Scoping Study

Education City

KhyberPakhtunkhwa

Pakistan

Extended Report

Contents

1. Acknowledgements

The project team extends grateful thanks to all those who have contributed to this study in Pakistan, Scotland and the United Kingdom. Particular thanks to the students, staff and vice-chancellors of universities in Khyber Pakhtunkhwa for participating in focus groups and the project reference group for their advice and insights.

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2. List of abbreviations

AURP	Association of University Research Parks
BUiD	British University in Dubai
CPD	Continuing Professional Development
CPEC	China Pakistan Economic Corridor
DIAC	Dubai International Academic City
EoI	Expression of Interest
FDI	Foreign Direct Investment
HE	Higher Education
HEC	Higher Education Commission
HED	Higher Education Department
HR	Human Resource
IASP	International Association of Science Parks
ICT	Information and communications technology
JIB	Jazz Institute, Berlin
KP	Khyber Pakhtunkhwa
NUST	National University of Sciences and Technology
OECD	Organisation for Economic Cooperation and Development
PLSM	Pakistan Social and Living Standards Measurements
PR	Public Relations
QSTP	Qatar Science and Technology Park
R&D	Research and Development
STP	Science and Technology Park
UCL	University College, London
UAE	United Arab Emirates
UKSPA	United Kingdom Science Park Association

3. List of tables

List of figures

4. Executive Summary

1. Globalisation and the growth of the knowledge economy have resulted in a new economic paradigm and regions need to create links between tertiary education and other stakeholders from government, and from social and economic sectors, in the development of joint projects that address regional needs. They also need to remove any institutional barriers for multi-disciplinary and institutional collaboration, technology transfer and other forms of engagement in regional and local development.

2. Around the world governments have responded to local and regional development needs in a range of ways including the development of science parks, science and technology parks, knowledge cities, education cities, learning cities, research parks and technopoles. Variance in the range of understandings of these concepts, and a blurring of boundaries between them, underlines the need for precision and clarity in defining aims and objectives and in communicating these.

3. The related research field is growing but evidence of success is mixed, with effectiveness, impact and outcomes affected by a number of social, physical, cultural, economic and governance factors (Dabinett, 2014).

4. Important pre-conditions which may influence progress are elements such as ‘risking taking, entrepreneurship, the structure of capital, the motivation of labor, the form and nature of creatively (Dabinett, 2014:13).

5. Given these pre-conditions, and security issues which may preclude international partnerships and foreign direct investment in the short to medium term, an approach for Khyber Pakhtunkhwa which is based on a phased plan of growth and development would enable the pre-conditions noted above to be put in place and underpin progress towards a knowledge city.

6. The most suitable model for development for Khyber Pakhtunkhwa is one which can respond to regional priorities, develop the human and professional capital that is needed to stimulate and advance economic growth and help to build capacity and capability across

key sectors, including education and industry. In the first phase of development four key centres / research institutes would potentially form the Knowledge City Cluster and could comprise a KP Leadership Institute (KPLI); Centre for Academic Development; Institute of Health and Well-Being and Centre for Innovation and Entrepreneurship. Once established each centre / institute would be required to have ‘strategic international partner.’ These have been identified from the evidence drawn from the scoping exercise though a follow on feasibility study can test their currency and priortiisation.

7. The establishment of an implementation board with representatives from all key stakeholders is required to oversee the development of the project. A potential model, drawing on current partnerships and collaborations is for the role of Chair of the implementation board to be shared, with one chair nominated from Khyber Pakhtunkhwa and one chair nominated from an international partnership.The process for such appointments is outlined in p62-63.

8. The site identified as a potential site is appropriate given its location in proximity to Islamabad and Peshawar. Universities in the area could act as ‘anchor universities’ for the cluster. In the first phase of development existing premises could be reassigned and refurbished with new state-of-the-art facilities constructed in the longer term. The development of online facilities should be seen as integral and the strategy should focus on ‘clicks and mortar’ rather than ‘bricks and mortar.’

9. An evaluation strategy should be built into the strategic plan to review progress and inform further development. This should serve as both ‘test of concept’ and ‘proof of concept.’

5. Definitions and nomenclature

Across the globe governments have responded to local and regional development needs in a range of ways including the development of science parks, science and technology parks, knowledge cities, education cities, learning cities, research parks and technopoles. Variance in the range of understandings of these concepts, and a blurring of boundaries between them, underlines the need for precision and clarity in defining aims and objectives and in the communication of these.

UNESCO notes that the term "science and technology park" encompasses any kind of high-tech cluster such as: technopolis, science park, science city, cyber park, hi tech (industrial) park, innovation Centre, R&D park, university research park, research and technology park, science and technology park, science city, science town, technology park, technology incubator, technology park, technopark, technopole and technology business incubator (UNESCO, online). UNESCO emphasises that the definition of terms is more than simply a matter of semantics (ibid). While the nomenclature may vary, the main features are broadly similar and the definition adopted by International Association of Science Parks and Areas of Innovation (IASP) offers some precision and clarity:

> “Science Parks” are organisations managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes provides other value-added services together with high quality space and facilities (IASP, cited in UNESCO, online).

This is the broad definition which has been adopted for the purposes of this study and report with the term Science and Technology Park (SPT) taken to encompass understandings of knowledge city / education city which are often acknowledged in the literature to be used interchangeably.

Differences in conceptualisation, nomenclature, terminology and approaches exist within and across regions and countries. Such diversity and fluidity, and blurring of boundaries, Rodriguez-Pose and Hardy suggest, present challenges for researchers and practitioners in seeking to identify links between specific park characteristics and outcomes (Rodriguez-Pose and Hardy 2014:4). Consequently they suggest, extracting clear policy lessons for why some parks work and others fail is made all the more complex as a result, not least because, as the EU noted in its report on *Setting up, managing and evaluating EU Science and Technology Parks* (EU, 2014),

> There are almost as many models of science parks as there are science parks. Every development is different, addressing a specific set of local circumstances, assets, opportunities and problems (EU, 2014:67).

In undertaking this study we have sought to draw on research and evidence to provide a report that is attuned to the current context and circumstances but offers scope and potential for future development.

6. Approaches, models and best practices

Context and framing of the report

Close relations with Khyber Pakhtunkhwa and Pakistan, and the University of Glasgow and the city of Glasgow, has provided an important context for this project. The Scottish government's Pakistan Plan, launched in 2010, recognised Pakistan as 'a significant international player within the Commonwealth as well as the country of origin for many who now reside in Scotland' (Scottish Government, online) and stated that 'we are committed to developing a strategic approach of engagement with the region and Pakistan in particular,' seeking to build on 'the historic and modern links between Scotland and Pakistan to develop a closer relationship between the countries' and which will 'create the potential for opportunities for the benefit of both' (Scottish Government online).

The plan noted that currently in Scotland there is a 'vibrant and diverse Pakistani community and many Scots have strong family, business and other links with Pakistan.' A number of business and trade links exist between Scotland and Pakistan, most notably in the chemical and mineral products, rubber and plastics sectors, with exports in 2008 estimated to account for around £20m

of trade. Other areas such as wholesale and retail hotels and other services are estimated to have accounted for a further £10m. School to school links and exchanges have been promoted through the British Council's Connecting Classrooms programme. In 2008/09, around 640 students from Pakistan were studying at Scottish universities and colleges. The key areas of focus identified in the 2010 plan included culture, business, trade and investment and tourism, with the aim of identifying existing activity and links, building on those and exploring new opportunities (Scottish Government, 2010).

Through its International Development Funding stream (South Asia), the Scottish Government has supported a number of projects in Pakistan. The key thematic priority for the programme is to address poverty alleviation and the Millennium Development Goals through sustainable economic development. Projects in Pakistan for which funding was awarded include:

- **University Of Glasgow** - Disaster Rehabilitation for Women (Pakistan)
- **Save The Children** - Empowerment and Protection (Pakistan)
- **Oxfam Scotland** - Empowerment of Poor Farmers in Sindh and South Punjab Provinces of Pakistan (Pakistan)
- **Christian Engineers In Development** - Community Water Project, Thar (Pakistan)
- **Islamic Relief Worldwide** - Small Scale Business Development (Pakistan)
- **Mercy Corps Scotland** - SKYE: The Start-Up Kashmir Youth Entrepreneur Development Project (Kashmir)
- **Leonard Cheshire Disability Scotland**- Livelihoods for Disabled People (Bangladesh, India and Pakistan).

The Scottish government’s refreshed Pakistan-Scotland Engagement strategy plan was launched in March 2016. Four key areas of collaboration between Scotland and Pakistan were identified: Trade, Investment & Enterprise, Energy & Water, Education & Skills and Culture & Heritage (Scottish Government, online).

Established links between universities in Scotland and Pakistan continue to be consolidated and the School of Education, University of Glasgow has been involved in hosting leadership development programmes for Deans and Registrars from Pakistan from Pakistan and KP region since 2015. Thus the work undertaken as part of the scoping study is seen as part of an on-going

commitment to capacity and capability building in the region, working towards more enduring and sustainable partnerships in the longer term.

Conduct of the scoping study and field research

The plan for undertaking the scoping study involved qualitative and quantitative research, including desk-based research and field research in Khyber Pakhtunkhwa. This was an adaptive process as emerging findings, particularly during the field research component, required adjustment and adaption of the planned research and its phases. The scoping exercise consisted of four main elements: desk-based research; semi-structured interviews; focus groups with students and vice-chancellors; and site visits.

As with all empirical research studies undertaken by staff and students from University of Glasgow, approval for the study was given by the College of Social Sciences Ethics Forum following the submission of an application for ethical approval. In line with the conditions of ethical approval, individuals who agreed to participate in the study are not identified by name.

Desk-based research involved sourcing and analysis of policy documents from KP government and relevant departments; review of literature on science parks and science and technology parks; survey of relevant current models adopted or in development in Pakistan and abroad; and review of other additional relevant documentations including newspapers and websites.

Field Research and consultations

During a week-long visit to the region a number of meetings were held to discuss the proposed initiative. Focus groups were held with students from three universities from the region and with Vice Chancellors from nine universities. Follow up interviews were conducted in person or via Skype with three vice chancellors who were unable to participate in the focus group held in Peshawar. A summary of meetings and focus groups is provided in Table 1 below.

As part of the study consultation meetings were held with (i) a senior adviser and director of a UK based Research Park and (ii) a senior university leader (Vice Principal) with responsibility for internationalisation in a Scottish university.

Table 1 Summary of meetings and focus groups

Format	Participants
Meeting	Chairman, Higher Education Commission, Pakistan
Meeting	Adviser, NUST
Meeting	Minister for Higher Education, KP
Meeting	Secretary, Higher Education Department, KP
Meeting	Additional Secretary, Higher Education Department, KP
Focus Group	9 Vice-chancellors and 3 Deans from universities from KP region
Focus Group	32 students and staff from 3 universities in Peshawar
Meeting	Additional Secretary HED Punjab / Project Director Lahore Knowledge Park

A Reference Group was convened for the project consisting of:

- Syed Ahsan Raza Shah, Consul General of Pakistan to Scotland
- Counsellor Raja Hanif, Glasgow City Council
- Dr Azra Meadows, University of Glasgow
- Dr Peter Meadows, University of Glasgow
- Dr Khalid Khan, Additional Secretary Higher Education Department KP
- Mr Hamza Salim Ahmed, Project Manager HE & Skills British Council Pakistan.

The purpose of the reference group was to act as a consultative and advisory group for the scoping team to discuss emerging findings from the scoping exercise.

Framing the study

In framing the conceptual parameters of the scoping study several key questions were identified as essential to being able to advance the study. These include:

- What are the features of current theoretical and applied approaches to regional economic development?
- What is the relationship between regional economic development and higher education capacity building and how can it be strengthened?
- What are the distinguishing features of models such as science and technology parks and knowledge cities and what are the necessary pre-conditions for development?

These key questions are now considered in the following section which draws on current literature on approaches to regional development and is informed by the expertise of members of the research team in advising regional governments.

Promoting regional development – strategies and approaches

Globalisation and the growth of the knowledge economy have resulted in a new economic paradigm with wide reaching implications for regional development and spatial planning. With some notable exceptions, higher education institutions, particularly research-intensive universities, have traditionally tended to be self-contained entities focused on the creation and development of basic knowledge for scientific purposes and prestige. This has, however, changed.

The new economic paradigm, which stresses the importance of tertiary education to economic development, has stimulated the higher education sector to more directly engage in the national and/or global economy. Furthermore, national and regional governments and supra-national institutions are developing regional policy frameworks, incentives and/or infrastructure to encourage higher education institutions to respond to local and regional needs. The recognition that higher education can play a key role in development is now a fundamental underpinning of most economic development strategies, both at international, national and regional level.

There are at least four dimensions of development where the higher education institutions can make substantive contribution. These dimensions are human capital and skills development, knowledge creation and transfer, cultural and community development, and regional capacity building. These are discussed below.

- Human capital and skills development is the single most important factor for economic growth of countries and regions. Nurturing relevant skills to fuel growth is the best guarantee that a region will prosper in future. Tertiary education institutions face the challenge of meeting the social and economic needs of the population in terms of opportunities to study and the relevance of qualifications offered. Increasing participation rates in education, widening access to tertiary education and reducing dropout rates are the best strategies for expanding the stock of human capital in the region. Active collaboration between higher education institutions and the industry can also forge a stronger alignment of the educational provision with regional and labour market needs and ensure the entrepreneurial skills of graduates and their employability.

- The promotion of regional innovation and the development of a *Regional Innovation System* are important drivers of long-term economic growth and competitiveness. Higher education institutions have the capacity of contributing to the effectiveness of innovation policies and practices in the region through research and knowledge transfer. Higher education institutions can collaborate with local business to design RDI programmes that allow not only for high-tech development but also for incremental advances. Strong linkages between science and technology departments and business departments and facilities within the higher education sector can foster the support for service and industry, and promote technologies with cross-sector fertilization potential.

- Social, cultural and environmental development underpins, stabilizes economic growth and improves community health and welfare, security and social cohesion as well as clean, healthy and sustainable environment. Tertiary education institutions cannot avoid the responsibility of responding to the social, cultural and environmental needs of the region and can collaborate with other tertiary education institutions in the design and implementation of extension and community development activities and seek ways to empower communities to find their own solutions to economic, social, cultural and environmental challenges.

- Capacity building within tertiary education institutions and the region in which they are located are beneficial to both parties. The extent to which tertiary education institutions are engaged in regional human resource development and innovation depends largely on their cooperation with regional agencies and the policy context relating to financing, regulation and institutional and national policies. Regions need to create links between tertiary education and other stakeholders from the government and from social and economic sectors in the development of joint projects that address regional needs. They also need to remove any institutional barriers for multi-disciplinary and institutional collaboration, technology transfer and other forms of engagement in regional and local development.

