essential prerequisites for the progression of sustainable development [xi]. The up-front linkage between studies is through development of skill-set, which as a result increases opportunities for well-paid productive employment, consequently, facilitating people to fully exploit their potential confidently [xii].

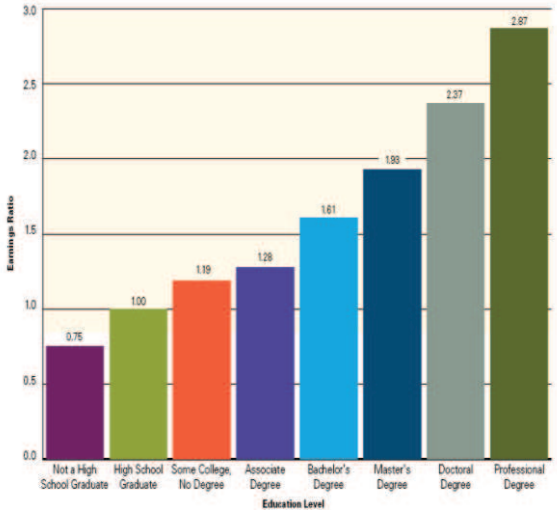

Fig. 2. Life Time Earnings of people with different education levels [xxvii]

Higher education ensures sustainable economic development and prosperity in the society. It also generates improved economic conditions; regrettably, disadvantaged countries like Pakistan face considerable economic deficiency as far as higher education is concerned [xiii]. Poor quality education system may be one of the most vital rationales why deprived countries like Pakistan remain underdeveloped [xv]. Quite interestingly, deficient areas in Pakistani society like lack of Liberty, Freedom of Choice, Exploitation of Innovation, Capital Investment and Good Governance belong to subsets of Education [xxvii].

Human capital development studies correspond that it is infact the human resources of a country (and not its capital or natural resources) that finally determine the speed of its economic growth, and social development. Education hasa significant inverse relationship with poverty as it provides employment opportunities and rejects poverty [viii]. The real wealth of any nation is its people who strive to develop new ideas and then create processes and mechanism to bring wealth to the society [xxvii]. Development studies related to Southern Punjab have consistently advanced

the possibilities for development and progress in higher education in this region. The development process aims to eradicate poverty and ongoing displacement based on region's resources, institutes and cultures. One factor that proves to lessen inequality and poverty has been the investment in human capital, which is replicated in the investment to development of knowledge and professional skills [xv].

As of 2007, only 6% Pakistanis (9% male and 3.5% female) were university graduates. This figure is expected to increase to 10% until 2015 and 15% by 2020 [xiv]. Government of Pakistan spends only 2% of GDP on Education (primary to tertiary level) for the last one decade of which major portion is spent on recurrent expenses like staff salaries leaving behind a very small budget for quality enhancement, faculty development, and establishment of new programs.

III. Significance of Master's Program in Engineering Management

Engineers equipped with technical management skills can better contribute in developing economies of countries like Pakistan. The developingcountries are facing challenges like sustainability, technology innovation and environmental protection, necessitating a need for integration of technical and management skills to counter these problems. There is an emerging need for organizations to integrate technical and business skills to solve these difficulties [xvi]. This is especially true in Pakistan where mega construction projects and industrial development particularly in the fields of energy, transportation, manufacturing and mining are expected to occur in the coming years. Thus, there is a dire need to establish an educational setup where engineers can acquire advanced management skills to outperform in their fields.

Universal trend demonstrates that engineers who are well-versed with the principles of business and management are bestowed with leadership responsibilities in an organization. Understanding ability ofadvanced technology and conforming management strategy is basic essence behind securing a competitive position in any high-tech firm or public sector organization. Due to emerging interdependence between technology, industry, economy and society, more opportunities would be available for engineers to use their potential as leaders, not only in business but also in the multinational and government organizations [xvii]. In today's competitive environment, employers seek technical people that not only understand technology they use, but also know the business needs of the company. According to Engineers of 2020, a report published by the National Academy of Engineering, business savvy attitude and leadership potential are among the desirable skills for future engineers [xxvii].

