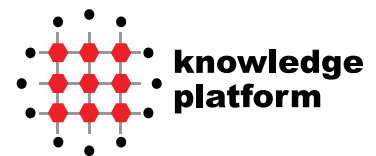**BRITISH COUNCIL**

knowledge platform

THE UNIVERSITY RESEARCH SYSTEM IN PAKISTAN

KNOWLEDGE PLATFORM
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A **KNOWLEDGE PLATFORM**
PROJECT IN COLLABORATION WITH
THE BRITISH COUNCIL IN PAKISTAN

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Foreword

We live in a post-industrial world in which the process of discovery and innovation is, more than ever, driven by active, structured research. Increasingly, research is gaining importance in driving government policy, corporate strategy and social change. A periodic evaluation of a country's research system has therefore become a strategically important activity. We are proud of the seminal effort represented by this report, which might represent the most sustained evaluation to date of Pakistan's university research system. This report aims to achieve an immediate impact on research and innovation in Pakistan and will encourage continuous evaluation and debate on the direction of research and innovation in the country.

Since the Higher Education Commission (HEC) was established in 2002, university research has made considerable strides. The HEC has launched a series of research funding programmes and has made publication a core criterion for advancement to senior faculty positions. As one indication of progress, the number of research publications by Pakistani researchers have grown from about 800 in 2002 to over 12,000.

This report, co-created by Knowledge Platform and the British Council with the support and endorsement of the HEC, is a timely evaluation of Pakistan's research system that will help the HEC chart the evolution of the university research system in Pakistan. It takes a broad but detailed look at the research system, with a focus on research in universities. The report is based on consultations with almost 200 faculty members and leaders and an evaluation of over 20 universities and research institutions.

The British Council and the HEC have had a longstanding collaborative relationship anchored in both research and capacity development. The British Council and the HEC have recently launched the Pak-UK Education Gateway, with one of its principal aims being to generate research partnerships between Pakistani and UK institutions. The findings of this report will be instructive for the design and development of Gateway and to support the aims of HEC's Vision 2025.

While assessing the substantial progress made in the development of research in Pakistan, the report suggests several ideas to further advance research and innovation in the country. First, provide a greater role for academics to guide the research agenda and funding allocation process through the establishment of research councils and the formulation of a research excellence framework. Second, allocate greater funding towards thematic research that addresses Pakistan's most urgent challenges. Third, increase the appetite for university research among government agencies, the private sector and the donor community by developing linkages and good practices. Fourth, cultivate communities of practice

and knowledge networks, both physical and online, domestic and cross-border. Fifth, drive research excellence by promoting mentoring and collaboration. Sixth, improve incentives to deliver impact-oriented research by revising the research evaluation system beyond publication metrics.

We look forward to the vigorous debates that this report will provoke among education stakeholders and the academic community to enable Pakistan's research and innovation agenda to flourish.

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Introduction

With the support of the Higher Education Commission of Pakistan and the British Council, Knowledge Platform conducted in 2018 a seminal research project titled *The University Research System in Pakistan.*

The project—which may represent the most widespread engagement on the subject with faculty members and other experts to date—canvassed academic and research institutions across the country and conducted interviews, focus groups and surveys with a view towards understanding key challenges facing, and identifying practical measures for strengthening, the university research system in Pakistan.

This report sets out our findings and proposes a set of recommendations to further strengthen the university research system in Pakistan.

Our intensive engagement with faculty members shed light on the multi-faceted challenges facing the sector, the successful initiatives that are already underway and aspirations for the future.

Most faculty members were laudatory of the leadership of the Higher Education Commission and the growth of research in universities in Pakistan from a low base in 2001, although some were dismissive of research gains so far and pessimistic about the future.

At the same time, almost every single faculty member we interviewed offered a critique of the existing system and many offered suggestions for improvement.

The most pervasive themes we encountered were the need to intensify faculty debate and collaboration, increase research funding, build demand for research in the government and the private sectors, assert academic rather than bureaucratic control over research decisions, expand thematic research on national challenges, develop flexible evaluation criteria, and build faculty skills in research methodologies, collaboration, dissemination and commercialisation.

Our report explores these themes in some detail and provides recommendations to place university research in Pakistan at a considerably elevated plane of enquiry,, innovation and impact.

ACRONYMS

For a list of acronyms used in our report, see **Appendix 1**: *Acronyms*.

Individuals Participating in Interviews and Focus Groups: **181**

146

35

1=10   Male   Female

- Professor — 28%
- Associate Professor — 17%
- Assistant Professor — 19%
- Lecturer/Researcher — 11%
- Other — 25%
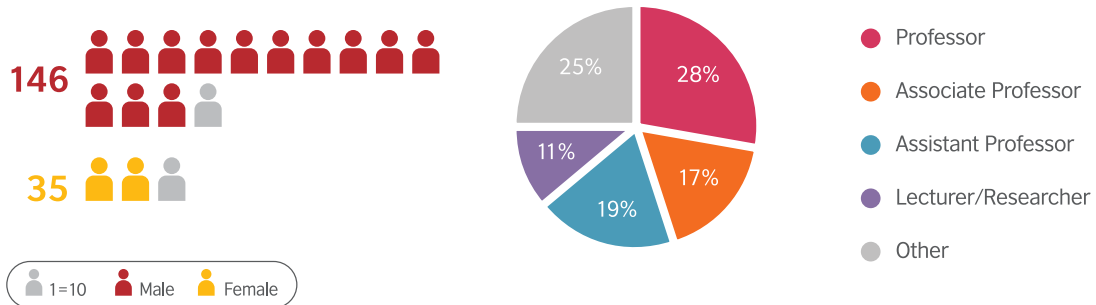
Individuals Participating in Online Survey: **283**