The potential for economic development impact of Higher Education

It is widely recognised through experience and academic work that higher education makes an important contribution to economic development, whether in the context of high, low or middle income countries (for an overview see for example McMahon (2000, 2009)). These impacts occur through a range of channels and manifest themselves at different timescales, from the immediate to the intergenerational. Some of these are tangible monetary benefits, which clearly accrue to a particular individual or an institution, such as labour market benefits of graduates, whilst others are more diffuse and less tangible, such as knowledge spill-overs or contributions of higher education to civic society.

Whilst many benefits of higher education resonate with the higher aspirations of society, such as for an educated population and technical progress, it is important not to lose sight of the more mundane benefits from expanding the HE sector. HE is a production sector like any in the economy, it purchases inputs and pays wages. These expenditure (or demand) impacts are felt immediately in the local economy of a Higher Education Institution (HEI). Analysis of these impacts have come under criticism (e.g. Siegfried et al 2007), as individual institutions have sought to exaggerate their importance in the local economy, for instance by double (or even multiple) counting of impacts. Similarly, it has been questioned if there is a net-expenditure impact of HEIs, given that they are often simply spending public funding that could be allocated to other ends. However, that does not mean all expenditure impacts are bogus. Hermannsson *et al* (2014a) discuss this issue in the context of Scotland. It transpires that only about half of the HEIs incomes are subject to the binding budget constraint of the Scottish Government. Furthermore, the HE sector in Scotland is more closely tied to the local economy than public expenditure on average, due to the higher share of wages in its expenditures and less imports of inputs. Of course, the Scottish HE sector, is atypical in that is a significant provider of export earnings from foreign students.

More fundamentally, qualified individuals directly stimulate the productive capacity (supply-side) of the economy through the skills they offer in the workplace, but also through a range of indirect effects. Furthermore, many of the benefits of education are non-pecuniary. In order to classify these supply-side and wider impacts we follow McMahon (2009) in classifying these along two axes, private or public and market or non-market. This results in four categories (see Table 1):

private market benefits, private non-market benefits, external market benefits and external non-market benefits.

Private market benefits of education are the labour market benefits enjoyed by individuals as a result of their level of education. They manifest themselves in higher earnings and lower unemployment rates, relative to less qualified individuals. Similarly, private non-market impacts of education are the benefits enjoyed by individuals outside of the labour market that are directly attributable to their level of education. These include positive effects on health, longevity, happiness and many other benefits. These effects are strongly correlated with income and other attributes, which make it challenging to identify the specific contributions of education.

Table 2 Examples of the benefits of education and their classification

		Who benefits?	
		Private	**External**
Type of benefit	**Market**	Higher wages Higher employment Lower unemployment	Higher productivity of other workers (productivity spillovers) Higher Total Factor Productivity (TFP) due to knowledge spillovers
	Non-market	Better own health Longer life expectancy Improvement in happiness	Less crime Democratisation Civic society

External impacts of education (or externalities) refer to benefits enjoyed by wider society as a result of the level of education of the general population. These externalities can be manifested in terms of higher wages and higher profits and are reflected in GDP per capita. However, they are not “internalised” by particular qualified individuals and are enjoyed by other agents in the economy. Examples would include the higher productivity and wages of non-graduates generated

by working with graduates and the education system's (typically focussing on HEIs) contribution to R&D and innovation.

Similarly, external non-market impacts improve quality of life, but are not necessarily directly translatable into pecuniary benefits. Examples would include any education-induced: reduction in crime levels, improvements in public health, democratisation or political stability. These are non-monetary benefits that are captured at a social level as an indirect impact of the level of education in the community. They are not captured in measures of economic output but may improve other development indicators. This category would include education’s contributions to various types of social advancement, such as the quality of culture or the rule of law, as reflected in quality of life metrics, for example happiness scales (independent of the effects of income on the same metrics to avoid double counting).

It is apparent that accurately attributing these effects to their source is challenging. Often outcomes are difficult to measure, random assignment is usually not possible and there are various confounding factors that need to be taken into consideration. However, significant steps have been taken to clarify these issues, such as through studying natural experiments. Assuming these effects simply do not exist can lead to under investment in education that is harmful to society.

Magnitude of impacts

Arguably the most salient impact of education is manifested in the additional skills of the working population. An extensive literature documents the labour market benefits of education (typically referred to as the returns to education) at various levels of schooling, in different countries at different times. Sometimes the results are further disaggregated by characteristics such as gender, discipline and social background. A key result, repeatedly found in studies of this kind is that qualifications are associated with an increased likelihood of employment and more qualified workers generally earn higher wages. Due to an obvious inability to conduct controlled experiments in the field, verifying the causality between education and income has proven difficult. More recently a wealth of papers has been published utilising advanced statistical approaches, i.e. instrument variables, controlling for fixed effects (using samples of twins) and natural experiments,

to clarify the issue.[1] Typically these studies find higher returns to education in lower income countries where education levels are generally lower. This is seen as consistent with the notion of diminishing returns to education, with the return to education falling as the average education levels rise. However the dynamism of these diminishing returns is more complex than a simple analysis of increasing supply within a comparative static framework might suggest, as it is not only the supply of education that can change but the demand for it as well.

Yusuf and Ul Haq (2014) use the 2008 Pakistan Social and Living Standard Measurement (PSLM) to analyse the association between level of education and earnings at a regional level in Pakistan. For all provinces in Pakistan they find very strong returns to higher education. In KP province the average graduate earns about twice as much as a worker with primary education. Moreover a worker with post-graduate qualifications earns approximately three times as much as a worker with primary education. There are also significant benefits to achieving lower level qualifications. Although more modest than the benefits of HE, these returns are far stronger than generally observed in high income countries. For example, a worker with upper secondary qualifications typically has earnings about 1.5 times that of those holding primary qualifications. The study by Yusuf and Ul Haq (2014) does not report separately on technical and vocation qualifications. This is possibly because formal vocational/technical qualifications are not common in the Pakistani labour market, as reported by Ikram *et al* (2015). Non-monetary benefits and external benefits are of course in addition to these direct labour market benefits.

Interaction between human capital and wider economic circumstances

The economic impacts of the HE sector do not occur in isolation but depend on an interaction with wider developments in the host regional economy and the economic environment more generally. To clarify this, it is useful to think about how the additional human capital provided by a new graduate contributes to the economy. On average a graduate in Pakistan has improved the market worth of his labour by about 100%. This implies that his/hers productivity has increased by 100%, in the sense that results of a day's labour are now 100% more valuable before.[2] Each year as more skilled cohorts enter the labour market the stock of human capital increases and hence the productivity of labour. For this to translate into improved competitiveness vis-à-vis competitor

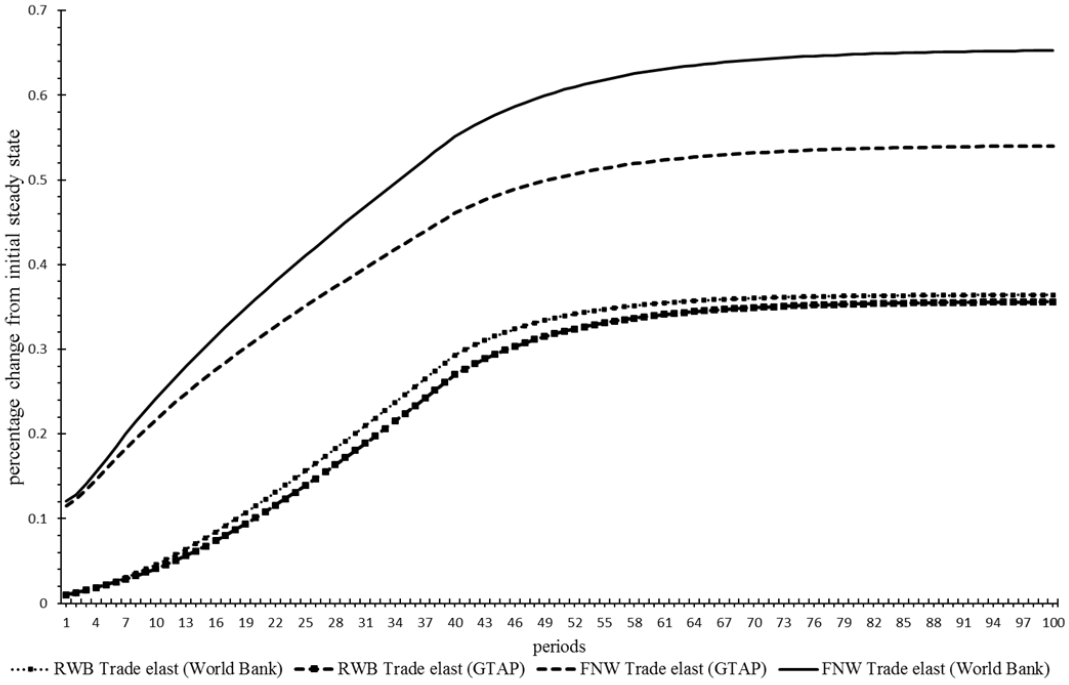
[1] Numerous reviews of the microeconomic literature on returns to education have been published. Examples include Dickson and Harmon (2011), Checchi (2006), Blundell *et al* (2005), Psacharopoulos & Patrinos (2004, 2002), Harmon and Walker (2003) and Krueger and Lindahl (2001). Typically these estimates are obtained through regression analysis of cross-sectional surveys of the labour market. An earning function (see Mincer 1974) is fitted where indicators for formal education, labour market experience and individual characteristics are used to explain wage income.
[2] For a further discussion of the assumptions involved and the transmission from human capital to macroeconomic impact see Hermannsson et al (2014b).

regions, KP region must be increasing its human capital stock faster than competitors. If this is the case export activity is likely to be stimulated, which in turn has knock-on impacts elsewhere in the economy.

Hermannsson and Lecca (2016) use a Computable General Equilibrium (CGE) model to explore the sensitivity of the macroeconomic impact of increasing the human capital stock for Malawi, a small, landlocked, Sub-Saharan economy. Although not directly comparable to KP province the principles involved are the same. The impact changes by orders of magnitude depending on how the labour market responds and how readily competitiveness is transformed into increased export sales. These results should provide grounds for optimism for the KP province.

Firstly, the new motorway development linking KP province to the China-Pakistan trade corridor could mean that trade costs are lowered, further bolstering the impact of expanding the human capital stock. Second, the province is starting from a low base in terms of its human capital development. Therefore, there is ample scope for reinforcing developments in the HE sector with increased attainment at lower levels of the skills spectrum. A comprehensive discussion of a potential skills policy for KP province can be found in Chapter 5-B of Ikram et al (2015). Therefore, it should be possible in principle to start a virtuous cycle of economic growth, which is reinvested in human capital thereby maintaining and reinforcing the region's competitiveness.

Figure 1 Comparison of projected GDP changes under alternative assumptions about labour markets and price elasticity of exports (% change from base year). Source: Hermannsson, K., and Lecca, P. (2016).



Approaches and models for regional development: from science parks to technopoles

One of the strategies that national and regional governments opt for to promote and stimulate economic growth and development is the establishment of specific sites for research and development, knowledge exchange; business innovation and production. This varies in number, scale and range from region to region and the adoption in recent years of models of development such as knowledge city, education city, learning city, science park, science and technology park, research park and technopolis presents particular challenges when seeking to define and typologise these. Often these terms can be used interchangeably and be taken to mean one and the same thing, while in reality, though similar, there are differences. Additionally while the number of such entities has grown globally, a research base from which to draw from to inform further development has been slower to emerge.

Recent publications which attempt to map and explain the phenomena and gauge impact include: Carrillo (2006) *Knowledge Cities Approaches, Experiences, and Perspectives*; Oh and Phillips (2014) *Technopolis Best Practices for Science and Technology Cities* and Rodriguez-Pose and

Pardy (2014) *Technology and Industrial Parks in Emerging Countries.* In relation to knowledge cities, Carrillo points out that 'conceptual and empirical studies on Knowledge Cities constitute an emerging, pre-paradigmatic, and multidisciplinary field.' He suggests that the emergences of knowledge cities can be characterized as pre-paradigmatic and while growing rapidly, the field still lacks a consensus regarding appropriate conceptual and methodological frameworks (Carrillo, 2006: xii-xiii).

Knowledge Cities

In their chapter in Carrillo (2006), 'An Emerging Pattern of Successful Knowledge Cities' Main Features,' Ergazakis, Metaxiotis and Psarras seek to discern the defining features of knowledge cities while acknowledging some of the complexities related to this. They note however that 'many cities globally claim themselves as being already knowledge cities while at the same time other cities have elaborated strategic and action plans in order to become one.' They argue that 'there is neither a coherent framework nor a unified methodology for the design and implementation of successful knowledge cities' and they suggest that 'the real success of knowledge cities is still under investigation in the research community (Ergazakis, Metaxiotis, and Psarras, 2006: 3).

According to Ergazakis, Metaxiotis and Psarras (2006:4) the concept of knowledge city is very broad and may refer to all aspects of social, economic, and cultural life of a city. Drawing from earlier work, (Ergazakis *et al*, 2004b), a knowledge city is defined as 'a city that aims at a knowledge-based development, by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge.' This can be achieved through the continuous interaction between its citizens themselves and at the same time between them and other cities' citizens. The citizens' knowledge-sharing culture as well as the city's appropriate design, IT networks and infrastructures support these interactions" (Ergazakis, Metaxiotis and Psarras (2006:4). They caution that the process of developing a knowledge city is neither quick nor simple and advise that efforts to develop a knowledge city should have assured the active support of the entire society, i.e., local government, citizens, private sector, organizations, universities and so on (ibid).

In their conceptualization of a knowledge city, the focus is on the transformation of a city into a 'knowledge city' rather than the creation of a completely new entity. In this respect, knowledge city aligns closely with the model of a learning city which has evolved in recent years and which UNESCO defines as 'a city which effectively mobilises its resources in every sector to:

• promote inclusive learning from basic to higher education;
• re-vitalise learning in families and communities;
• facilitate learning for and in the workplace;
• extend the use of modern learning technologies;
• enhance quality and excellence in learning; and
• foster a culture of learning throughout life.'

In so doing it will create and reinforce individual empowerment and social cohesion, economic and cultural prosperity, and sustainable development (UNESCO, 2013). These criteria have been used by a number of cities and regions in developing their strategies to becoming learning cities.