Research on approachesto improve engineering education has identified management and innovation skills as essential to success in an engineering career. Researchers [xviii] also believe that engineering curricula that do not address innovation and higher-level technical management are depriving students of essential competencies for engineering success in the global marketplace. Such deficiency precludes career enrichment and advancement in public and private sector, and perhaps more significantly, makes it harder for them to reach their full potential. Progressive organizations increasingly desire interdisciplinary knowledge of both engineering and management [xix] of their employees. These facts clearly demonstrate that there is ever increasing demand for engineering professionals to acquire management and entrepreneurial skills [xx].

A Master's program in Engineering Management is distinctive due to its highly integrated nature. Such program can fulfil the demand of professionals in the fields of business knowledge, technology entrepreneurship, technical management and engineering in the complex environment of technology driven industry. Engineering Management program enables engineers to think on a broader spectrum in a wider world; they are not just bound in a single paradigm. In addition to doing technical jobs, they can compete in money making and knowledge making business and consultancy. Engineering Management program enables the graduates to factor in business related issues in their decision making. This program also reduces resources required for training fresh engineers in management. The combination of management concepts and technical focus presented in Engineering Management program allows new graduates and working professionals to acquire the management skills necessary to excel in today's technical world. Engineering Management program also encourages development of 'Business Eco-system' design, a process to develop an environment to incubate entrepreneurial activities, especially technology start-ups, and to create jobs for the workforce.

Unlike a Master's degree holder in Science or conventional Engineering disciplines, Engineering Managementdegree offers business perspective needed by technical managers. Compared to traditional MBA programs, an Engineering Management program emphasizes skills suited for technology-based organizations. Fig. 3 [xvi] compares the expected acquisition of skill set for an engineer entering Masters in Business Administration or Master's in Engineering Management degree program.This is why World's top notch universities like Georgia Tech, Stanford University, MIT, University of Ottawa and number of others mentioned in Appendix I offer successful inter-disciplinary MS Engineering Management program. American Universities listed in Appendix II and

identified in [xxvi] also offer PhD program in Engineering Management.

It may be worthwhile to note that as per Agenda No. 7 of 59th EA&QEC meeting of Pakistan Engineering Council a body which regulates engineering programs in Pakistan, MS Engineering Management is considered as an 'engineering degree' in Pakistan.The Higher Education Commission (HEC) and the National Business Education Accreditation Council (NBEAC) in Pakistan recommended 3.5 years of study for engineers who wish to get an MBA degree [xxi-xxii]. Comparatively, only 1½-2 years are required to get a Master's in Engineering Management with an option of getting a degree with thesis or simply on course work basis.

MEM graduates have brighter job prospects of becoming CEOs, Chief Operating Officers, Chief Technology Officers, Entrepreneurs, General Managers, Production and Manufacturing Managers, Business Analysts, Technology Consultants, Business Strategists and academicians in Engineering Management faculties around the globe.