193

90

1=10   Male   Female

- Professor — 12%
- Associate Professor — 12%
- Assistant Professor — 42%
- Lecturer/Researcher — 34%
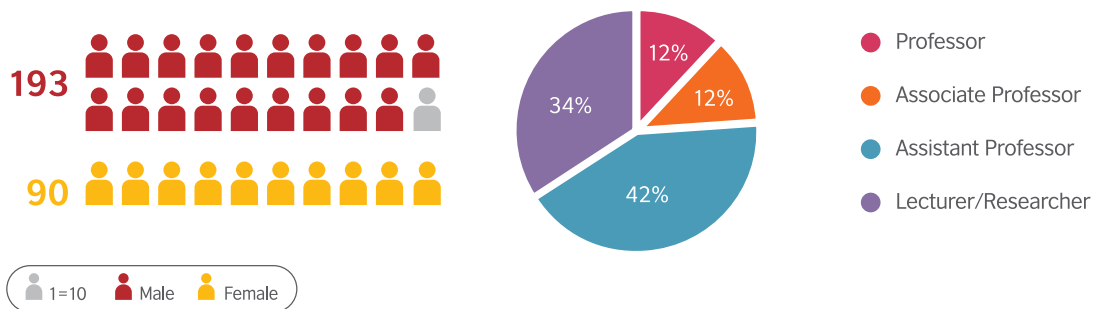
Participating Universities: **14**

Other Participating Institutions: **12**

Executive summary

2002 was a watershed year for Pakistan's university system. That year, the Federal government's apex oversight and support institution for the university system, the University Grants Commission (UGC), was superseded by the considerably more empowered and interventionist Higher Education Commission of Pakistan (HEC).

Under the leadership of the HEC, the number of universities has almost quadrupled from 52 accredited institutions in 2001 to over 193 accredited institutions today. At present, slightly over 45,000 faculty members teach about 1.4 million students (representing a student-to-faculty ratio of over 30:1). While expansion of the university system and student enrolment has been impressive, this also means that many universities have been formed relatively recently. The faculty members in universities are themselves relatively inexperienced: approximately 39,000 junior faculty members are led by only 6,300 professors and associate professors (representing a junior-to-senior faculty ratio of over 7:1).

Since its establishment, the HEC has also done an impressive job in bringing research from an episodic and somewhat marginal activity into the centre of university life. The HEC's principle instruments in doing so have been the expansion of research funding and linkage of senior faculty promotions to research publications. The university system has responded emphatically to these incentives :research output has climbed from under 800 publications in 2001 to over 12,000 publications in 2015.

In its recently published Vision 2025 statement, the HEC has set forth an ambitious research agenda under which it plans to lead higher education institutions as the principle drivers of a knowledge-based Pakistani economy. This will require reforming the university research system by taking it to a considerably elevated plane of inquiry, innovation and impact[1].

The HEC's success in developing research activities at universities has come at a price. Its emphasis on research publication has marginalised other research activities. To date,core education stakeholders (policymakers,, government officials, regulators, donors, business leaders, professionals and media representatives) and the wider public remain disengaged from university research: they generate little by way of demand for research-driven solutions.

While there are notable exceptions, faculty in Pakistan view research as an activity that has, at its principal end, journal publication as a requirement for career advancement. Many faculty members across Pakistan feel that research is treated as a 'numbers game' in which quantity is incentivised over quality, and faculty

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1   Higher Education Commission Pakistan, *Vision 2025*.

discourse by and large misses the spirit of enquiry and debate, the passion to solve globally or locally meaningful problems, and the frictional camaraderie of belonging to communities of practice. Funded through individual research projects, driven by personal career targets, unwanted by the government and private sectors as providers of insights, resident in bureaucratically managed institutions, and overloaded by teaching obligations, most faculty members feel that research is a solitary and often isolating exercise.

While faculty members have research publication targets for career advancement, they recognise that their research skills need development in almost all aspects. The research community recognises that development of such skills requires a culture shift that would emphasise the value of mentoring and collaboration. In the West, this has been cultivated over centuries, and most senior faculty members' development has been rooted in these practices, whereas this is only the case for a privileged minority of their Pakistani counterparts. Under these conditions, it is unlikely that Pakistan can take the same path to research excellence that has been followed by mature university systems.

The HEC is acutely aware of the challenges it faces in enhancing the research system in universities in Pakistan, but its own capacities are limited. It is a government-controlled organisation staffed to a substantial extent by individuals who work within the prevailing bureaucratic system of control and response. Its research funding budget is miniscule even when benchmarked against emerging markets standards, and considerably smaller than its budget for funding overseas scholarships for Pakistanis.

Yet, the HEC recognises that it must nurture communities of practice that tend to flourish against the constraints of bureaucracy. While doing so, the HEC is aware it must also address the needs of a massive and rapidly expanding young population that is hungry for education, eager for accreditation, and desperate to find jobs in an economy that has been left behind in the Asian growth spurt of the past fifty years.