Science Parks, Science and Technology Parks, Technopoles

Models of urban and regional development that have been adopted in recent decades include Science Parks, Science and Technology Parks and Technopoles. However, as noted above in relation to concepts of knowledge city, the nomenclature and conceptualisation of the 'science parks' is fluid, with the terms used variously (Dabinett, 2014:4) and increasingly reflecting a trend towards hybridisation. Consequently, Dabinett (2014:6) notes that research and policy analyses have shown that 'science parks' came to be used as a term to refer to quite different projects, and very different experiences.

Gyurkovics and Lukovics (2014) in a chapter on 'Generations of Science Parks in the Light of Responsible Innovation' suggest that 'There is no uniform concept description of "science parks" in professional literature and what initiatives are labeled by science and development policies with this term changes from country to country (Gyurkovics and Lukovics, 2014:195 in Buzas, 2014). They argue that very different development policies (e.g. technopolis, business parks) are often also put under the "science park umbrella term – incorrectly. Drawing on the assimilation of definitions of sciences parks developed by three key global science park associations[3] (Albahari et al. 2010), Gyurkovics and Lukovics (2014), distinguish four elements that are present – explicitly or implicitly – in all of the definitions:

- the importance of geographical proximity and the (physical) environment;
- partnerships with knowledge creating institutions, universities;

United Kingdom Science Parks Association (UKSPA),
Association of Universities and Research Parks (AURP)
International Association of Science Parks (IASP)

- encouraging knowledge/technology transfer; and
- encouraging the creation of new businesses (incubation services) (Gyurkovics and Lukovics, 2014:195).

They define the four functions which a science park can fulfil in its region's economic system as:

- *the technology transfer function*, i.e. mediating advanced technologies and supporting their dissemination;
- *the knowledge creating function*, i.e. the encouragement of the innovation activity;
- *the "seedbed" function,* which plays a decisive role in the creation of a special environment; and
- *the incubation function*, i.e. the encouragement of the creation of new technology-intensive businesses (ibid).

Gyurkovics and Lukovics (2014) suggest that which of these functions is more dominant is strongly determined by the profile of the given science park and the identity and motivations of its owners, though according to IASP in most cases, the creators and owners of science parks are universities (IASP 2012 in Gyurkovics and Lukovics, 2014:195).

Table 3: Summary of the Different Definitions of Science Parks (adapted from Parry, 2006; Gyurkovics and Lukovics, 2014).

Association	**Defining Features**
UKSPA	A Science Park is a business support and technology transfer initiative that: - encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses; - provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit; - has formal and operational links with centres of knowledge creation such as universities, higher education institutes and research organisations.
IASP2	Areas of innovation, of which science, technology and research parks (STPs) are a highly specialised type, play a key role in the economic development of their environment. Through a dynamic and innovative mix of policies, programmes, quality

	space and facilities and high value-added services, they - stimulate and manage the flow of knowledge and technology between universities and companies; - facilitate the communication between companies, entrepreneurs and technicians; - provide environments that enhance a culture of innovation, creativity and quality; - focus on companies and research institutions as well as on people: the entrepreneurs and 'knowledge workers;' - facilitate the creation of new businesses via incubation and spin-off mechanisms, and accelerate the growth of small and medium size companies; - work in a global network that gathers many thousands of innovative companies and research institutions throughout the world, facilitating the internationalisation of their resident companies.
AURP3	A university research park as a property-based venture, which: - master plans property designed for research and commercialization; - creates partnerships with universities and research institutions; - encourages the growth of new companies; - translates technology; - drives technology-led economic development.

The evolution of science parks, and the emergence of the 'Science Park Movement' gives some sense of the development of science parks in the second half of the 20th century and 'three generations' of science parks that are seen to have emerged.

Rodriguez-Pose and Hardy (2014) argue that the popularity of science and technology parks as models of development was driven by the emergence of a handful of archetypal centres of innovation such as Silicon Valley and Massachusetts Route 128 in the US, Cambridge Science Park in the UK, Sophia Antipolis Technology Park (France); Tsukuba Science City, Japan and Hsinchu Technology Park (Taiwan) (Rodriguez-Pose and Hardy, 2014:2); (Gyurkovics and Lukovics, 2014:195). In relation to 'Silicon Valley's evolution as a prototype model, Dabinett in Oh and Phillips (2014) observe that:

> 'Science city' based urban development is a highly normative construct that has on many occasions been advanced as a way of replicating Silicon Valley, an expression of a

particular form of growth and production of wealth and power, which itself has not been reproduced throughout the USA (Oh and Philips, 2014:15).

In the first phase of development, most science parks were established in the outskirts of cities, to re-vitalise run down industrial areas, or were housed by university campuses, and their operation was managed by one single organisation (EC, 2008 in Gyurkovics and Lukovics, 2014:197) though later developments focused on city centre locations. As they have evolved approaches to management, operation and innovation have adapted and changed. Based on these aspects, Annerstedt (2006) distinguishes three science park generations (Annerstedt, 2006 in Gyurkovics and Lukovics, 2014:197. These are summarised in Table 4 below.

Table 4: Summary of key features of three generations of science parks

Generation	Features
First generation	Usually located in the immediate proximity of universities, in an area designated for this particular purpose. It gives home to a variety of incubation and business services and has access to external sources of financing. Such parks are managed exclusively by the university, through some foundation or self-owned enterprises, and their key goals are to broaden universities' economic opportunities and to support university-related business activities and communities. First generation parks are organised and operate along the linear, "science push" model of innovation. What they consider as their most important task is to get new scientific results into their practical market utilisation in the quickest and smoothest way. Owing to this linear approach, the only thing that they consider as the basis of innovation activities is research and development and the results deriving from them.
Second generation	Second generation science parks can also be considered as some sort of "extension" of universities, but they are not necessarily located in the immediate proximity or operate under their exclusive supervision (Annerstedt 2006). The key driving force of their operation is the creation of innovation oriented businesses and the support of their growth, rather than the economic utilisation of the university's research results. Hansson *et al*. (2005) identify the difference between first and second generation parks as follows: while the aim of the former is to create opportunities for new businesses for the economic utilisation of their (i.e. the universities') economic results, the latter focus on the creation of technologies suitable for economic utilization and on making university students entrepreneurs. Besides, in the actual operation of businesses, the latter pay more attention to the needs and requirements of businesses and, as a result, such parks offer a broad portfolio of high quality services. The management tasks related to the park are mostly performed by some privately owned business organisation, the representatives of the academic and local government sector being involved only in certain matters, which are related to the actual operation and regulation of the park. The approach of second generation science parks towards innovation

	can be described with the “market pull” model (Annerstedt 2006).
Third generation	The third generation of science parks exists in bustling urban regions. They are the manifestation of cooperation between economic, academic and government players and the place of operation of organisations participating in global and regional innovation activities (Annerstedt 2006). The declared aim of these parks is to improve the welfare of the local community, through supporting efficient cooperation between the above mentioned three types of players. However, a well operating third generation park also offers a broad portfolio of innovation related services, contribute to the development of their regions' entrepreneurial culture and establish two-way communication between the creators and users of knowledge and technologies. These science parks' innovation approach can be described with the interactive, feedback-based innovation model. Their management is based upon long-term partnership between the private and public sectors. In matters of strategic importance, actors decide together but the day-to-day management tasks of a third generation science park are performed by a jointly owned business organisation, which has a professional team of experts. Third generation parks are an organic part of the urban regions that give home to them (Annerstedt 2006) and their aims are not shaped to suit only a small group of players.

In analysing the features of science parks as they have evolved, Gyurkovics and Lukovics (2014) emphasise that universities continue to be the key players of science parks but the parks' level of success now requires cooperation between the different players of their broader environment (Gyurkovics and Lukovics, 2014:198). For them it is exactly the network of relations with universities that to a great extent determines the successfulness of science parks' (ibid). As the 'third mission' of universities became more explicit from the late 1980s and 1990s, with the growing expectation that the academic sector should generate some profit for society (Goldstein, 2010 cited in Gyurkovics and Lukovics (2014) and the need for universities to reduce reliance on government funding and seek additional and alternative funding streams, two different models of universities emerged: (i) the engaged university model; and (ii) the entrepreneurial university model. For Gyurkovics and Lukovics (2014), the profile and level of development of a university can be a decisive factor in the successfulness of a science park. They argue that it makes a huge difference what field of science the institution with which the park and its businesses cooperate excels in.

In the initial phase of growth, science parks tended to be located in developed countries, primarily in Western Europe, where a number of economies were shifting to a post industrial base. For Komninos (1997) this began in the early 1970s and was based on a more experimental approach

and included the science parks in Cambridge (England), Heriot-Watt (Scotland), and Sophia Antipolis (France) (Komninos, 1997, cited in Oh and Philips, 2014: 4).

Komninos (1997) identifies the second phase of science and technology practice as occurring in the 1980s, with more than 100 parks being set up throughout Western Europe or more specifically the European Union (EU). The growth in the number of science parks at this time, according to Komninos, was connected to wider political and economic frameworks, concerned with productive restructuring, the disintegration of productive capacities, the rise of small businesses and the new demands for R&D, innovation and producer services (Komninos, 1997, cited in Oh and Philips, 2014: 4).

Research studies on this phase and approach to regional development show the types of science parks which emerged to be hugely variable, ranging from small business incubators, such as business and innovation centres, to large physical and land-use developments seeking to significantly replace old productive systems or to create new economic spaces or growth poles. Despite this variety some common features were identified including:

- University-production co-operation, which creates a technology and innovation environment open to firms;
- Infrastructure which transfers technology and business services to SMEs or larger firms;
- A number of innovative firms that create a pole for innovation capable of diffusing technology and know-how to the wider productive system round the park (Komninos, 1997, cited in Oh and Philips, 2014: 5-6).

Komninos has provided a helpful typology of the types of entities which emerged in Western Europe as part of the second wave or second phase of development of science parks (Komninos 2002, in Oh and Philips, 2014:6). These are summarised below.[4]

Science parks

The simplest way to plan and develop new technology districts and industrial spaces. The aim is creating environments favourable to technology transfer and technological development and the main focus is to boost the creation of technology-based firms.

[4] Adapted from Komninos, 2002, cited in Dabinett, G., (2014) 'A New strategic approach to science cities: Towards the achievement of sustainable and balanced spatial development' in Oh., D-S., and Philips, F., (2014) *Technopolis*, London: Springer.

Research parks

Usually located close to one or more universities or similar academic and research institutions. Its emphasis is on research rather than development and the key is academic/research liaison at the leading edge of science and technology. Normally, production plants are precluded.

Technology parks

A development to accommodate companies engaged in the commercial application of high technology, with activities including R&D, production, sales and servicing. They are distinguished from science and research parks because of a greater emphasis on production though academic involvement is also essential.

Innovation centres

A facility catering for the needs of predominantly new businesses engaged in the development and marketing of new technological products and services.

Business incubators

A place where newly created firms are located in a rather limited space with the aim increasing the chance of growth and rate of survival of these firms by providing them with modular building facilities, common technical facilities, and also managerial support and back-up services.

While the number of science parks (or their variants) in Western Europe grew in range and diversity, the impact and outcomes from such projects also varied, with some more successful than others. Limitations were identified in relying on the science/technology park project-based approach in achieving job creation, business growth and industrial restructuring. In the 1990s and early 2000s, a new strategic approach to regional development policy placed greater emphasis on networking and institutional external economies to support technological innovation and the European Commission (EC) launched a series of programmes and schemes to support, strengthen and advance these (Dabinett, 2014:7). Key features of this strategy included:

- a *bottom-up* approach, giving emphasis on the regional technology demand;
- a *regional* approach, focusing on the development of a territorial entity on the basis of a consensus between the government, the private sector, the universities and the research centres;
- a s*trategic* approach, combining the analysis of the regional technological development and the definition of long-term priorities and short-term actions;
- an *integrated* approach, linking the efforts of the public and private sectors towards the common goal of increasing regional productivity and competitiveness; and
- an *international* approach, considering the global market trends and enhancing international technology and economic cooperation (Dabinett, 2014:8).

The aim, according to Dabinett (2014) was that the development outcomes should be secured not only by projects such as science and technology parks, but also by the institutions in the region which can offer some guarantee of continuity and implementation. It is also acknowledged in this approach that there is no simple panacea for less developed regions, but rather the active searching to achieve these outcomes develops the institutional and cultural-based innovativeness of a region that in turn is necessary to trigger adaptation and flexibility required by the knowledge economy (ibid).

As science parks in Western Europe continued to evolve from their initial conception, in Japan and East Asia, the trend was increasingly towards technopole development (Castells and Hall, 1994 in Dabinett, 2014:9). Technopole, or technopolis is derived from the Greek for technology city.

Using an empirical typology based on international experience, Dabinett seeks to classify the descriptors for technology parks, science cities, and techopoles further (Dabinett, 2014). Technology parks are seen as ‘attempts to induce new industrial growth by attracting high-technology manufacturing firms to a privileged space. The function of technology parks is defined in economic development terms with a deliberately established business area, resulting from government and/or university efforts. Science cities are seen as strictly scientific research complexes, with no direct territorial linkage to manufacturing. They are intended to reach a higher level of scientific excellence through the synergy they are supposed to generate in their secluded scientific milieu. Finally technopolis programmes promote the localisation of national programmes, regional development and industrial decentralisation (Dabinett, 2014:9).

According to Dabinett (2014) within this typology science cities are seen as ‘‘new settlements, generally planned and built by governments, and aimed at generating scientific excellence and synergistic research activities, by concentrating a critical mass of research organisations and scientists within a high-quality urban space (Dabinett, 2014:9). They are also often presented as tools of regional development, intended to assist the decentralisation of scientific research, with all the prestige that involves, to the national periphery or, failing that, the metropolitan periphery’’ (Castells and Hall 1994 in Dabinett, 2014:9). The creation of such a site was seen to be ‘symbolic and material proof of the nation state’s commitment to science and technology, and the spatial concentration was to give real as well as symbolic presence to national scientific resources’ (Dabinett, 2014:9). This concept was perceived to aim at promoting a new regional culture that differed from conventional regional development that centred on land utilisation and infra-structural improvements (ibid).

Science cities can be seen instruments to establish a core area of regional development (Goldstein and Luger, 1992 in Dabinett, 2014:12) and as a way of as a way of linking high-tech industries with regional development through economic innovation (Oh and Masser, 1995 in Dabinett, 2014:12). The benefits are seen to include:

- providing a major location or space for business-science ventures;
- attracting foreign investment;
- promoting the transfer of new and emerging technologies;
- providing a major location and space for the development and commercialisation of knowledge-based products and services;
- providing the ability to adapt existing technologies to local conditions and needs;
- increasing added value to exports;
- improving foreign exchange earning;
- providing the ability to purchase new technologies;
- improving environmental conditions;
- improving economic performance;
- ushering the host country into the global economy; and
- reducing poverty (Oh, 2005 in Dabinett:2014:9).