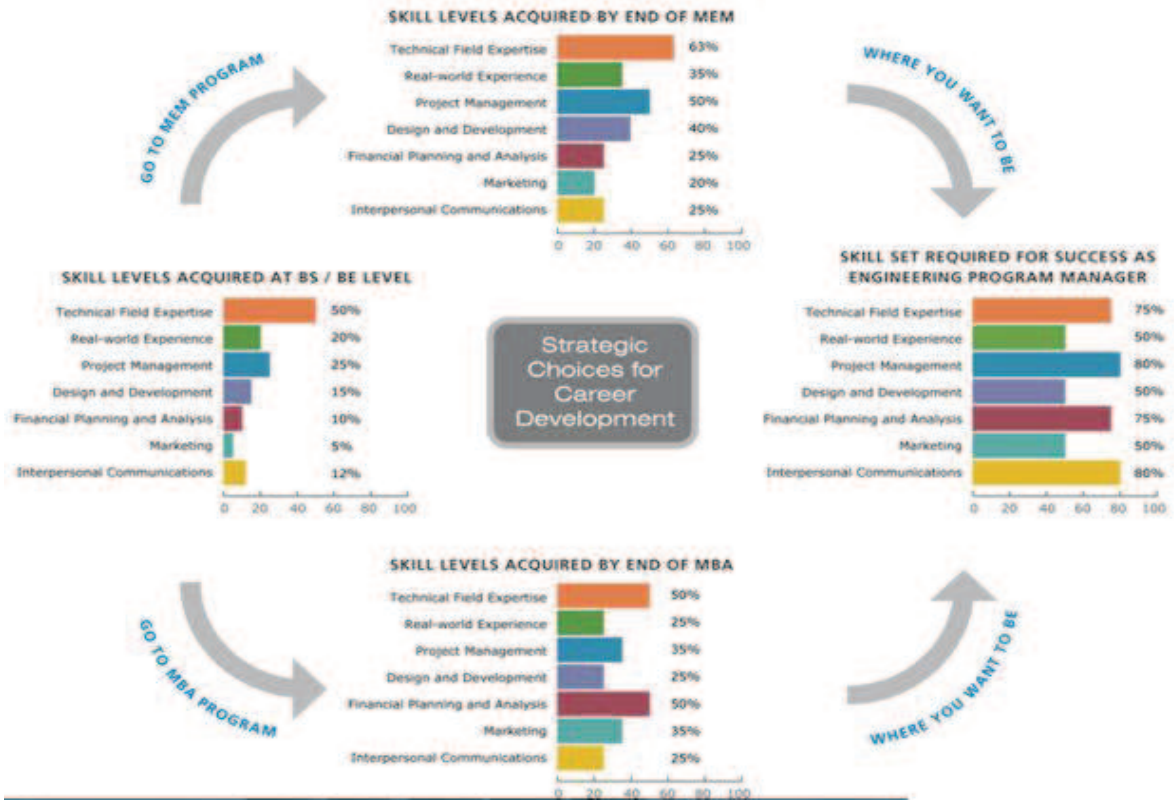

Fig. 3. MBA v/s MEM: An outcome based comparison [xvi]

IV. University of Ottawa Model of Masters of Engineering Management

The Masters of Engineering program in Engineering Management at University of Ottawa, Canada is run by sharing resources from Faculties of Engineering, School of Information Technology& Computer Science, and Telfer School of Management. Professors from different faculties teach Engineering Management courses, and Engineering Management students attend classes with Business Administration, Engineering or Computer Science students to study the courses of their choice to complete their credit hours. Class rooms, computer labs, library and admin staff are also shared by different departments. There is minimum expenditure to run this inter-disciplinary program as it hardly requires sophisticated research lab facilities, and courses taught in this program are of generalized nature. Despite the above stated facts, MEM is a highly popular program among students due to the availability of diversified courses and research areas. Due to its high demand, the MEM program offers admissions three times a year and has a higher merit as compared to conventional M. A. Sc. and M. Eng. admissions three times a year and has a higher merit as compared to conventional M. A. Sc. and M. Eng. programs. Most importantly, the MEM program generates handsome revenue for Canada's capital university and fulfils the higher education needs of engineers working in technology parks andhi-technology industries around theregion.

The essence behind the success of the inter-disciplinary MEM program is a peaceful environment and streamlined educational and administrative system of University of Ottawa, Canada. This is supported by excellent inter-departmental communication,

coordination and tolerance to share resources and faculty, and flexibility offered to the students to select any graduate level course offered in the entire university. This helps the students to tailor their degree according to their professional needs and make the MEM program high in demand for the North American employers. University of Ottawa is among top universities in the World [xxiii] with its Telfer School of Management among top most North American business schools [xxiv] located in Canada's National Capital Regionandnear World's largest Project Management Institute and World's 2nd largest IT industry in the Kanata region [xxv].