Despite all these challenges, admirable progress has been made: the HEC is well respected, universities respond to its signals, and faculty members have managed to generate research despite their teaching loads. With careful, prioritised reform over the coming seven years the HEC (in partnership with government, donors, the private sector and civil society, and with the support of universities and faculty members) will be able to revolutionise the culture of research in Pakistan.

This report provides an overview of the university research system, and makes the following key recommendations:

Recommendation 1: Implement institutional changes

Recommendation 1.1: Form research councils (consisting of a coordinating research council with discipline-based sub-councils) comprising faculty members and practitioners to drive the research and quality agenda.

Recommendation 1.2: Create tiers of universities to reduce the research load on some universities and increase research funding for and expectations of other universities.

Recommendation 1.3: Merge offices of research, innovation and commercialisation and quality enhancement cells. This would create a single cell within universities with responsibility for strengthening university research and quality as well as enhanced capabilities in research collaboration, fund-raising, dissemination and commercialisation.

Recommendation 1.4: Reform faculty promotion and human resource practices to create a wider pool of senior faculty members and empower faculty 'stars'.

Recommendation 1.5: Launch a world-leading digital communication and collaboration platform to drive research quality and innovation, empower communities of practice and enable research dissemination and commercialisation.

Recommendation 1.6: Deepen research collaboration relationships with international universities to infuse global innovations and best practices into the Pakistan research system.

Recommendation 2: Reform research funding

Recommendation 2.1: Expand the research funding pie by inducting the government, donor and private sectors as research sponsors and clients.

Recommendation 2.2: Implement a research excellence framework programme under which the research councils recommend and evaluate research funding programmes. These could either constitute project-specific grants for individuals or block grants for departments.

Recommendation 2.3: Fund thematic research around Pakistan's pressing challenges such as economic development, education, healthcare, environment, water, energy, civil society, governance and

security.

Recommendation 2.4: Fund social science research pertaining to issues relevant to Pakistan, an area which has so far been under-funded.

Recommendation 2.5: Reform funding practices for laboratory equipment by funding shared laboratories and training of neglected technical staff.

Recommendation 3: Reform the research measurement system

Recommendation 3.1: Reform the quality measurement system so that multiple measures are used to measure research publication quality and, in addition, due accord is given to leadership in research, solving meaningful problems, developing research capability, mentoring, collaboration, dissemination and commercialisation.

Recommendation 4: Nurture a purpose and quality-driven research culture

Recommendation 4.1: Build academic discourse on tertiary education itself so that the HEC and universities use their own condition as the 'ground zero' for transparent, collaborative, evidence-based policy formulation, implementation and monitoring.

Recommendation 4.2: Promote a culture of research that embraces research practice, collaboration, dissemination and commercialisation as a major change management drive.

Recommendation 4.3: Promote mentoring and other practices to develop research capabilities by explicitly developing and supporting mentoring and collaboration practices and enabling their dissemination through technology.

THE UNIVERSITY SYSTEM IN PAKISTAN

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The university system in Pakistan has grown considerably since the first university—the University of the Punjab in Lahore—was established in 1882 in the territory that now constitutes Pakistan.

In 1947, the newly independent Government of Pakistan established the UGC as a national commission responsible for supporting and overseeing universities across the country.

In 2002, the UGC was superseded by the HEC, a federally-constituted, independent and autonomous institution responsible for funding, overseeing, regulating and accrediting the higher education sector in Pakistan.

Accrediation
→ Universities
→ Journals

Scholarships
→ National
→ International

Support
→ University Development
→ Faculty Development
→ Sports
→ IT Infrastructure
→ Smart Campus

Quality Assurance
→ Tenure Track Statues
→ Faculty Appointment Criteria
→ Journals
→ University QUality System
→ Quality Enhancement Cell

Research
→ Research Grants
→ Web Platforms
→ Office of Research, Innovation and Commercialisation

Under its statutory charter, the HEC is governed by a commission led by a government-appointed chairman (with the status of a federal minister) and seven other federally or provincially appointed officials, as well as by ten individuals from the academic and private sectors. In practice, the HEC is governed as an autonomous government body (the full commission had not met for two and a half years, but now has committed to meet every six months).

In 2010, the 18th Amendment to the Constitution of Pakistan substantially enhanced provincial autonomy and, among other matters, advanced the devolution of education to the provinces. Beginning in 2013, provincial higher education commissions (PHECs) were established to support and oversee universities in the provinces. While it is expected that the relationship between the HEC and the PHECs will evolve, at present the HEC remains the principal funding and regulatory authority for the university sector.

Since the establishment of the HEC in 2002, the number of universities in Pakistan has grown dramatically through accreditation of both pre-existing colleges and newly-established academic institutions.