Given these potential benefits, Dabinett (2014) suggests that:

> the possibility therefore arises to utilise such a potentially powerful regional development instrument to enhance the capacities of developing countries in their management of science, technology and innovation' (Dabinett, 2014:13).

However, he warns that effectiveness, impact and outcomes are affected a number of social, physical, cultural and governance factors as well as economic factors. He cautions that 'outcomes are not inevitable, nor do they follow supposedly inevitable pathways of successful development.' It is important to take into account local conditions in specific spaces and places which may condition important elements such as risk taking, entrepreneurship, the structure of capital, the motivation of labour, the form and nature of creativity (Dabinett, 2014:13). Eight potential limitations are identified:

1. The technopolis development remains as a 'satellite development', and fails to become fully integrated within the wider economy and spatial development processes. Further development increasingly becomes dependent on attracting new investment through the provision of land and skilled labour that is a cheaper offer than that in the major existing cities. Outcome could create a cost competitive model, highly dependent on wider economic conditions.

2. The technopolis is only able to significantly attract mobile FDI, creating a branch plant syndrome with little, if any, endogenous-based growth and embedding of capital, skills or technological knowledge. Productive and service tasks are largely routine, involving subcontracting and overspill functions decentralising on cost or capacity grounds from main core economies.

3. The technopolis fails to fully develop appropriate university–business links. There is a lack of key creative and entrepreneurial professionals in the local universities or businesses, or path-dependent social relationships continue as barriers to fully developed interactions. Failure or limits to such interaction can be reinforced by prevailing national state policies towards university-based education, research and entrepreneurial activities, and the lack of challenges to established professional and social relationships which discourage new relationships and entrepreneurship.

4. The technopolis is unable to develop sufficient soft infrastructure to support research and technological development, in particular no forms of venture capital and international knowledge

exchange. Further growth becomes more dependent on increasing the hard infrastructure of the area — roads, airports, buildings — thus reinforcing satellite and dependent development trajectory.

5. Failure or limits to the relocation of high-level, internationally competitive R&D activities, furthering the spatial division of high order scientific and technical labour.

6. The technopolis is characterised by a lack of inter-industry linkages and voluntary collaboration, and a lack of spin-offs from universities, laboratories and research centres. Business and entrepreneurial cultures remain embedded in previous cultures of trust, reward and dependency.

7. The technopolis development is limited and frustrated by unproductive rivalry and competition between local governments and development agencies. This can lead to ineffectiveness and inefficiency, but can also increase the fiscal burden.

8. The technopolis success is severely limited by the failure for national and regional policy development objectives to be appropriately integrated. Contradictions occur between sector goals and spatial outcomes (Dabinett, 2014:14).

Dabinett (2014) warns that, within the science city/technopolis model, there is a potential threat that ‘practices will too easily develop an emphasis on the property and physical dimensions of urbanisation and regional development.’ In the new global knowledge economy, he suggests, the new geography of economies is supposedly ‘‘not the result of natural endowments of land, labour and capital but rather it is powered by innovation and entrepreneurship; and this in turn is the product of real people acting in real places” (Dabinett, 2014:16). Consequently, science cities are socially constructed as much as they are the product of bricks and mortar, financial and agency instruments (Dabinett, 2014:17).

In the preface to *Technopolis* (2014) Hong Chui Yum of the World Technopolis Association suggests that developed nations build technopolis / science and technology parks (STPs) to stay at the forefront in R&D and commercialisation of cutting edge technologies. Developing nations, he suggests also desire to develop STPs as a means of improving their capacity of technology-based economic growth and regional innovation which will eventually enhance their national competitiveness (Oh and Philips, 2014:v).

It is recognized however that not all technopolis projects will succeed and that part of their success will depend on them being sustainable socially, environmentally, creatively, and financially (Oh and Philips, 2014:xiii). Their design and construction is also an interdisciplinary project, requiring knowledge of architecture, city planning, sociology, finance, politics, geography, technology strategy, R&D management, technology transfer and commercialization, education, as well being attuned to local politics and culture (ibid). Oh and Philips (2014) add a further caveat, noting that obstacles to technopolis abound and that citizens and legislators may oppose focusing investment in one area of the country for technology development purposes, when other districts remain needy. Refocusing educational institutions for innovation and entrepreneurship, they purport, is not an easy task (ibid).

While science and technology parks have proliferated around the world since the first generation emerged in the 1970s, much of the research and literature on their development and impact had focused on developed countries. Studies have found their impact to be variable and localised. Rodriguez-Rose and Hardy's meta analysis of science and technology parks, reported in *Technology and Industrial Parks in Emerging Countries - Panacea or Pipedream* (2014) provides one of the most recent and comprehensive studies.

Their study provides an analysis of how the technology and industrial park phenonomen has developed in emerging economies and provides in-depth case studies from Latin America (Brazil, Mexico, Argentina, Chile, Venezuela, Columbia, Uruguay and the Dominican Republic) with additional examples from Asia (China, India, Malaysia and the Philippines), Africa, and the Middle East (South Africa, Tunisia and Jordan) (Rodriguez-Rose and Hardy, 2014:4).

From their in-depth analysis and study, they conclude that technology and industrial parks have the potential to engender technological upgrading of their host economy and initiate knowledge spillovers and raise regional competitiveness. Such parks can become engines of employment growth skills upgrading and export revenues (Rodriguez-Rose and Hardy, 2014:98). They caution however that such parks should be considered enabling or facilitating tools, rather than deterministic ones. They conclude that in the absence of supporting strategies, the vast majority of parks in operation today can be argued to be questionable developments, where any benefits are often more than cancelled out by the high cost of implementation and opportunity of alternative strategies (Rodriguez-Rose and Hardy, 2014:98).

From their study of parks across Latin America, Asia and Africa, they found that success stories were predominantly in places where the theory predicts they would be successful. Such places or regions, they suggest, resemble the environments of industrialised economies, with existing technological capabilities and critical masses of firms and skilled employees that meet the requirements of both technology and industrial parks. They note that in some states, such as China, science and technology parks have become windows demonstrating the progress made within their regional and national economics and so attracting higher technological activities. Such instances, they suggest, tend to be the exception, rather than the norm (Rodriguez-Rose and Hardy, 2014:98).

Based on their evidence, they advise caution, since their findings indicate that for the majority of emerging economy regions, developing successful technology and industrial parts is not only unrealistic but wasteful. They argue that a better strategy would be to initially focus on developing the necessary labour skills, and in some, cases the prerequisites for science and technology to be utilised for economic growth and regional development. This would include building human capital, enhancing competition in sheltered industries to raise productivity and in formal and informal institutions (Rodriguez-Rose and Hardy, 2014:98). They also provide some 'lessons learned' from their research including:

- a need for greater levels of public investment to attract FDI, which is facilitated by the rationalisation of clear rules and legal creativity;
- a need to address the low levels of experience found in the planning, implementation and operations of parks, particularly in terms of business, financing and networking aspects;
- a need for greater engagement between academic leaders and Technology Park projects particularly in terms of harnessing university knowledge resources or entrepreneurship and innovation; and
- a need to articulate and coordinate park strategies, both regionally and nationally, to engender a system of initiatives that complement, rather than undermine each other (Rodriguez-Pose and Hardy, 2014:98-99).

From their findings they suggest that technology and industrial parks are often regarded as a 'policy panacea' and that the successful cases have been the exception rather than the rule. They argue that the 'the majority of parks in emerging countries are failing to deliver, rendering the promises of making huge leaps up the innovation ladder and of unleashing development little

more than pipe dream (Rodriguez-Pose and Hardy, 2014:1). Hence they underline the importance of identifying the existing local conditions and designing appropriate place based policies (Rodriguez-Pose and Hardy, 2014:99).

Effective approaches in developing STPs

As noted in the previous section, differences in conceptualisation, nomenclature, terminology and approaches present challenges for researchers and practitioners in seeking to identify links between specific park characteristics and outcomes and extracting clear policy lessons for why some parks work and others fail is made all the more complex as a result (Rodriguez-Pose and Hardy 2014:4). However the proliferation in the number of science parks or similar entities in the 50 years since the first was established at Stanford University provides a growing evidence database for analyzing and extrapolating the key features that are essential to and impact upon future success or otherwise.

With more than 365 parks employing 750,000 people, the European Union has sought to identify and capture the types of practices that are central to the establishment, operation and evolution of science and technology parks (EU, 2014). In its advice and guidance report on good practice in *Setting up, managing and evaluating EU Science and Technology Parks* (EU, 2014), key elements of success are seen to be the characteristics of the local economy, the local research base as well as the degree of local partnerships among public and private stakeholders (EU, 2014:foreword). Drawing from the evidence base the report notes key characteristics that differentiates STPs from a good quality business park or other pure property investment. Such characteristics include:

- careful tenant selection policies;
- selective prioritization of the newer knowledge-based technology industries;
- engagement with the knowledge base (primarily universities and public research organisations);
- cooperative engagement with other public and private sector actors;
- ownership or operation of one or more business incubation schemes; and
- provision of professional business support and innovation services designed to increase the depth and extent of innovation-led and knowledge based business in the region or

locality as well as within their park (EU, 2014:2).

The EU report noted academic comparative studies of STPs across regions and nations which have found a link between the apparent success of STPs and the strength and diversity of the local economy where they are founded. Such studies found that, in general, stronger and more diverse economies with good local innovation ecosystems tend to produce STPs that are generally regarded as amongst the more successful (EU, 2014:2).

Relationships with external organisations, and with universities in particular, are seen as critically important in the development of a STP. Close proximity to a university stakeholder or partner is generally believed to be helpful to establishing and maintaining a working relationship. In the context of the STPs considered in the EU report, this is illustrated in the figure below, reproduced from the report:

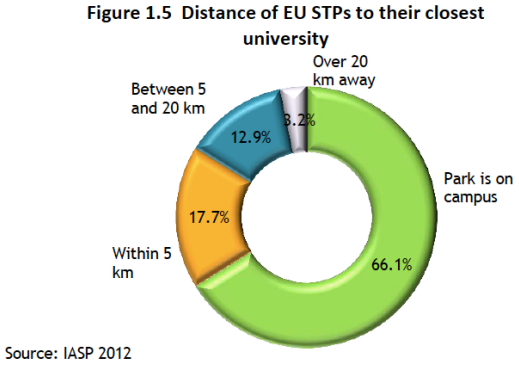


Figure 2: Distance of EU STPs to closest universities (EU, 2014:16).

In this case, the figure shows that that 84% of STPs are within 5km of their closest university and 66.1% are either on or adjacent to the university campus. However the relationship operates between the STP and the university is often multidimensional and can include the provision of services;[5] incubation activities;[6] and cluster building EU, 2014: 17).[7]

[5] Property linked (e.g. meeting room hire, secretarial services, café or broadband and digital telephony, social and recreational facilities)
☐ Business support services to assist SME start-up and grow (e.g. finance, marketing or training, etc.)
☐ Innovation services (e.g. R&D, technology transfer services, specialised high value scientific equipment)
☐ Networking services (e.g. bringing together business from both within the park and similar knowledge-based businesses elsewhere in the locality for specific events).
[6] Delivering new innovation-led businesses.
[7] Cluster building through inward investment and the support of specific fields of technology.

As STPs have evolved in the first two decades of the 21st century the model adopted is one where STPs are seen as an integral part of the local innovation ecosystem that understand and work with it and also design and deliver programmes that reduce weaknesses in the innovation ecosystem. Such STPs may also create collaboration spaces to bring innovation actors together and act as host to the programmes of other actors as a means for increasing the visibility of the entire innovation ecosystem. Within such models, the studies cited have found a greater degree of balance between the need for short-term financial returns to secure sustainability against the opportunity to accelerate innovation-led business and economic growth. It is noted that where the public sector is involved in an STP, the subsidies and grants they provide serve as 'patient money' allowing the STP time to secure its economic development objectives as well as financial sustainability. Engagement with the private sector is nevertheless important for capital investment for development and responding to sector driven needs and requirements (EU, 2014:2-3).

From the analysis of the key success factors for STPs, the EU report identified essential components in the planning and development of any new STP venture. They include:

- setting out the strategy and objectives of the new park and deciding on the best model for implementation;
- engagement of the knowledge base – an active, effective and multi-dimensional relationship with a university or other public sector research organisation is often seen as crucial – usually working best where the university sector also has a remit to transfer knowledge and technology to industry;
- interaction with the public sector at local/regional, federal / national level since STPs are not stand-alone organisations but closely connected with the development of the innovation ecosystem;
- securing the land, capital and revenue to establish the STP and ensure its on-going growth (often a critical and time-consuming stage) and retaining focus on the objective to create a working environment that stimulates innovation and knowledge-based business growth;
- assessing the nature of the local skill base and strategies for STPs to address any weaknesses in entrepreneurship levels or technology-SME management skills;
- addressing the availability of regional and national markets or corporate supply chains;
- selecting the package of services to deliver to tenant companies and businesses in the wider economy – STPs need to analyse the local innovation ecosystem to identify the

weaknesses that they should seek to reduce by working with local partners or by creating added value professional services as well as property offerings;

- deciding on the appropriate science park model – most STPs stakeholders require that the STP achieves financial sustainability within a reasonable timescale but can involve grants and subsidies to allow time for viability to be secured while pursuing the economic development goals;
- selecting a strong leadership based on a board / committee structure that has good connections into the local economy (private and public) and a CEO with appropriate sector experience and strong leadership and management skills (EU, 2014:2-3).

The EU report urges caution in the rush to focus STP planning on infrastructure and buildings noting that often ‘too great an emphasis is given to the STP’s land and property’ rather than consideration of the improvements an STP could bring to an innovation ecosystem. A more appropriate approach, the report suggests, would be to stress the identification of the combinations of property, services and partner working arrangements that are most likely to supply the ‘need’ for a more efficient and effective innovation ecosystem (EU, 2014). Guidance is however provided on factors to consider in identifying a proposed site with criteria including:

- proximity to the knowledge base, making it easier to develop links with local knowledge partners, usually universities;
- visibility in a prominent location, close to the knowledge base and / or to a major road or transport interchange;
- accessibility by a variety of transport links including air, road and rail;
- size - research studies recognise the complexities associated with determining the appropriate size with a scalable approach favoured. While the initial set up phase may only require a small site there needs to be scope for expansion and growth;
- availability - planning conditions and ownership status in place;
- potential for landscaping; and
- value and price.