V. Resource Availability for Instituting a MEM Program in Southern Punjab

Feasibility Study to establish an inter-disciplinary Master's program in Engineering Management (based on University of Ottawa model) at Higher Education Institutes in Southern Punjabwas carried out through surveys. Institutions were evaluated on the basis of availability of PhD faculty, charter of institution, geographical location, operational engineering programs and financial resources. As per the University of Ottawa model, existing Engineering and Business programs will be required to contribute towards a proposed postgraduate Master's in Engineering Management program.

The resource availability and preparedness of these institutions towards initiating an MEM programs was studied through an evaluation matrix (Table I) that measured these institutions on the following factors: engineering programs, business programs, postgraduate programs, PhD faculty, accreditation, industry, industrial liaison, admission strategies, and infrastructure. The following study discusses the practicality of starting MEM program at institutions of higher learning in Southern Punjab. The results are tabulated at the end of the study (Table II).

TABLE I
THE EVALUATION MATRIX TO ASSESS RESOURCE AVAILABILITY AT SOUTHERN PUNJAB INSTITUTIONS OF HIGHER LEARNING.

Resource Availability					
	Engineering Programs	Bachelor's level multi-disciplinary engineering programs	Bachelor's level engineering programs in 3 or more disciplines	Bachelor's level engineering programs in 1 or 2 discipline	No bachelor's level engineering program
	Business Programs	Offers both BBA and MBA degrees	Offers BBA and plans to offer MBA and MS degrees	Offers BBA only	No business program but have program in computer science
	Postgraduate Programs	Postgraduate programs in both engineering and business administration	Postgraduate program in business administration	Postgraduate program in computer science	No postgraduate program
	PhD Faculty	Experienced PhD faculty in engineering and business admin.	PhD faculty in businessadministration / management	PhD faculty in engineering and computer sciences	Limited PhD faculty
	Accreditation	PEC, NBEAC, HEC	PEC and HEC	NBEAC and HEC	Only HEC
	Industrial Presence in Vicinity	Several industrial units with technical manpower / engineers	Corporate Offices and Service Industry only	Some Industrial Units	Limited presence of industry (3 or less)
	Industrial Liaison	Strong industry-academia linkage.Joint research & consultancy projects	Managed to get R&D funded projects, internships and trainings	Establishing Contacts with Local Industry	Limited industry–academia linkage
	Admission Campaigns & Marketing Strategy	Well-developed and managed admission campaigns. Availability of need based and talent scholarships	Institute is renowned and already have tough competition for admissions and scholarships	Developing marketing strategy for institute. Admission campaigns and scholarship hunts are in progress	Little or no attention towards admission campaigns and marketing of institute
	Academic & Civil Infrastructure	Fully furnished academic blocks, library, lecture theatres, research labs	Shared academic blocks, class rooms and labs	Academic Block, shared labs and class rooms	Rental building, no labs, limited class rooms
		Excellent = 4	Good = 3	Fair = 2	Poor = 1
		Maximum Score: 36			

A. COMSATS IIT, Sahiwal Campus

Available academic and administrative resources at COMSATS Institute of Information Technology, Sahiwal are nearly adequate to successfully launch and run a broad spectrum MS program in Engineering Management with minimalcapital and recurring costs. Such a program will be popular and is expectedto generate higher revenue than the current MS programs in Management, Computer Science and Bio-Sciences. Lecture theatres, class rooms, library and academic blocks are already available on campus during evenings / weekends, and can be improved with the passage of time, for potential EM students. It is noted that the Institute is already running an executive MBA program on weekends.