CUMULATIVE GROWTH IN PUBLIC AND PRIVATE SECTOR UNIVERSITIES

PUBLIC   PRIVATE

Source: Higher Education Commission
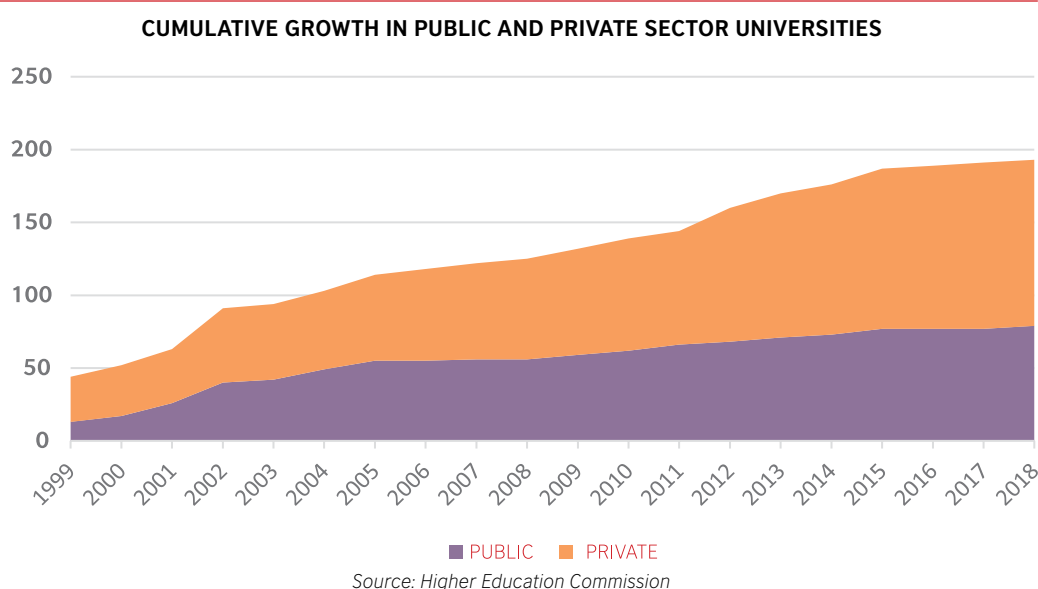
The public universities also have approximately 3,000 affiliated colleges, which are provincially regulated and act as feeders to their linked universities.

UNIVERSITY GROWTH BY PROVINCE

AZAD JAMMU & KASHMIR   BALOCHISTAN   GILGIT BALTISTAN   SINDH

ISLAMABAD CAPITAL TERRITORY   KHYBER PAKTUNKHWA   PUNJAB

Source: Higher Education Commission
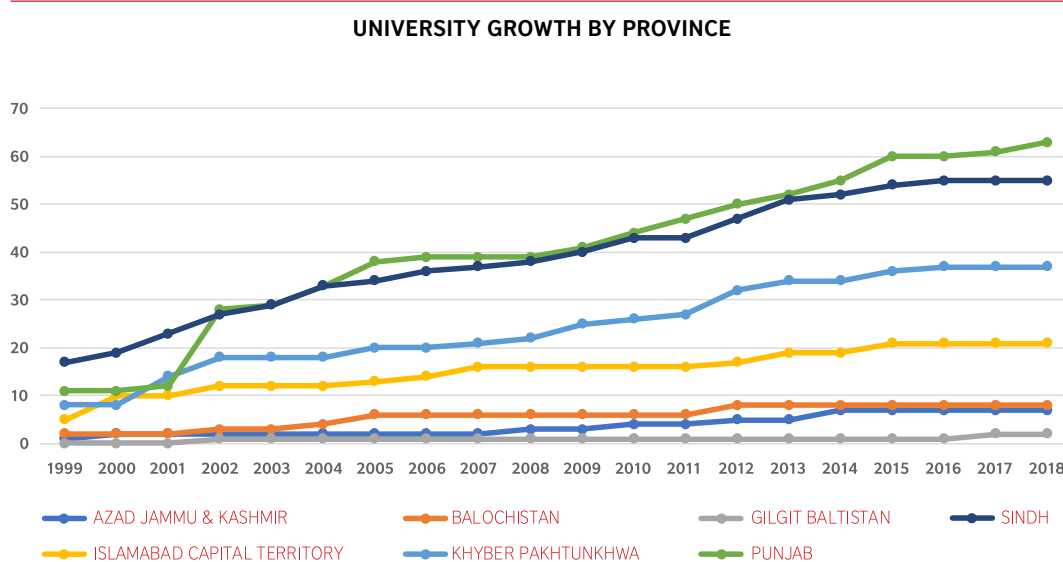
Today, over 45,000 faculty members at over 193 accredited universities across the country educate approximately 1.4 million students.

At present, the university system in Pakistan produces a very low level of PhDs per university. In 2014, on average, public universities graduated 12 PhDs and private sector universities graduated 1.4 PhDs (a combined average of 7.6 PhDs

AFFILIATED COLLEGES BY PROVINCE (TOTAL 2,913)