It is noted that experience from a number of science park developments has shown that a serviced multi occupancy building should be at least 3,000 square metres in size to allow for a critical mass of tenants and economies of scale in the provision of services (EU, 2014:59).

Allen (2006) cited in the EU Report (2014:33) defined eight criteria for creating a successful STP from which four key criteria are noteworthy:
(i) An STP is connected to and involved in the implementation of national and regional economic development policies and so is not a ‘stand alone’ venture.
(ii) Connectivity and networking at all levels are essential to the STP and its tenants.
(iii) Equal emphasis on ‘brains and bricks’ so that while the built environment is important it is not as an end in itself, but an aid to the process of creativity, interaction and innovation.
(iv) An STP of this type should see itself as a “gateway” to opportunity for its clients and not simply as a “destination” (Allen 2006 in EU, 2014).

In planning a new STP key stages have been identified as:

- setting out the strategy and objectives for the new park within the context of the regional innovation ecosystem and deciding on the best model for implementation;
- active engagement of the knowledge base;
- interaction with the public sector at local/regional, national / federal level to secure and align resources;
- securing the land, capital and revenue to establish the STP and ensure its ongoing growth;
- assessing the nature of the local skill base; and
- addressing the availability of regional and national markets or corporate supply chains EU, 2014:52).

There is recognition from research also that the growth and development of STPs and similar entities is evolutionary, requiring an estimated 10 years for an STP to evolve towards the state where it has a fully experienced management team, a well developed portfolio of properties and services and has become a fully accepted partner in the local innovation ecosystem (EU, 2014:146). Overall size is also seen to be important with the research showing that it is

‘Only at levels above 20,000m^2 do most parks start to develop a wide range of property styles and collaboration spaces to meet the needs of the research, SME and corporate sectors’ (EU, 2014:146).

Global and regional models

As noted in previously since the 1970s there has been a growth in the adoption of science and technology parks and more recently science cities as approaches to transforming the orientation of local economies towards more knowledge based economies has intensified. With such proliferation, (Rodriguez-Pose and Hardy (2014:2) cite the example of Latin America where in the last two decades over 150 parks have been set up) the focus of the following section is to highlight initiatives of interest and relevance for the proposed development in KP.

Education City

Education City, Doha, Qatar, offers a prototype for the development of a state of the art branch campus model. This model consists of an extended, integrated, multi campus 2,500 acre site. Within the site there are branch campuses of leading universities (Virginia Commonwealth University School of the Arts in Qatar, Weill Cornell Medical College in Qatar, Texas A&M University at Qatar, Carnegie Mellon University in Qatar, Georgetown University School of Foreign Service in Qatar and UCL, Qatar. It also includes the Rand Corporation; Al Jazeera Children's Channel; The Doha Debates; Al Shaqab Equestrian Academy and The Qatar Science and Technology Park (Qatar Foundation, online).

Education City has been successful in attracting leading international universities to set up branch campuses. These branch campuses do not offer a full suite of academic programmes but focus on ‘niche’ areas of provision or high demand programmes. For example, UCL Qatar operates as ‘a leading centre of excellence for the study of cultural heritage’ (UCL, Qatar, online). The UCL Institute of Archaeology plays a central role in provision and staff from this oversee Masters degree programmes including:

- MSc in Conservation Studies;
- MA in Museum and Gallery Practice; and
- MA in the Archaeology of the Arab and Islamic World.

In addition to providing accredited postgraduate degree programmes, UCL Qatar works in close partnership with the local community to provide outreach and continuing professional development (CPD) for staff from the Qatari culture and heritage services. Optimising shared resource in terms of campus provision, services and facilities is a key feature of Education City and as the model has evolved this has extended to staff collaborations and exchanges.

The Qatar Science & Technology Park (QSTP) is also located within Education City and is designed to be the primary incubator for technology development, fostering the environment required for accelerating commercialisation of research and supporting innovation and entrepreneurship. The Qatar National Research Strategy (2012) shapes the work and activity in through it four themes: Energy, Environment, Health Sciences and Information & Communication Technologies. Through its location in Education City the science park has access to the resources of its cluster of leading research universities. The aim of the QSTP is 'to grow Qatar's "post-carbon economy" by encouraging companies and institutes from around the world to develop and commercialise their technology in Qatar, and by helping entrepreneurs launch technology businesses' (QSTP, online).

Knight (2015) describes Qatar's Education City and Science and Technology Park as a 'an interesting but unique model' given that the Qatar Foundation has a central role in governance and funding for the on-going development of Education City and incentivizing opportunities for international universities through their branch campuses and covering all operational costs. While Qatar's petro-economy and its status as one of the world's fastest growing economies guarantees resources for state-of-the-art facilities and infrastructure, from a comparative perspective the focus is not on the potential for replicability but rather on the integration of international universities and companies as part of an education hub, the challenges this brings and the processes that facilitate it.

Dubai International Academic City (DIAC)

Dubai International Academic City (DIAC) was established in 2007 with the aim of developing the academic profile of the region, creating an educated work force and establishing the UAE as a knowledge-based economy. DIAC helps to meet the needs of a rapidly growing population in the UAE and an increasing demand for Higher Education. DIAC is the world's largest free zone that has been dedicated to Higher Education and offers very generous tax-free benefits.

The location is approximately 20 minutes from Dubai business district and consists of an 18 million square feet campus that is self-contained. The facilities are considered to be state-of-the-art. The student population is over 24,000 and represents 145 different nationalities. Many of the partners have moved into purpose-built campus buildings. There are branch campuses from ten different nations and DIAC has a strong international profile. British universities represented include: University of Exeter; Manchester Business School; University of Bradford; Heriot Watt University and Middlesex university. There are also American, Australian, European, Indian and Pakistan universities located in DIAC.

There is a wide range of options available from the different Higher Education providers that ranges from undergraduate to postgraduate provision. Heriot Watt Campus, for example, provides specialized programmes on management, engineering, built environment, food science and fashion. Amity University Dubai (India) offers choices such as: Aerospace engineering; Nuclear Science; Telecom; Event Management; Hospitality; Retail management and Tourism. The British University in Dubai (BUiD) works in partnership with British Universities, including the University of Glasgow, to provide high quality Higher Education based on the British model and has recently launched a new PhD programme in Business Management.

There are a number of significant advantages to the model of DIAC. First, Dubai is easily accessed by air and road. There is a modern airport which is an international travel hub and has excellent links with other parts of the world. The airport is well positioned in the city of Dubai and has easy and quick access to DIAC. Second, the institutions in DIAC are based within a specific, demarked geographical area at the edge of the city and some of the smaller institutions can share resources such as buildings and catering spaces. There is a strong possibility that institutions can interact with each other. Third, there is a wide choice of Higher Education institution available and institutions originating from different parts of the world. This means that there are different types of Higher Education qualifications available: for example, qualifications from the American model and the British model. This represents considerable investment by external Institutions but also offers a wide variety of opportunities for prospective students. Fourth, the presence of external Higher Education institutions means that there is a possibility that they may expand their activities in DIAC by offering more degree programmes and offering different disciplines, increasing the range of opportunities for the students. Fifth, the different institutions may also engage in research

activity in the area – this has the potential to contribute to the local knowledge economy and create jobs. Sixth, the presence of the institutions may also lead to further expansion within the country and within an area such as the Emirates, consolidating links, collaboration and partnership. Seventh, DIAC provides a more cost effective option for many students as they can save on travel and living costs in other parts of the world. BUiD, in particular, offers part time degrees and these can be accessed by the wider Emirates community. This means further qualifications and Higher Education are being accessed by a wider range of people. Professionals are able to acquire further qualifications and skills which can enhance their working practices and improve their career progression.

There are also significant disadvantages to this model. First, this model is very costly and involves a very substantial level of political and financial investment. The construction of an academic city takes considerable time and requires sustained political will and drive. It would require long term planning and investment.

Second, the quality of the programmes, the learning and teaching, and the overall experience offered by the external Institutions needs to be very high and commensurate with the quality of the experience that exists in the institutional home country. This has serious implications for the staffing and administration of any replication of this model. Part of the attraction of the external Institutions is the prestige of many of the academic staff – are some of these staff going to be teaching on the programmes?

Third, the students may have the experience of external Higher Education, but they do not have the experience of living and studying abroad. Despite the costs incurred, this is very attractive to many students and they aspire to acquire qualifications from high status institutions, but also valuable life and cultural experience.

Fourth, there is a danger that the external Institutions accept all incentives, such as tax-free allowances, and withdraw once these allowances have been rescinded. This has huge implications for the sustainability of this model and could prove very costly to the home nation in the long term, with very few benefits.

Fifth, there is a possibility that external Institutions use their presence to expand their own operations, augment their profile and capture a larger share of the student market. This could

prove to be quite damaging to the profile and prestige of the local universities and to the local economy.

Sixth, there is a serious risk that this model can lead to lack of investment in local universities and this has very grave implications for the future of the growth of local Higher Education, for capacity building in the academic workforce, for the local economy and for the local knowledge economy.

Seventh, the risk to the local universities could potentially damage the autonomy and the quality of local Higher Education. The local Higher Education providers could be perceived to be second-rate unless they have strong links with the external Institutions and they may be compared (unfavourably) with the external Institutions. This has very serious implications for the future of the local Higher Education Institutions and could provide barriers to their attempts to create international profiles and reputations

China - 'Creative Clusters'

In China the number of industrial / science and technology parks has grown dramatically since the 1980s and it is estimated that there are currently 1,115 parks in operation, including 54 national science and technology zones, over 100 university science parks and almost 1000 provincial industrial parks (Rodrigues-Pose and Hardy, 2014: 47). All core regions and most provincial capitals have at least one industrial or technology park in operation or planning (ibid). While state planning and resourcing, as well as favorable locational advantage,s have resulted in a number of successful initiatives, many others have less successful due to overly ambitious or poorly conceive projects (Rodrigues-Pose and Hardy, 2014: 98).

More recently in China, regional innovative strategies have focused on 'creative clusters' promoting knowledge-intensive services, especially architecture, engineering, consultancy, advertising and publishing activities (Cai and Liu, 2015: 16). The Tongji Creative Cluster exemplifies a new model of a regional innovation system in contrast to the massive university-based science parks in China (ibid).The case of the Tongji Creative Cluster demonstrates a combined bottom-up initiative and top-down coordination which can be a very suitable and effective way of developing regional innovation systems in China (Cai and Liu, 2015: 27).

The following are seen as international good practices extracted from the OECD reviews.

Berlin universities of applied sciences contributing to creative industries

The Berlin tertiary education institutions provide a wide range of relevant study programmes for both “creative professionals” who work in management, business, finance and legal issues, health care, etc., and in the “creative core” i.e. those working in ICT, architecture, arts and science and education. In addition, the tertiary education institutions offer dedicated studies in performing arts – for example, jazz courses by the Jazz Institute Berlin (JIB) and contemporary dance courses by the Co-operative Dance Education Centre.

The JIB was established in 2005 through a fusion of the jazz departments of the Berlin University of the Arts (UdK) and the Hans Eisler College of Music. This concentration of capacities has enhanced the institution’s status in the international creative scene. The JIB strives to assist each student to find his/her own artistic identity as a jazz musician. The JIB provides individual free spaces that allow for exchange of attitudes and ideas. In addition to musical knowledge which is diverse and cross-cultural, international networking offers students important professional points of contacts. The Berlin Jazz scene and the music industry both benefit from the JIB. In the Winter semester, the JIB moves into its own building on Einsteinsufer which was renovated with European Union funding. Its centre piece is a concert hall that seats 300 guests. There is also a professional sound studio with excellent acoustics, rehearsal rooms and a caféteria.

The Co-operative Dance Education Centre, created in 2006 at the initiative of the Berlin Senate, a collaboration of the Berlin University of the Arts and the Ernst Busch School of Performing Arts integrates education and vocation in contemporary dance and choreography. The centre is financially supported by the Berlin Senate, the Foundation for Cultural Training and Consultation as well as by Tanzplan Deutschland. This approach and form of institutional anchoring has been nationally recognised as a model for Arts’ education. The UdK offers a nonconsecutive postgraduate Masters programme entitled “Art in Context” and directed at people who seek to position their artistic work in the context of society. The “Art in Context” Programme was first established in 2002 and offers four specialisations: artistic work with social groups, artistic work with cultural institutions (including art museum studies), artistic work in public spaces and artistic work in the context of media and academia. The institute has 70 to 80 students of whom 60% are

non-German, and almost 75% female. The institute co-operates with different partners, such as museums, city institutions and private organisations.

Source: OECD (2010), Reviews of Higher Education in Regional and City Development: Berlin, Germany, OECD, Paris.

6.5 Rovira i Virgili: Creating incentives for faculty participation in third mission activities

The University Rovira i Virgili in Tarragona has an active third mission agenda, including entry points for small and medium-sized enterprises (SMEs) into the university knowledge base, social and cultural programming in 22 cities in southern Catalonia and active participation in fostering a knowledge-based petro-chemical industry cluster in the sub-region.

Contracts for the university faculty recognise their importance in these outreach efforts and give value to their participation. The university faculty contract has been re-organised around a system with a ten-point base.

All faculty are expected to undertake research and to teach with the minimum contractual obligations constituting six of the expected ten points. To reach the expected ten points, faculty can contribute in a variety of ways, according to their interests and expertise. For some faculty, this may mean giving presentations in programmes in which the university is developing a presence. For others, it may mean working with a SME to implement a technology transfer or technology commercialisation project. For other faculty, reaching the ten points may mean additional research and publication.

The goal of this governance strategy is to set a base expectation for faculty performance in core activities. This evaluation method also creates the flexibility to allow faculty to contribute in arenas related to the university's goals which expand its third mission activities. All of the criteria for performance constitute a unit contributing to the ten-point base. These are publicly available and the activities of each faculty member toward achieving the base standard are available to all members of the department. The goal of the university in developing this evaluation programme is to create a more transparent and accountable institution. In future, it would be useful to give even greater visibility to the university's expertise in this area.

Source: OECD (2010), Higher Education in Regional and City Development: Catalonia, Spain, OECD Publishing.

Models and approaches within Pakistan

NUST Science and Technology Park

Planning for a Science and Technology Park is underway at the National University of Sciences & Technology (NUST), Islamabad on a 50 acre site co-located with the main university campus. NUST is one of only two universities in Pakistan to have been listed in the Times Higher Educational Supplement rankings on BRICS and Emerging Economies Rankings 2016 (Times Higher Educational Supplement, online). Planning for the NUST STP began in 2012 and the aim is to become 'a hub for public and private technological enhancement and development of human capital'. Its mission is to: encourage technology-based economic growth through creating and supporting knowledge based enterprises from within Pakistan and for FDI in the form of local cities of multi national companies. It would also serve as a pilot project for development of other STPs in Pakistan.