CIIT Sahiwal hasfour Engineering Management graduates from World's renowned universities and Project Management Professional certified among its faculty. It also has seven PhDs each in Mechanical Engineering and Management Sciences departments, six PhDs in Computer Sciences department, two in Civil Engineering, and three in Electrical & Computer Engineering department, as well as several faculty members enrolled in PhD programs in different local universities who can teach a diversified variety of core and elective courses and supervise research projects. Since this institute is running under the administrative control of Federal Ministry of Science & Technology, the availability of funds would not be an issue. It is recommended that Engineering Management program should run under the administrative control of well-established Mechanical Engineering department.

CIIT Sahiwal is located on almost central location on Lahore-Multan G.T Road. It has in close proximity engineering industries like Engro Foods, FaujiFresh n Freeze Pak Pattan, Yousafwala Grid Station, Michell'sOkara, Lakson Tobacco, Philip &Moris Tobacco Okara, Qadirabad Coal Fired Power Plant, Ittefaq Sugar Mill Pakpattan, as well as engineers working in service industry like PTCL, MEPCO, Sui Gas and Cellular Network Providing Companies. A majority of those engineers will be candidates for admission into the MEM program when it is launched.

CIIT Sahiwal has strong and well-established network of admission campaigns, career counselling and marketing. It can easily motivate engineers working in industries in this region to improve their qualification in evening/weekends.CIIT Sahiwal can expect a higher number of students in the proposed MEM program. It is so because of high demand and lack of competitors in the region, who offer a similar kind of unique program from which architects, town planners and engineers from any background can equally get benefit.

B. NFC Institute of Engineering & Technology, Multan

NFC IET Multan was established in 1994 after it was upgraded from Technical Training Centre of National Fertilizer Corporation. NFC IET is the oldest engineering institution in Southern Punjab, and was once the only engineering institution from Lahore to Hyderabad. The institute imparts engineering education in Chemical, Electrical, Petroleum & Gas, Civil and Mechanical Engineering in addition to Bachelor's program in Business Administration, Computer Science, Environmental Science and several BS Technology programs.

NFC IET have PhD faculty in Civil, Mechanical, Chemical, Environmental, Computer and Power Engineering;five MBAs, two MPhil Computer sciences, and several faculty enrolled in PhD in Engineering and Computer Science disciplines who can teach a variety of core and elective courses.After being declared an independent Federal Degree Awarding Institution in 2012, NFC IET has launched new programs in engineering, technology and other non-engineering disciplines. Teaching staff, who have years of industrial and teaching experience, but could not get Master's degree due to non-availability of such opportunity in the region, can take admission in the pioneer batch of MEM and after completing this degree, can start teaching the forth coming batches.

NFC IET has an advantage of well-established research laboratories and industrial liaison with process industries nationwide.In addition to fresh engineers, architects and town planners who are still looking for jobs, potential students could include professional engineers working in industries in 150 Km radius such as KAPCO, PARCO, Pak Arab fertilizers, AES Lalpir, Rousch power plant, Nestle Food, Fauji Kabirwala Power plant, SNGPL, WAPDA/NTDC, DG Cement, Fatima Sugar & Textile mills, PAEC's uranium fields etc. These corporate employees can pay a higher tuition fee and can easily come to attend classes on evening / weekends.

C. Bahauddin Zakariya University, Multan

Located in Multan, Bahauddin Zakariya University (BZU) is the largest university of south Punjab. It is a degree awarding institute in more than 60 disciplines, including Pharmacy, Medical, Engineering, Humanities, Business Administration, Law, Art, Music, Computer/IT/Telecom, Agriculture and Languages. Subsequent to a presentation delivered to the Vice Chancellor and Registrar of BZU on the potential for establishment of MEM program, the following observations were recorded: BZU hasthree PhD faculty members in College of Agricultural Engineering and 4 PhDs in Institute of Computing to teach MS Telecommunication program. Faculty of Engineering & Technology at BZU, comprised of College of Engineering & Technology, Institute of Advanced Materials and College of Textile Engineering, collectively have six dedicated PhD faculty members and several who are enrolled in PhD

programs in engineering disciplines in local universities. These faculty members can teach diversified elective courses and supervise projects in their own areas of interest. Three existing PhDs, and others with M.Phil. degrees in Management/Business Administration, who arefaculty members at the Institute of Management Sciences, can easily take care of core management courses to be taught in the MEM program. BZU Multan has recently started MS programs in Electrical and Civil engineering.