- AZAD JAMMU & KASHMIR
- BALOCHISTAN
- GILGIT BALTISTAN
- ISLAMABAD CAPITAL TERRITORY
- KHYBER PAKHTUNKHWA
- PUNJAB
- SINDH
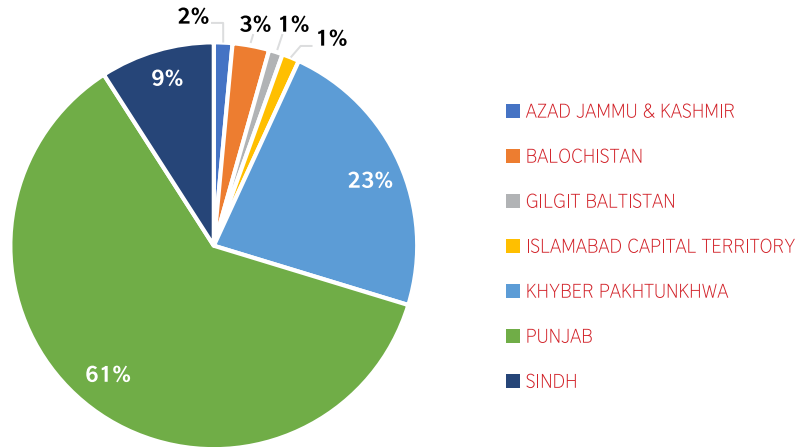
Source: Higher Education Commission

graduated per university).

FACULTY IN PUBLIC AND PRIVATE SECTOR UNIVERSITIES (45,358)
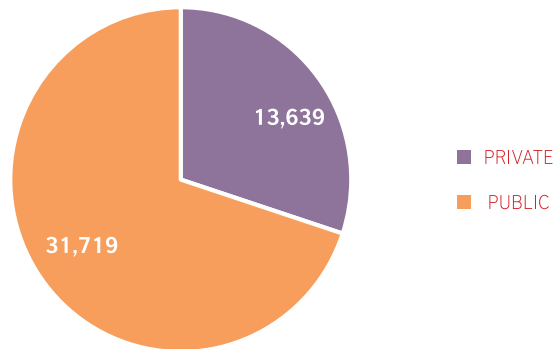
- PRIVATE
- PUBLIC

ENROLLMENT IN PUBLIC AND PRIVATE SECTOR UNIVERSITIES (1,382,813)
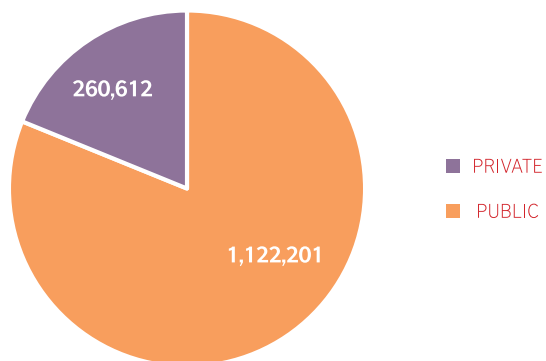
- PRIVATE
- PUBLIC

Source: Higher Education Commission

PHDS AWARDED BY PAKISTANI UNIVERSITIES (2010 – 2014)

Legend: PUBLIC PRIVATE
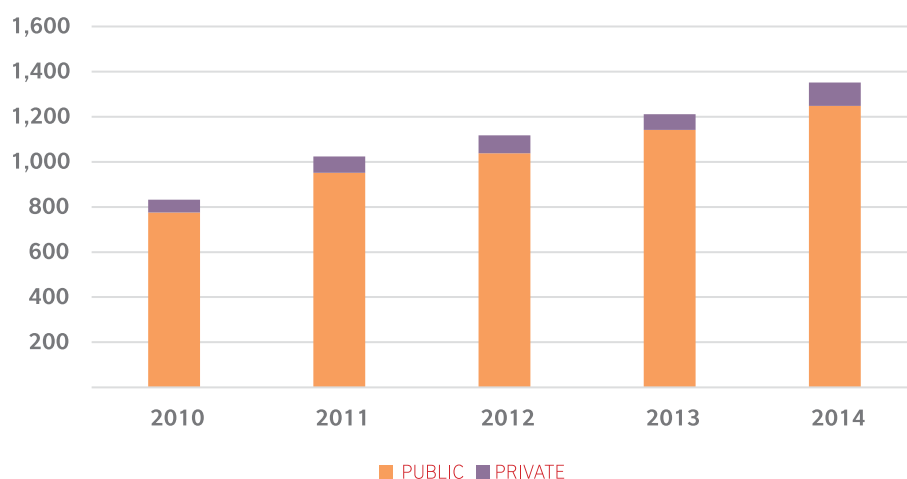
Ratio of PhD-awarding universities to PhDs awarded in 2014	
Type of University	University / PhDs
Public	1 to 12
Private	1 to 14
All	**1 to 7.6**
Source: Higher Education Commission	

In order to supplement and improve academic quality, the HEC also provides scholarship funding for overseas study. The HEC does not publicly provide data on its scholarship budget, but this budget is considerably larger than its research funding budget, and the HEC is a net transmitter of revenue to foreign universities. As of September 2018, the HEC fully funded 1,614 PhD candidates enrolled in overseas universities. As the HEC only publishes minimal data on the return on investment of its foreign scholarship programme, it is very difficult to estimate its efficacy and impact.