The vision for the STP involves developing a unique Knowledge Based Multi-Industry Cluster including segments of the IT& Telecom, Engineering, Bio tech/Bio Pharma, Banking/Financial Services, Defense Technologies, Power and Automotive Industries. It is envisaged that the park will be established collaboration with federal and provincial government bodies, International development donors, private equity participants and venture capitalists and potentially through a joint venture with Tus-Holdings (the operating company of Tsinghua University Science Park), China, with which a Memorandum of Understanding (MoU) was signed in 2016.

In setting out the plans for governance, funding and operation, the pace for development was noted, with the need for patience to build the necessary systems over a time horizon of 10-20 years rather than simple often politically driven short term horizons (Parry and Oh, 2012: 38).

Lahore Knowledge Park

Plans for a Knowledge Park on an 852 acre site in Lahore are progressing. The underpinning concept for the park is to exist as a 'stand alone entity' while following 'international parks' standards of a space for collaboration between academia, R&D and industry' (HED, 2015:5). It is envisaged that the Knowledge Park will consist of separate clusters or 'micro parks' each of which will have a particular focus and potentially an anchor link to a university (ibid). Amongst the many features of the proposed park, in addition to the micro parks are plans for a gated community, hotels, sports stadium, hospitals and allied health facilities and shopping malls (ibid). The initiative is to be developed by a public private partnership and the 'The Lahore Knowledge Park Company' (LKPC) has been registered. Following a feasibility study, recruitment to key, senior operational posts and procurement of PR and HR services has now been advertised and master planning for the project started (HED, online).

Education City, Karachi

In 2013 the provincial assembly in Sindh passed The Education City Act 2013. According to this Act a newly constituted Sindh Education City Board would oversee the development of the Education City. The vision for Education City, Karachi involves a 9000-acre site hosting over 50 institutions and 150,000 students. Plans for the development of the site set out three phases of development. In the first phase 2900 acres would be developed over 5 years. A further 3011 acres would be developed over 7.5 years. The final 3011 acres would be developed in phase three, also lasting 7.5 years.

Influenced by other Education City models such as Qatar, Education City, and Karachi is being built on the lines of the Dubai International Academic City (DIAC), which is the world's only free zone, dedicated to higher education. Seven Local Universities/Institutions are the stakeholders including Agha Khan University, Newports Institute of Communications & Economics, Shaheed Zulfikar Ali Bhutto Institute of Science & Technology, Sindh Institute of Urology & Transplantation, Sindh Madressa Board's Quaid-e-Azam Public School, Sir Syed University of Engineering & Technology and Ziauddin University (all from Sindh). Plans for developing Education City, Karachi have progressed to the masterplan phase. Projected costs for the first phase of development and infrastructure are estimated to be Rs 13.9 billion (Sindh Board of Investment, online).

Summary

The aim of this section has been to situate the study within the broader field of approaches to regional development and the wider literature on science and technology parks. As has shown, differences in conceptualisation, nomenclature, terminology and approaches exist within and across regions and countries. Such diversity and fluidity, and blurring of boundaries, Rodriguez-Pose and Hardy suggest, present challenges for researchers and practitioners in seeking to identify links between specific park characteristics and outcomes. Consequently they suggest, extracting clear policy lessons for why some parks work and others fail is made all the more complex as a result (Rodriguez-Pose and Hardy 2014:4). Nevertheless, some key messages emerge from this chapter including:

- the importance of strategies for human capital development as part of any initiative;
- the centrality of local universities as core initiators, facilitators and contributors;
- the need for any initiative to be carefully attuned to local needs and priorities; and
- the need to create, develop and promote the conditions and elements which contribute to success including: risk taking, entrepreneurship, the structure of capital, the motivation of labour, the form and nature of creativity (Dabinett, 2014:13).

The research evidence, guidance and advice in setting up STPs and similar entities; approaches adopted in other regions and key messages from the literature collectively provide key pointers and strategies for the approach to be considered for KP region and have helped to shape and inform the recommendations presented in Chapter 7. The uniqueness of the specific context of KP region is an important factor and this section concludes by exploring this through a situational analysis.

Situation Analysis

Khyber Pakhtunkhwa, formerly North West Frontier Province, forms one of the four provinces of Pakistan covering a territory of approximately 74,521 sq km with a population of over 22 million (KP Government online). Administratively, the territory is organised into three major areas: (i) settled areas (the districts of Abbottabad, Bannu, Battagram, Charsadda, Dera Ismail Khan, Hangu, Haripur, Kohistan, Kohat, Karak, Lakki Marwat, Mansehra, Mardan, Nowshera, Swabi, Peshawar and Tank; (ii) Provincially Administered Tribal Areas (PATA) and (iii) Federally Administered Tribal Areas (FATA). The province is governed through a provincial assembly with 124 elected members. Elections to the provincial assembly take place every 5 years.

The challenges which the regional government need to adddress are considerable with Khyber Pakhtunkhwa described by the World Bank (2015) as 'one of the most crisis-affected provinces in Pakistan' which has suffered from the fallout of the conflict in Afghanistan, resulting in a precarious security situation as well as prolonged political and social instability (World Bank, 2015). The situation has been compounded in recent years as region's rapidly growing population has been enlarged further by a growing number of refugees.

According to the World Bank, Khyber Pakhtunkhwa is also one of Pakistan's less developed regions, with some economic and social development indicators also lagging the national averages (World Bank, 2015). In terms of human development, the province has also traditionally lagged in human development, especially education (World Bank, 2015). Data from the 2014 Pakistan Social and Living Standards Measurement Survey indicated that the adult literacy rate in KP was 53 percent (30% for women) (World Bank, 2015; Pakistan Bureau of Statistics, 2014). In 2015, a slight improvement was reported with the rate at 54.9%. Largely rural, with a dominant agricultural sector, there is a need to diversify the economy and grow the private sector. The majority of the population earn their livelihood from farming or retailing activity, carried out on a small scale and generating low income (Planning and Development Department 2010:7).

In its 'Comprehensive Development Strategy 2010-2017,' the government's Planning and Development Department noted that the province needed to 'embark on a sustained improvement in the life of its citizens by enhancing its resource base' (Planning and Development Department, 2010) but particular challenges were the regional's locational disadvantage, the challenge of on-going militancy and refugees and energy shortfalls and impact on industry (ibid). The cumulative effect has been that:

> as a direct result of higher input costs, electricity shortages and prevailing insecurity in the region, the private sector in the province could not thrive as it did in other parts of the country. Consequently, there are fewer employment opportunities within the province. Many of the young workforce often migrate to other parts of the country or the Middle East in search of employment but, since this workforce is poorly skilled, they are unable to secure better paying jobs (ibid).

The Comprehensive Development Plan outlines the government's strategy for addressing and overcoming these challenges. Reform, investment and strengthening of the education system at all levels (school, technical and vocational and higher education) forms a central plank of this strategy.

Commitment to this is evident in the growth in the higher education sector in recent years. Currently there are 29 universities in the region (19 publically funded universities and 10 are private universities). The total number of universities in Pakistan is 177 (HEC, online). The establishment of five new universities was agreed recently: Turbat University in Balochistan; Upper Dir University; Women University Swabi; Women University Mardan and Abbottabad University of Science and Technology, with facilities in other universities to be upgraded (Daily Times, 2016).

As a result of the autonomy given to provincial governments with the 18th Constitutional Amendment, in several of Pakistan's provinces projects have been initiated to support regional development, economic advancement and knowledge creation and mobilisation through the development of hubs such as knowledge cities, science and technology parks and research parks. These include a proposed Science and Technology Park at the National University of Science and Technology (NUST); an Education City in Sindh and Lahore Knowledge Park as mentioned above. These are at varying stages of development.

For KP region the development of a similar entity offers the prospect of a strategically located site facilitating regional development, economic advancement and knowledge creation and mobilization at a critical time of economic growth as a consequence of the China Pakistan Economic Corridor (CPEC) and ongoing stabilization in the region. The recent announcement of the creation of ‘special economic zones’ under the direction of Khyber Pakhtunkhwa Economic Zones Development and Management Company (KPEZDM) signals the on-going development of the regional economic infrastructure with a vision to create ‘state-of-the-art economic zones-industrial estates and accelerate-growth in industrial sectors by efficient and effective management of economic-zones.’ The development of an knowledge city / STP has the potential to form an integral part of this and serve as a ‘gateway’ and ‘bridge’ to the strategically important knowledge base in universities and to articulate with the recently announced Industrial Policy (KP Government, 2016).

A situation analysis was undertaken as part of the scoping study. Situation analysis is understood as a ‘analytic device’ that enables the researcher to seriously consider the various ‘contexts’ of their research focus including pertinent organizational, community, national and international conditions (Clarke and Friese, 2007: 33). In this case a SWOT analysis was undertaken.

Strengths	Weaknesses
• Potential site on critical CPEC axis. • Developing infrastructure and access routes. • Prospect for further infrastructure development linked to CPEC axis. • Strengthened higher education sector and growing number of universities. • Growing national and international reputation with international partnerships and links. • Highly qualified graduates able to undertake employment in global contexts and leadership roles locally. • Defined industrial strategy launched in 2016 to target industrial development and priorisation by sector. • Identification of sector priorities to include construction, tobacco and farming as well as mineralogy and hydropower (as per industrial policy, p22). • Rich endowment of natural resources. • Increased regional stability.	• Slow pace of development. • Insufficient skilled manpower. • Absence of strategy for workforce development. • Conflict legacy impacts on potential to attract international investment. • Overemphasis on building infrastructure without parallel plan to attract investors and occupants. • Over reliance on public funding for capital investment.
Opportunities	**Threats**
• Scope to shape proposed knowledge city as 4th generation STP. • Potential to develop expertise and outreach through online platforms. • Growing number of well-qualified graduates from local and international universities as potential employees and leaders. • Attract international students from China and other parts of the world. • Attract high quality international staff. • Develop as regional hub for R & D in specified sectors. • Growth in number of SMEs led by women as a result of incentivisation.	• Escalation of terrorist activity and regional instability. • Impact of instability in neighboring regions and wider global contexts. • Local opposition to proposed site and initiatives. • International universities set up rival branch campuses. • Failure to attract / retain high quality staff. • Failure to attract local and national investors resulting in overreliance in public sector funding. • Viability risks. • Governance issues and procedural irregularities. • Change of government / policy. • Cessation of funding.

7. Potential model and recommendations for Khyber Pakhtunkhwa Region

The scoping exercise in general, and the field research component in particular, underlined the variance in the range of understandings of the concepts of knowledge city, science city, science and technology park and the blurring of boundaries between them. As discussed in previously, this is generally consistent with the evidence from wider research but underlines the need for precision and clarity in the selected model, in defining its aims and objectives and in communicating these.

It was clear from the scoping exercise that the selected model needs to serve the regional economy and reflect regional priorities which are seen to include agriculture, minerals and gems, forestry, bioscience, health and well being, nutrition and tobacco. Other areas for development include information and nanotechnologies, accounting, management finance, knowledge exchange and knowledge transfer. A key focus needs to be on promoting industrial growth in the region and supporting local industries, as emphasised in the 2016 Industrial Policy document (KP Government, 2016).

Evidence from the scoping exercise also emphasised the need for the strategy and approach towards developing the knowledge-based economy to involve collaboration with industry and with regional universities which can also serve as a means for their capacity and capability building. Through this the research culture within universities can developed and strengthened. Another important message was that there needs to be a strong focus on building human capital as well as any potential infrastructure. This should entail development of the school curriculum and teacher education as well as provision in the higher education sector. A key area in need of provision is the development and provision of ‘soft skills.’ Strategies to address gender disparities and education of females should be prioritised.

In relation to potential governance model the emergent view from the literature and the field research was that governance for the project in its development and implementation phase should be clearly specified and not reside with any one stakeholder but shared collectively. While it is important to have legislative support it is equally important that the initiative is depoliticised and insulated from local politics. Models of funding for the project should also be based on partnership involving the private and public sectors. Co-construction and partnership should be underpinning principles.

The potential for a new knowledge city / SPT to impact positively was recognised, a clear view from the literature and the field research was the need for a phased model of growth and development where network hubs and innovation clusters form the first phase of development, evolving towards a science and technology park/city in a planned and systematic way based on evaluation of outcomes. The time scales for each phase of the project should be realistic – the planning phase can take up to 5 years. This aligns broadly with the advice and guidance given in the EU report (2014:146) on the need for a scalable project which may take up to 10 years to evolve.

International links and partnerships are important to advancing models for regional development. This could be in the form of foreign direct investment (FDIs) and partnerships with international universities. Potential partners should be carefully chosen with appropriate incentives to attract them to the region. There is an appreciation that the vulnerable security situation in the region means that attracting international investors and partners to have a physical presence is unlikely in the short to medium term but possible in the longer term. This does not however preclude alternative forms of collaboration using online media and platforms. Recent announcements that a UK based company, Asian Precious Minerals (APML), will build a new cement plant in KP region, with an investment of US$400 million, is an important indicator of growing international confidence in the region (CPEC, online) allied with the growth in FDI from China (CPEC, online).

While the research literature emphasized the importance of selecting the most appropriate site, with criteria suggested (EU, 2014: 59), in the field research the option to adapt and modify existing premises, and to re-brand existing educational institutions was also proposed. A clear message was that location and infrastructure development requires ongoing and careful deliberation.

Finally, a focus on sustainability should be paramount, both in terms of environmental issues and land use but also more broadly in developing a model that looks towards sustaining local communities and their economies in the future.

As the previous chapters have shown, approaches and models for regional development vary greatly and are hugely contingent on local needs, priorities, vision and ambitions. An important consideration is that the model adopted in Khyber Pakhtunkhwa reflects the strategic vision for regional development in the longer term and not simply the replication of models adopted In Pakistan or in other international contexts.

Evidence from the scoping exercise undertaken as part of this study suggests that there is a need to reach a shared understanding of a conceptual model and agreed nomenclature for the proposed project. There needs to be agreement on the model / unit of governance that will be capable of advancing the project, irrespective of changes in personnel or government. It is also important to identify and prioritise provincial economic imperatives linked to the initiative. Evidence from the scoping exercise also underscored the centrality of capacity and capability building for provincial universities as part of the initiative, and recognition that the development of an Ox-bridge style initiative with high level international partnerships is aspirational in the short to medium term but other forms of partnership (online collaborations, short term exchanges) could be advanced in the interim.