Cost-Benefit Analysis made on the request of Campus Director an initial setup of MEM program at BZU Sub-campus Sahiwal is given in Appendix III. If proper marketing strategy is adopted, BZU Multan can expect more students in the MEM program because of its high demand and absence of competitors in the region. However, deficiency of inter-departmental coordination and sharing of administrative and human resources, students' union strikes, and intervention of political elements has been observed and confirmed from a number of sources inside the University.

D. The Islamia University of Bahawalpur

The Islamia University of Bahawalpur is one of the two public sector universities in Southern Punjab. It has University College of Engineering & Technology imparting Electrical Engineering education at undergraduate and postgraduate level with different specializations. UCET IUB, which is already running MS Electrical Engineering program with couple of specializations, hasthree permanent PhD faculty members and several others with postgraduate qualification in Electrical or Computer Engineering. This college serves the need of higher education in Engineering for the people of Bahawalpur, R.Y Khan, Fort Abbas, Bahawalnagar districts. Launch of Master's level Engineering Management program in UCET IUB is feasible due to availability of PhD faculty in Faculty of Management Science. Potential students / target beneficiaries includeengineers from Fauji Fertilizer Company and Fatima Fertilizers Ltd. Sadiqabad, Liver Brothers R. Y. Khan, and several sugar and ghee mills in the area.

E. Namal College, Mianwali

Founded by Imran Khan in 2008, the college began as a technical training and diploma awarding institute, and now awards University of Bradford degrees for its undergraduate programs. Presently, the college offers two academic programs: four-year engineering degree program, namely a BEng (Hons) in Electrical and Electronic Engineering and a four-year computer sciences undergraduate program of BSc (Hons) in Computer Science.Namal College has attracted six PhDs each in their Computer Science and Electrical Engineering faculty. Prof. Dr. Muhammad Abbas Chaudhary, PhD Engineering Management from USA and former Vice Chancellor of UET Taxila is also serving on the faculty.

A proposal to establish an Engineering Management program at Namal College was forwarded to Director Administration of the college.If a post-graduate program in Engineering Management is launched at Namal College, professional engineers working in Pak-American Fertilizers and Maple Leaf Cement in Iskanderabad; Salt Mines of Kala Bagh, Nuclear power plant in Chashma and service industry of adjoining areas like Bhakkar, Khushab, Layyah, Nowshera and Mianwali can benefit from it.

F. MNS University of Engineering & Technology, Multan

Mohammad Nawaz Sharif UET Multan was running under administrative control of UET Lahore, has recently received charter from Govt. of the Punjab foran independent university status recognized by HEC. This is in-fact the very first initiative of Government of Punjab to establish a dedicated Engineering & Technology University in Southern Punjab. Classes for Engineering and Technology programs were temporarily started in buildings of Government College of Technology, Multan. This nascent institution is not yet ready to launch a Master's level program on its premises.

G. Air University Multan Campus

Air University, a Federally Chartered University, opened its campus in 2011 at Multan on the then Prime Minister Yousaf Raza Gillani's initiative to cater the need of students of Southern Punjab and adjoining areas of KPK, Balochistan and Sindh provinces. The Campus operates in a rented building in Multan cantonment area. Management and Computer Science departments are operational which offer undergraduate and graduate programs in Business Administration, CS, Maths and Economics. Launch of Electrical and Computer Engineering programs are being planned in Phase II, subject to land acquisition and construction of purpose-built campus in the suburbs of Multan, for which land at Bahawalpur Bypass has already been acquired. Although Air University has managed to attract PhD faculty in Management, Mathematics, Computer Science and Economics,its Multan Campus is pre-mature for launch of any postgraduate level engineering program pending the construction of a purpose-built campus and a well-established engineering department.