HEC-funded PhD scholars in overseas universities (September 2018)	
Country	PhD candidates
Germany	321
South Korea	228
France	222
United States	164
Australia	97
Turkey	90
United Kingdom	76
Malaysia	70
Belgium	53
Sweden	52
Italy	50
Austria	48
China	39
New Zealand	33
Thailand	28
Netherlands	12
Norway	12
Canada	9
Hong Kong	9
Finland	1
Total	**1614**
Source: Higher Education Commission	

DISCIPLINARY DISTRIBUTION OF HEC-FUNDED PHD SCHOLARS IN OVERSEAS UNIVERSITIES
(SEPTEMBER 2018)

- AGRICULTURAL & VETERINARY SCIENCE
- ARTS & HUMANITIES
- BIOLOGICAL & MEDICAL SCIENCES
- BUSINESS STUDIES
- ENGINEERING & TECHNOLOGIES
- PHYSICAL SCIENCES
- SOCIAL SCIENCES
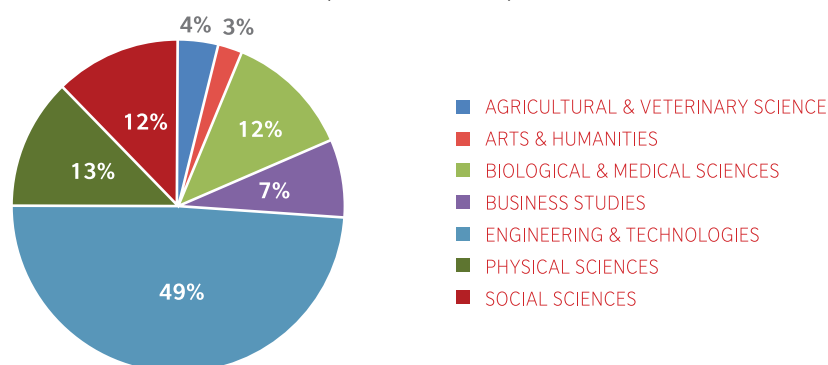
Source: Higher Education Commission

Prior to the establishment of the HEC, teaching was prioritised over research in the university context, and promotion of research was left to the discretion of individual universities. In 2002, the HEC made a major push to developing a research culture in universities.

The HEC's principle instruments in promoting research have been the expansion of research funding and explicitly linking senior faculty promotions to volume of research publications. The university system has readily responded to these incentives, and research output (as measured by publications) has climbed steadily since 2002.

JOURNAL PUBLICATIONS BY FACULTY IN PAKISTANI UNIVERSITIES
(estimates used for 2009 & 2011 – 2014)
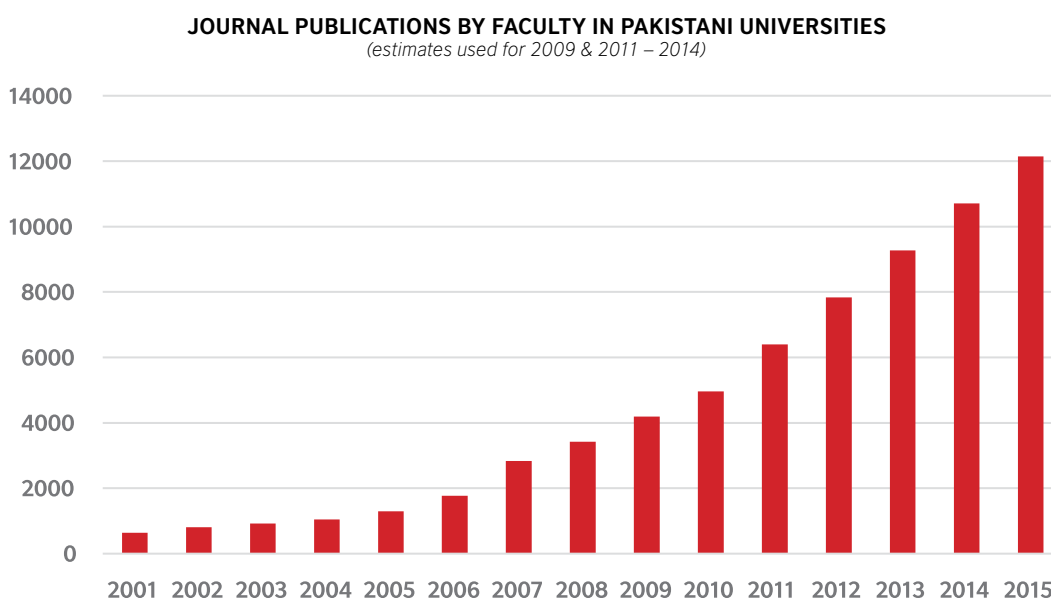
Source: Higher Education Commission with KP Estimates for 2011 – 2014

To enhance research quality, the HEC also funds and supports the establishment of Offices of Research, Innovation and Commercialisation (ORIC) at qualifying universities. These ORICs aim to increase and centralise research funding, publication, collaboration, capability development, dissemination and commercialisation. As a parallel exercise, HEC funds and supports the establishment of Quality Enhancement Cells (QECs) at qualifying universities to improve and monitor university quality more generally.