The range of models outlined and discussed in this report underlines the diversity of possible approaches and a key message from published research on the range of science parks and STPs is that having the greatest opportunity for success requires that the initiative is closely attuned to the local / regional context and needs. In the context of KP this requires acknowledgement that an unstable security situation may preclude inward investment and international partnerships.

While the scale and resourcing of Education City models such as Education City, Qatar may not be appropriate to the regional development needs of KP, nevertheless it does offer a helpful lens for considering what ‘niche’ sectors / disciplines particular to KP province would be attractive to international higher education institutions for collaboration and partnership; what incentives would be available to prospective international partners; how can sector needs and expectations in relation to the KP project be managed within a realistic yet progressive implementation framework.

Based on the analysis of the range of evidence from the scoping exercise, the most suitable approach for development for KP is one which can respond to regional priorities, develop the

human and professional capital that is needed to stimulate and advance economic growth and help to build capacity and capability across key sectors including education and industry. This aligns with the evidence from the research literature and the field research. This could be based on a phased model of growth and development that serves as both a ‘test of concept’ and ‘proof of concept.’ In the first phase of development a Knowledge City ‘hub’ or ‘cluster’ could be established. The key elements of this model with a draft strategic plan and indicative costings for infrastructure development are outlined below.

Knowledge City Cluster (KCC)

The ‘Knowledge City Cluster’ should involve existing universities as ‘anchor’ universities in the first instance. Agreement from the governing bodies of participating universities would need to be secured and a programme of consultation and engagement with the local community enacted. This aligns with the guidance given in chapter 6, drawing from the EU report (2014), that securing land and planning authorisation is important at an early stage (see p40 above).

Based on the analysis from the research literature and field research, which identified key priortiies but with a clear emphasis on the development of ‘soft skills’, four key centres / units could form the core of the cluster in the first phase of development. As a requirement of participation, each centre / unit would have a strategic international partner (SIP) with the potential to secure more partners in the longer term. Potential centres / units have been identified from the preliminary evidence from scoping study. A key purpose of a follow on feasibility study would be to provide more detailed evidence on the viability of this. The potential centres / units are:

- **KP Leadership Institute (KPLI)** – an interdisciplinary centre to provide high-level leadership development programmes for aspiring, current and future leaders from a range of disciplines and sectors.

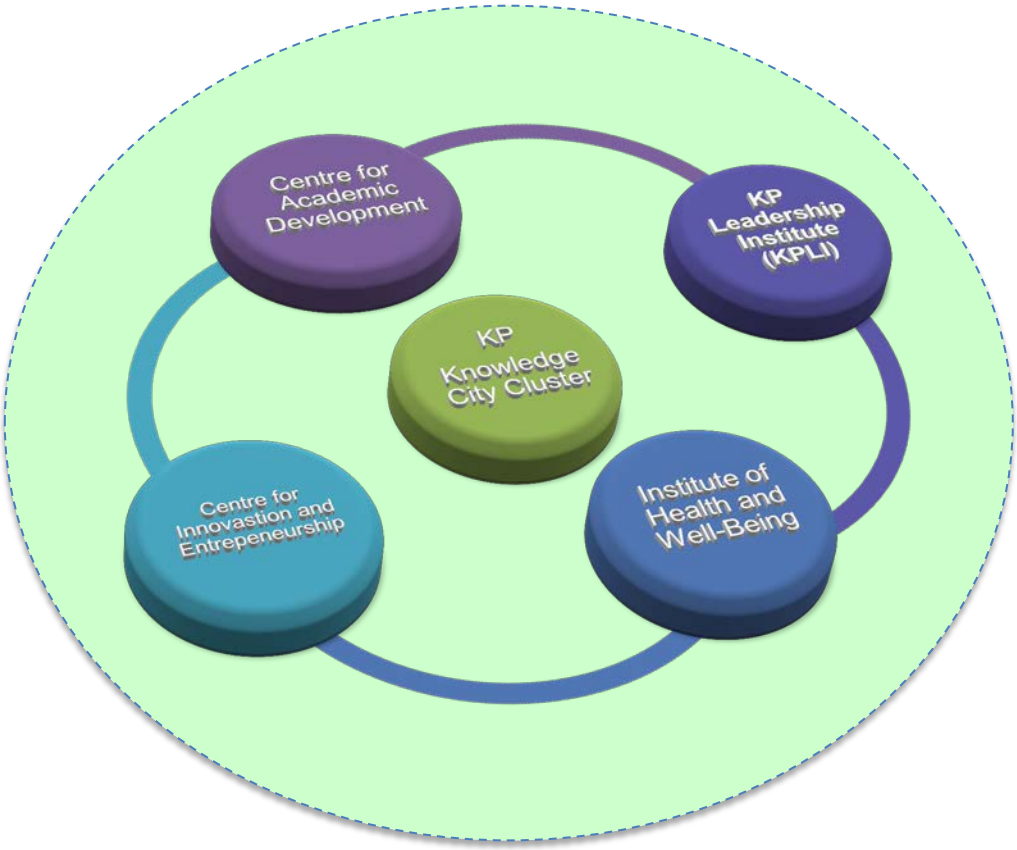
- **Centre for academic development** – the initial focus would be on institutional capacity and capability building for staff from provincial universities. In the longer term the scope and reach of the centre could extend to include the school sector.

- **Institute of Health and Well Being –** a research oriented institute with a focus on research and knowledge exchange focused on health and well being in the broadest sense, encompassing nutrition studies, community development and post conflict reconstruction.

- **Centre for Innovation and Entrepreneurship** - a specialised centre serving as an incubation hub for aspiring entrepreneurs but offering a range of outreach programmes for the development of 'soft skills.

The 'Knowledge City Cluster' could be located in a purpose built, state-of-the-art multi functional building, contiguous and accessible to the anchor universities. A key design feature would be to provide interdisciplinary working and collaboration so while each center /unit will have its own discrete work / office area within the building, open and flexible spaces to meet and collaborate, and shared space for bookable events, also accessible to local communities will be a key feature. This would align with evidence from research which show that 'many science parks also offer 'collaboration spaces' for short to medium term collaborative activities. Such central 'hub' buildings allow for extensive interaction between many different communities of interest and facilitates 'managed serendipity' which is essential to translate research results into innovative solutions (EU, 2014: 67). This is important in the first phase of development since 'the first multi occupancy building on a science park often doubles up as an 'incubator' or an 'accelerator' (providing a range of services to help fledgling businesses) and/or an innovation centre (offering innovation support for businesses to develop and market its products and services)' (*ibid*). This may involve the construction of new building within the identified site. There is scope however that existing facilities could be reassigned and refurbished for the project.

Figure 3: Knowledge City Cluster (KCC)



KCC - Online

Any model for development needs to be futures orientated and make best use of current and future technologies and digital media. As a complementary but contiguous initiative, an online platform should be developed as an e-city (electronic, education city). This is important on a number of fronts. First, it can ensure the visibility for the knowledge city / STP beyond the physical infrastructure and beyond borders. Second, it provides a means to engage with potential partners at an early stage or if security issues preclude an onsite visit. Third, it affords the potential for the

KP model to advance the STP as the 4th generation in the 21st century in recognising the scope and potential for online collaborations to drive innovation and change.

To advance this model, personnel who are highly skilled in digital literacies and online learning, and high-speed Internet access are pre requisite. Currently, developments in relation to online learning and MOOCS and SOOCS, and advances in relation to e-governance, make this a potentially attractive option but cognisance should be given to cultural preparedness and readiness for such a model. KCC-Online could develop its own suite of online MOOCS and SOOCS as a means to showcase regional expertise and sector specialization, to attract potential partners and investors and develop a pipeline into vocational and academic programmes offered by local universities and colleges.

MOOCS are 'massive, open, online courses' and SOOCS are 'selectively open online courses.' They are 'free' programmes of study designed to be studied online by large numbers of students. They and have been developed by a number of international universities as a means of extending their global reach. They are developed in collaboration with bodies such as Futurelearn and Coursera. Recent examples of MOOCs developed by the University of Glasgow are provided in Table 6 below as an illustrative example. There is scope also to develop MOOCS collaboratively as part of the international partnership requirement outlined on p59.

Table 6: Current MOOCS available from University of Glasgow (http://www.gla.ac.uk/study/mooc/).

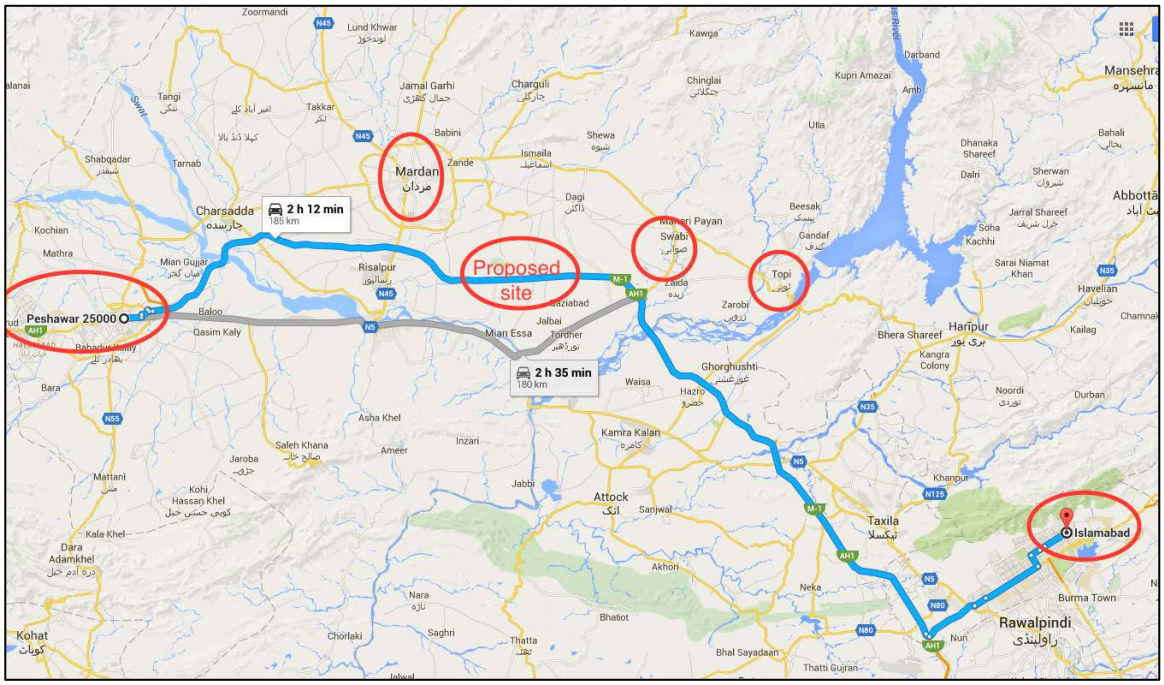
MOOC	Descriptor
The Right to Education: Breaking Down the Barriers	Explore whether "education for all" means all and what barriers are there to participating in education? How do you include "all" in the classroom?
Net that Job: How to write a CV online	Find out how to write a CV online that will help you stand out and net your dream job, with this free online CV writing course.
Multilingual Learning for a Globalised World	This course will explore multilingual education and how it can impact and improve education and even wider society.
World War 1: Paris 1919 - A New World Order?	Reassess the legacy of the Paris Peace Conference (1919) and how it sought to create a new world order
Robert Burns: Poems, Songs and Legacy	Celebrate Burns Night online, and dig deeper into the life and works of Robert Burns, with this free University of Glasgow course.

Cancer in the 21st Century: The Genomic Revolution	Discover how genetics is revolutionising the detection and treatment of cancer, with this free online course.
Antiquities Trafficking and Art Crime	Delve into the seedy underbelly of the art world, looking at smuggling, theft, fakes, and fraud, with this free online course.

Proposed site

The site identified to the research team as a possible location for the Knowledge City / STP is located at Col Sher Khan Interchange, Swabi. Given its midpoint location in relation to Islamabad and Peshawar and its location on a critical axial route of the CPEC, this is potentially an appropriate site. Universities in the area could act as 'anchor universities' for the cluster. In the first phase of development existing premises could be reassigned and refurbished with new state-of-the-art facilities constructed in the longer term. The development of online facilities should be seen as integral and the strategy should focus on 'clicks and mortar' rather than 'bricks and mortar.'

Figure 4: Proposed location



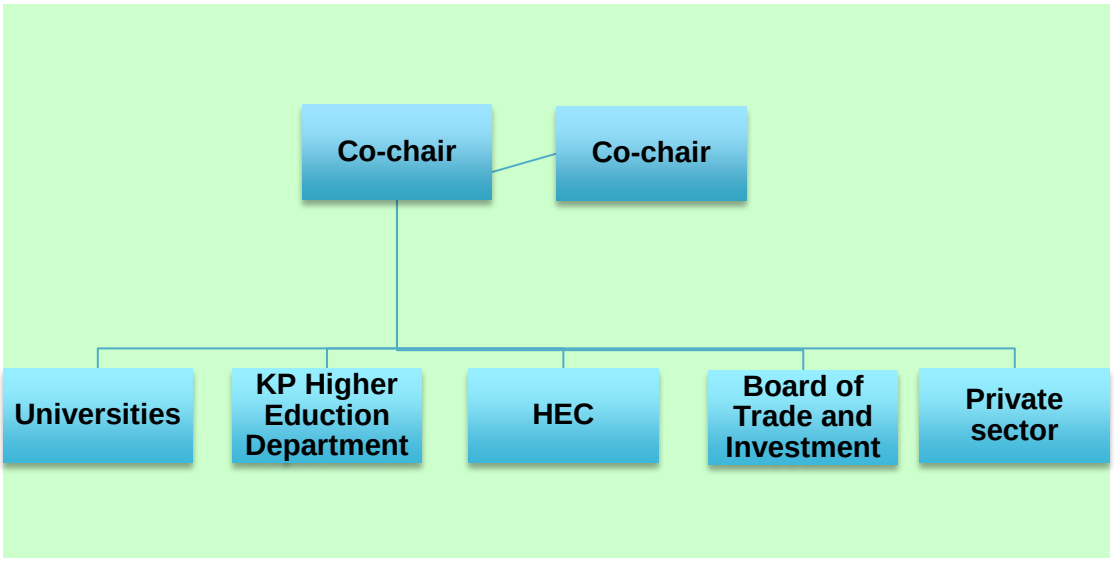
Governance

Governance arrangements for the proposed initiative will depend on the agreed model to be adopted and the funding structures for this. To advance the proposal to the next stage of development, an implementation board should be convened consisting of representatives from all key stakeholders. The chair of this board will play a critical role in advancing the project. A potential model, drawing on current partnerships and collaborations is for the role of Chair of the implementation board to be shared, with one chair nominated from Khyber Paktunkhwa and one chair nominated from an international partnership (see p59).