H. Institute of Southern Punjab

Institute of Southern Punjab, Multan is the very first and only degree awarding private institute in Southern Punjab and has established purpose-built campus on Bosan Road near BahauddinZakariya University's main campus. The Institute has Southern School of Engineering & Technology, which is offering

Bachelor's program in Electrical and Civil Engineering, for which Pakistan Engineering Council has also given green signal. However, scarcity of PhD faculty and permanent staff is currently a hindrance in the start of a postgraduate level engineering program at ISP.

I. Quantitative Comparison of Resource Availability

Table II offers a quantitative comparison in terms of resource availability at eight Southern Punjab institutions of higher learning for possible launch of a MEM program. As seen from the table, COMSATS, Sahiwal, and BahauddinZakariya University Multan exhibit highest preparedness for instituting a MEM program. The Islamia University, Bahawalpur also has similar readiness in terms of resource availability. The remaining five Southern Punjab institutions, however, need to strengthen their existing engineering and business programs to qualify for a launch of MEM program at their campus.

TABLE II
INSTITUTION-WISE COMPARISON OF RESOURCE AVAILABILITY TOWARDS LAUNCH OF INTER-DISCIPLINARY ENGINEERING

		COMSATS IIT Sahiwal	NFC IET Multan	BZU Multan	IU Bahawalpur	Namal College Mianwali	MNS-UET Multan	AU Multan	ISP Multan
Resource Availability	Engineering Programs	3	3	4	3	2	2	1	2
	Business Programs	4	2	4	4	3	1	4	4
	Postgraduate Programs	3	1	3	3	2	1	3	3
	PhD Faculty	4	2	4	4	2	2	3	1
	Accreditation	3	3	4	4	2	3	2	1
	Industrial Presence in Vicinity	4	4	4	3	4	3	4	3
	Industrial Liaison	4	4	3	3	2	2	4	2
	Admission Campaigns & Marketing Strategy	4	2	3	3	4	1	4	2
	Academic & Civil Infrastructure	4	4	4	4	4	1	4	3
		33	25	33	31	24	16	26	21

VI. Concluding Remarks

Quality higher education is vital in promoting economic progress and an affluent lifestyle of people in any geographical region. Higher education is positively correlated with better quality of life, better infrastructure and working conditions, prosperity, poverty alleviation, improved social fabric, law & order situation and decline in terrorism, some of the challenges faced by our country.

Residents of Southern Punjab have long been deprived of opportunities toward higher education in engineering and technology. Feasibility study and feedback received from Engineering Institutes in Southern Punjab state that a graduate level multi-disciplinary engineering program in Engineering Management can be launched with low capital cost, minimum recurring expenditures, nominal additional faculty and administrative resources.

Launch of a postgraduate engineering program at the geographically central region of Pakistan will link professional engineers with universities and institutions of higher education that will not only benefit people of Southern Punjab, but also serve adjoining areas of KPK, Sindh and Baluchistan. Such an initiative will spawn technology innovation and development of entrepreneurial skills, and promote industry-university liaison. It will initiate business &technology incubation and provide inter-disciplinary research culture to solve technical management problems of the industry as well as socio-economic problems of the people. In conclusion, establishment of post-graduate engineering management program in Southern Punjab will strengthen the industry-university liaison and provide quality higher education to the loving and soft spoken people of this educationally deprived region.