In its recently published Vision 2025 statement, the HEC has floated the idea of creating three tiers of universities:

1. TIER 1 universities (global centres of cross-disciplinary scholarship and research)

2. TIER 2 universities (publicly funded comprehensive institutions of higher learning for a large mass of qualified students)

3. TIER 3 colleges (institutions affiliated with universities that act as feeders to universities)

Vision 2025 also set forth a significant research agenda for the next seven years:

> "HEC plans on making higher education institutions the major source of new knowledge to create a knowledge-based economy. It plans on creating TIER 1 research universities with effective and well-staffed offices of research, innovation and commercialisation to add value to the economy in the emerging thrust areas of growth. The existing six internationally ranked research universities[2] will be supported to improve their ranking to be included in the top 200 universities in the world through their scholarly output published in impact factor journals."[3]

To support the Vision 2025 agenda, the HEC has set forth the following research-related objectives:

→ Strengthen the ORICs that have been established in leading universities, by including the provision of research and development grants for applied research projects with immediate national impact

→ Increase collaborative research with growing industries in the country

→ Enhance and expand business incubation centres in universities

→ Increase applied research programmes and establish 15 new science and technology universities with a focus on applied research

→ Enhance use of investments made in information and communication technologies

→ Increase research funding that will lead to international patents

→ Establish five research and technology parks.

Given a rapidly expanding university system, elevated goals for the sector over the coming seven years, and increasing but nevertheless highly constrained resources, the HEC and the university system will need to ensure that institutions and programmes are designed for success.

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2   As of 2016, six universities in Pakistan were placed by QS World University Rankings in the top 800 world rankings: National University of Sciences and Technology (#501), Quaid-i-Azam University (#651), Lahore University of Management Sciences (#701), University of Engineering and Technology in Lahore (#701), University of Karachi (#701) and University of Lahore (#701).

3   Higher Education Commission Pakistan, *Vision 2025*.

LITERATURE REVIEW

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Overview

One of the striking features of Pakistan's university system is how little it has been systematically studied. The HEC does not regularly commission research on its operations or on the university system, and, while the HEC publishes annual reports, data on its operations and on the university system is fragmented and not easily available. The little literature that exists has either been funded by multilateral or bilateral donors in the form of private reports or written by faculty members in articles of relatively limited scope. A growing number of opinion pieces in the press and in blogs provide welcome additional perspectives.

HEC influence

A 2017 review of the HEC's most valuable contributions to the tertiary education system notes four well-recognised initiatives:

1. the tenure track system that links senior faculty promotions to quantitative journal publication requirements

2. the prescription for curriculum standards and requirements

3. the quality and control system to measure university teaching quality

4. the faculty scholarship programmes.

Their research indicates that the HEC's reform measures are recognised and followed. (*Riaz et. al., 2017*)

A broader ten-year review of university research performance affirms the important leadership role of the HEC but suggests that a shift in focus is required towards the creation of high-impact research and a renewed innovation and collaboration drive within the university sector. *(Kumari at. al., 2017).*

The imperative to collaborate

Various studies have drawn attention to the volume of research bodies within the agricultural sector. The major research players are government bodies and some agricultural universities: research spending is very low, funding mostly derives from government agencies and donors, private sector funding is minimal, and the level of research coordination needs to be very substantially improved. One study reveals that the level of agricultural research and development funding actually fell 23% from approximately GBP 129 million to GBP 99 million in 2005 , while funding for this activity increased during the same period in China (119%), Malaysia (87%), India (82%), Bangladesh (35%) and Sri Lanka (31%). (*Bientema et. al, 2007*; *Afzal, 2007*).

A useful 2013 study funded by the United Kingdom's Department for International Development (DFID) provides an overview of entities that conduct educational policy research, including university departments, private sector consultancies, government institutes and donor agencies. The study notes that education plays a diminutive role in informing overall policy research, remains statistical in orientation and inadequately coordinated or articulated into a community of practice. The study indicates that there is considerable unrealised potential for universities to engage in policy research—a theme which is central to this report. (*Naveed, 2013*)

When it comes to the social sciences, there is a distinct dearth of research collaboration. This shortage is revealed by a 2015 paper, which shows that think tanks tend to dominate the policy research landscape, that universities remain isolated from government, industry and civil society, and that collaboration between think tanks and universities is highly circumscribed (*Naveed and Suleri, 2015*).

The weakness of social sciences research

The state of social sciences research is a topic that has received significant attention in the literature. Writers have observed that HEC has tended to be led by scientists who advocate for more concentrated development in science, technology, engineering and mathematics (STEM) related disciplines (*Kumari et. al., 2017*). Indeed, the HEC has tended to heavily favour these subjects over social sciences and the arts, which is reflected in the allocation of research funding. Social science and public policy remain neglected fields with inadequate capacity, funding and professional development. (*Haque and Mahmood, 1999*; *Arunachalam, 2012*; *Zaidi, 2002*; and *Inayatullah; 2001*). Naveed and Suleri (*2015*) summarise the situation as follows:

> "The analysis and evidences presented in this paper suggest that the formal knowledge systems for policymaking—think tanks and universities—are based on a weak foundation of social sciences in the country. The ongoing higher education reforms offer an opportunity to improve these foundations but only if their inherent bias against social sciences is addressed."

Non-STEM academics rely on donors and consultants for funding and visibility; they have limited scope to be either innovative or relevant (*Haque and Orden 2017*). Generally, these academics tend not to have the profile that government bodies look for in consultants. Haque and Orden (*2017*) draw attention to the implications of this in their report:

> "Not surprisingly, under these circumstances social science research has played little role in public policy in Pakistan. There are few policy debates, local theses or hypotheses being discussed. There is little demand for public policy research by policymakers as evidenced by the lack of funding for such work. Policymakers rely on donors to provide them with ideas and research."