Composition of National Implementation Board

The Implementation Board should include representatives of all key stakeholders for the agreed model. The composition of the Implementation Board could consist of:

Figure 5: Proposed composition of implementation board



Remit of Implementation Board

The implementation board should determine an appropriate work plan, commission future projects relating to the development of the project and receive and respond to reports from task groups assigned to take forward specific aspects of the project.

Appointments to the Implementation Board

The co-chair from KP should be nominated by the Chief Minister, KP. The international co-chair should be nominated following an invitation to express interest (EoI) issued on behalf of KP government by a relevant agency such as the British Council. Clear criteria relating to the role, remuneration and expenses should be issued as part of the information package accompanying the (EoI).

Following the appointment of the co-chairs for the implementation board, the co-chairs would oversee the appointment of the other board members. Board members should be nominated by their respective organisations.

Mitigation of risk

The model proposed above is designed to mitigate risk attached to the project. Research and evaluative literature also provide strategies to minimize risk and avoid failure.

The 2014 EU report advises that 'the risk to public sector funders is usually modest at the STP formation stage provided that the concept for the new STP is developed around the known success factors and, most importantly, a comprehensive feasibility study is conducted before any substantial investment is committed (EU, 2014:5). The report also notes that it is important that initial investment is proportionate to the risks identified through the feasibility study (i.e., avoiding over-building) but large enough and of a nature to start mitigating critical weaknesses in the local innovation ecosystem (EU, 2014: 5). In the model proposed here, the identification of strategically and sectorally important centres, an outward looking model of governance requiring an international co-chair, the potential to scale up gradually and reassign existing buildings, and the creation of a 'beyond borders' online operation offers scope to incubate and insulate and to provide the foundations for the test of concept that can fully developed through a feasibility study.

Draft strategic plan

The draft strategic plan below is based on a phased model of growth and expansion with the development of the Knowledge City Cluster occurring over three key phases. Plans for ongoing evaluation of the development of the project are integral to each phase of the strategic plan.

Phase 1 (Years 1-2) Initiation and test of concept. In the first phase **one** of the proposed centres / units will be developed; staff recruited to it to prepare for service delivery.

Phase 2: (Years 3-5) Consolidation and further development of cluster.

Phase 3: (Years 6-10) Expansion.

Detailed indicative costings for the infrastructure development of **one** institute / research centre have been provided. These are based on an assumption of the construction of a new building. Adjustments to costs would be required if existing premises are reassigned and modified. Staff costs are not included. Indicative costs development of one centre / unit are estimated to be: Rs: 260.47 million.

Key tasks and milestones

To progress the establishment of the proposed cluster the following tasks and milestones have been identified:

Phase 1: Initiation September 2017 – September 2019

Activity	Personnel	Milestones
Approval of phase one of project and funding	Government of KP and HED KP	September 2017
Appoint co-chairs and implementation board	Government of KP and HED KP	October 2017
Advertise and recruit CEO of Knowledge City Cluster (KCC)	Chairs and implementation Board	November 2017- January 2018
Recruit / depute (second) staff to key roles	CEO in consultation with Implementation Board.	January 2018
Confirm location / site and oversee establishment of Knowledge City Cluster in new premises	CEO in consultation with Implementation Board.	March 2018
Develop online platform and range of promotional materials	CEO in consultation with Implementation Board; development of online platform outsourced.	March - June 2018
Development of partnership funding and service-level agreements.	CEO and Implementation Board	March - June 2018
Design and develop programme of engagement and outreach activities (including courses, seminars and workshops) for delivery in Y2.	CEO and staff	July- September 2018
Development of communications strategy including social media opportunities and launch of web site.	CEO and staff	July- September 2018
Network of organisations affiliated to KCC established	CEO and staff in consultation with Implementation Board.	July - September 2018
Formal launch of Institute	Government of KP; implementation Board; affiliated organisations; CEO / Directors and staff	September 2018
Services offered by the Institute to be available: courses, workshops, consultancy, customized programmes	CEO / Director and staff	October 2018 – August 2019
Interim evaluation, review, plan for next phase of development	CEO / Director and staff; Implementation Board; Stakeholders	August – September 2019

Phase 2 Years 3-5 Key Development Tasks

- Further expansion of site with additional centres / institutes
- Ongoing development of online platform
- Development of network of international partners
- Market analysis of potential income generation activities regionally / globally
- Development of opportunities plan for commercial tenants
- On-going marketing and promotion of available services
- Interim review of governance and staffing profile
- Evaluation, review, plan for next phase of development

Phase 3 Years 6-10 Key Development Tasks

- Further expansion of site
- Ongoing development of network of international partners
- Exploration of new markets regionally / globally
- Review and development of plan for commercial tenants
- On-going marketing and promotion of available services
- Evaluation and review.

Figure 5: Illustrative staffing profile for initial institute / centre (phase 1)

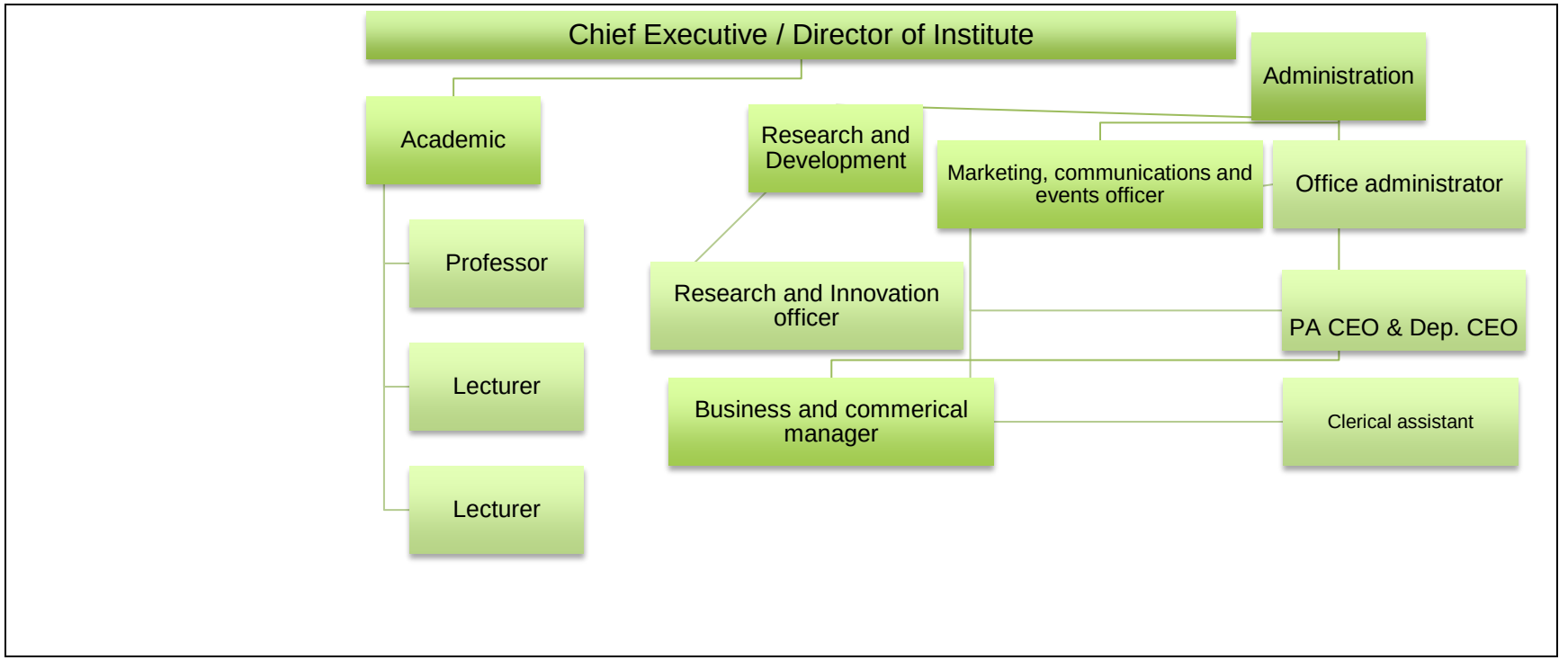


Table 5 Indicative Costs for physical infrastructure for one unit (research centre) in Knowledge City Cluster

No	Research Institute / Centre	Unit Area (Sft.)	Qty	Total Covered Area (Sft.)
Teaching and Learning Facilities				
1	Lecture Theatre (capacity: 200)	5000	2	10,000
2	Lecturer Hall (capacity: 100)	2000	2	4,000
3	Teaching Rooms (capacity: 40)	775	8	6,200
4	Information Technology Suite	1,650	2	3,300
5	Other laboratories	1,500	2	3,000
6	Library	7,500	1	7,500
Research and Academic Facilities				
7	Offices for professors / senior academic staff	250	8	2,000
8	Office for Associate Professors	250	10	2,500
9	Research offices for 24 researchers	1,300	4	5,200
Meeting, networking and social spaces				
10	Common room (females)	350	1	350
11	Common room (males)	350	1	350
12	Staff room	625	1	625
13	Committee room	1,200	2	2,400
14	Seminar / meeting room	1,200	4	4,800
Administrative and support facilities				
15	Reception	150	1	150
16	Offices for administrative Staff	550	4	2,200
17	Stores	225	2	450
18	Catering facility; storerooms, janitorial facilities etc.	50	2	100
19	Corridors and circulation space	35%		19,294
	Total Covered area			**74,419**

Estimated per sft cost : Rs. 3500
Total Cost: Rs. 260.47 Million

The indicative costs above do not include charges for consultancy and site development and utilities.

Future Business Planning

Future business planning for the project should include the development of a business plan, identification of sector priorities, potential partners and companies with experiences in developing / delivering similar projects.

A business plan for the project should include the objectives of the project; the key stakeholders and their contributions and expectations for the project; resources required; project plan; management team and detailed financial plan (Parry, 2006:43).

According to the KP Board of Investment (2015) priority sectors and potential areas for investment in KP include tourism; mines & minerals; energy and power; agriculture and livestock; oil and livestock. The Board of Investment's strategy is to attract inward investment in these sectors by creating an investor friendly environment with favorable incentives. These priority sectors align broadly with the evidence gathered through the scoping study. A clear message arising from the scoping study is the need for human capital development to support the region's economic development. A key feature of the 'Economic Revitalization of Khyber Pakhtunkhwa and FATA' project[8], is the rehabilitation of small and medium enterprises (SMEs). These priorities have informed the proposed centres / institutes for the Knowledge City Cluster / Hub.

Once the agreed model and the range of incentives for partnership and investment are agreed, future partners can be identified. This should include national and international universities, SMEs, national and global companies and NGOs.

[8]This is one of 11 projects set up under the World Bank administered Mutli Donor Trust Fund (MDTF).

Firms with global experience of designing and constructing Knowledge / Education Cities

Based on research undertaken the following companies / organisations have been identified as having global experience in the development and construction of science and technology parks and similar projects.

a) Cam-Sci

Cam-Sci is described as the UK's leading knowledge economy consultancy with a strong track record in guiding some of the UK's most successful innovation and science parks from concept development through to funding and delivery. It offers a full range of services from concept planning to Services that can be provided by Cam-Sci include:

- Vision and concept development
- Feasibility and demand
- Risk management, demand creation and early occupancy
- Creating communities of interest
- Master planning, planning, design and specification development
- Business planning and investment strategies
- Operational planning
- Marketing, brand building and place making
- Science park funding and joint ventures

Cam-Sci has recently been appointed by Queen Margaret University, Scotland as Knowledge economy Economy Consultants to Advise on Land Development Strategy. Previous clients (as listed on the company's website include):

- Thames valley science park
- Liverpool science park
- London urban biomedical park
- Nottingham bioscience facility
- Newcastle city council and Newcastle university gateway building
- Liverpool knowledge quarter: knowledge brand development.

Sources:
http://www.cam-sci.com
http://www.qmu.ac.uk/marketing/press_releases/QMU-Appoints-Leading-Knowledge-Economy-Consultants-to-Advise-on-Land-Development-Strategy.htm

b) DTZ- UGL Company

DTZ has with global experience in advising on the development of educational hubs, higher education facilities and branch campuses. DTZ describes itself as 'a truly diverse global leader in property services offering industry leading, integrated solutions across investment, agency, leasing agency, property and facilities management, project and building consultancy, valuation, and investment and asset management.'

The company has been involved in projects in India, China, Bahrain and United Arab Emirates. They have advised a number of UK as well as international universities on the development of Transnational Education (TNE) strategies. The Education and Innovation services offered by the company include:

- Market research on in-country and international student demand patterns and preferences
- Business planning and strategy advice on new branch campuses and educational joint ventures
- Financial modelling of new educational ventures
- Physical masterplaninng and real estates advice
- Implementation of TNE ventures
- Facilities Management of TNE ventures
- Services focused on education asset management, student residential accommodation and the development and operation of science parks.

Source:**http://www.dtz.com/StaticFiles/UK/C616_Education%20-%20International%20Consultancy.pdf**

c) **Bilinger GVA**

Bilinger GVA has been closely involved in the development of science park developments across the UK, working in collaboration with universities, science park operators, regional development agencies, local authorities and both public & private sector developers. As such the company is able to advise and assist with the development of a science park from inception to completion. This ranges from undertaking initial site appraisals, economic impact, implementation and delivery strategies and demand assessments, through to marketing, leasing, development and sales, we work to agreed timescales and fee structures. The services the company can provide include:

- Detailed assessments of projects
- Implementation advice to enhance deliverability
- Market appraisals
- Negotiating and structuring development partnerships between public and private sectors
- Planning analysis
- Financial appraisals
- Market and demand assessments
- Project management
- Leasing and sales.

The company's client base includes a number of UK universities. Science parks with which they have been involved include: Coventry UTP, Keele Science Park, Malvern Hills Science Park, Bristol and Bath Science Park, Pebble Mill Science Park.

Source: http://www.gva.co.uk/offices/science-parks/

d) KEO International Consultants

KEO International Consultants was founded in 1964 and through its

component companies can provide world-class professional design and management services for mega-projects. In 2001 KEO was appointed as the Programme and Construction Manager for Education City for the Qatar Foundation. KEO provided expert advice on land use development, design management, cost and schedule management, quality control and full service construction management. KEO have also been involved in a number of education initiatives in the Middle East.

Source: http://www.keoic.com/index.htm

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