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APPENDIX I

World renowned universities that offer successful Masters of Engineering Management programs include:

USA:

University of California at Berkley, University of Michigan, UCLA, Purdue University, University of

Wisconsin at Madison, University of Illinois at Urbana Champaign, Virginia Polytech University, Texas A&M University, Ohio State University, Iowa State University, Kansas State University, Wayne State University, University of Louisville, University of Colorado New Jersey Institute of Technology, University of Pennsylvania, Missouri University of Science and Technology, George Washington University, University of Southern California, University of Florida, Stevens Institute of Technology, California State University, Columbia University, Florida Institute of Technology, George Washington University, John Hopkins University, Penn State University, Rochester Institute of Technology, Stevens Institute of Technology, Syracuse University, University of Texas at Arlington, University of Wisconsin, University of New Orleans,

Canada:
University of Alberta, Memorial University of New Foundland, University of Waterloo, University of Calgary

Saudi Arabia:
King Fahd University of Petroleum and Minerals, King Saud and King Abdul Aziz University

Korea:
KAIST, Yonsei University, Seoul National University

China:
Peking University, Tsinghua University, Dalian University of Technology, Wuhan University, Shanghai - Jiaotong University, Harbin Institute of Technology, Beijing Institute of Technology, University of Science & Technology Beijing, Huazhong University of Science & Technology, University of Science & Technology China, UCAS

EU:
Oxford University, Swiss Federal Institute of Technology, London South Bank University, University of Warwick, University of York, Teesside University, University of Warwick, Technical University of Denmark, Istanbul Technical University

Pakistan:
NUST E&ME College Rawalpindi, GIK Institute Topi, UET Lahore and Taxila, University of Lahore, NED Karachi, QUEST Nawabshah, MUET Jamshoro, CASE and MAJU Islamabad.

APPENDIX II

American Universities offering PhD in Engineering Management.

Airforce Institute of Technology, George Washington University, Missouri University of Science & Technology, Oklohoma State University, New York Institute of Technology, Old Dominion University, Southern Methodist University, Stevens Institute of Technology, Texas Tech University, University of Alaska Fairbanks, University of Huntsville Alabama, University of Tennessee Space Institute, Western New England University, Michigan Technological University, Norwich University

APPENDIX III: COST BENEFIT ANALYSIS

Keeping in view resource requirements at BZU sub-campus Sahiwal and after having detailed discussion with Campus Director; a rough estimate for *kick starting* MEM program is as follows:

Expenditure:
01 Associate Professor / HoD = Rs.195,000/-month
PhD + experience + publications (fixed Salary /all inclusive) = Rs. 2,340,000/year
01 Asst. Prof/Conv. Admissions & Campaign
= Rs. 130,000/month
PhD Qualified / MS 4 years' exp. (Fixed Salary /all inclusive) = Rs. 1,560,000/year
01 Lecturer = Rs. 70,000/month
(MS Engg Mgt. qualified) = Rs. 840,000/year
01 Visiting Faculty Member = Rs.50,000/Sem
(MEM qualified hourly remuneration 2 courses)
= Rs.100,000/year
01 Naib Qasid = Rs. 15,000/month
Salary / year = Rs. 180,000/year
Cost of Marketing / Admission Campaigns in 150 Km Radius = Rs. 200,000/year
TOTAL COST = Rs. 5,220,000/year

Earnings:
Admission Fee = Rs. 25,000 (at time of admission only) X 45 = Rs. 1,125,000/-
Tuition Fee = Rs. 45,000/semester/student X 45 students X 2 semesters/year = Rs. 4,050,000/-
Exam Fee = Rs. 5,000/semester X 45 students X 2 semesters / year = Rs. 450,000/-
Security = Rs. 10,000/ semester X 45 students / year
= Rs. 450,000/-
Registration Fee = Rs. 2,000/ semester X 45 students X 2 semesters / year = Rs. 180,000/-
Library Fee = Rs. 1,500 / semester X 45 students X 2 semesters / year = Rs. 135,000/-
TOTAL EARNING =Rs. 6,390,000/-

TOTAL REVENUE / YEAR
= Earning *minus* Expenditure
= Rs. 6,390,000/- *minus* Rs. 5,220,000/-
= Rs 1,170,000/-

Estimated Profit of Rs. 1.17 Million per year