The pressure to publish and its impact

In the popular media there is a lively debate on the quality of research. Proponents point to the impressive growth in the volume of citations and publications coming out of the university system, while opponents contend that citations and publications have proliferated because the HEC has explicitly linked publication with career promotion. These opponents contend that this incentive system has led to citation communities or cartels, fake journals and websites (*Osama et. al.*, 2009; *Hoodbhoy, 2009*). In response to this, the HEC publishes a list of such websites and has started to decertify journals.

The pressure to publish has also led to other practices that are being investigated by the HEC. For example, incidents of plagiarism appear to be on the rise (*Hoodbhoy 2009, 2013 and 2017*; *Mahmood, 2009*, *Nurilhuda 2012*). To counter this, the HEC adopted a plagiarism policy in 2009 which has resulted in more methodical quality assurance.

Summary

While much more extensive research of the university system and the HEC needs to be conducted, the core findings in the literature to date, which complement our own, are as follows:

→ The HEC plays a strong influential role in the evolution of the research system and this role must be mindfully exercised based on continual impact evaluation

→ The research industry is under-resourced and over-fragmented. Universities need to learn how to collaborate effectively with each other as well as with other research-oriented entities. They also need to engage with, and provide meaningful solutions to, the government, donors and the private sector

→ There is considerable need to invest in high quality social sciences research

→ The current incentive system of linking promotion to publication has had serious ramifications and must be reformed if research is to attain a meaningful and high-impact quality threshold.

SELECTED READINGS

For a list of selected readings that have informed our report, see **Appendix 2**: *Selected readings.*

RESEARCH AND RELATED FUNDING

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Overview

Pakistan has an exceptionally low level of research and development spending. Taking into account government, private sector and other sources, less than 0.25% of GDP is invested in research and development, which is less than half of the (already very low) level of spending in South Asia as a whole.

R&D SPENDING AS % OF GDP (2015)
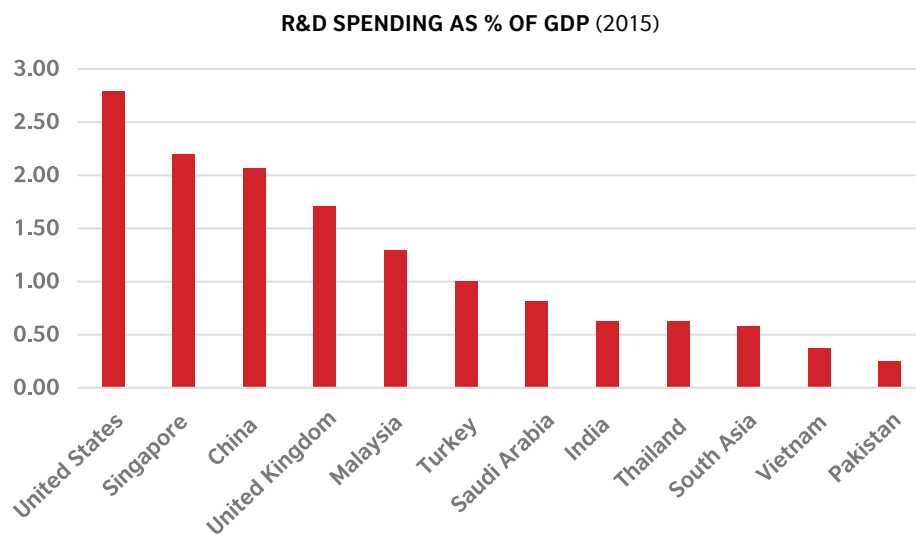
Source: The World Bank

In Pakistan, the government (principally the federal government), multilateral and bilateral donors provide the bulk of funding for research and related activities.

Government funding for research is divided into three principal streams.

1. A **substantial portion of government funding goes directly to government institutes, commissions and departments** with research mandates. These entities tend to internally consume their research funding rather than collaborating with universities.

2. A growing amount of **government research funding is channelled to two principal agencies—the HEC and the Pakistan Science Foundation (PSF)—**which are mandated to provide research funding for both public and private sector universities. Federal and provincial government departments also provide funding directly to universities, with limited allocations for research. The recently constituted PHECs also have extremely limited research funding budgets for universities in their respective provinces.

3. The government also imposes a **cess (i.e. levy or surcharge) on certain industries and economic activities and makes available a portion of the collections available to entities tasked with**

promoting such industries and activities, including through research and development. Historically, such entities have had negligible levels of engagement with the university sector. However, Ignite National Technology Fund (formerly the National ICT R&D Fund), which obtains revenue from a cess on the telecommunications sector, has established a dynamic relationship with the university sector focused on innovation that could serve as a model for other industries.

Donor funding for research and related activities also has three principal streams.

1. A limited level of donor funding is delivered in the form of **grants to government agencies** (principally the HEC), often to support research collaboration between Pakistani universities and universities in the donor countries.

2. A less frequently used, but potentially significant donor funding stream is channeled through entities such as the **HEC or directly to universities.** This aims to build research capacity or research centres of excellence, typically in collaboration with universities in donor countries.

3. The more substantial part of donor funding is made available for the **requirements of their aid programmes in Pakistan**. Most of this funding is directed to international consultants while a much smaller amount is provided to a a select number of domestic consulting firms. These international and domestic consulting firms tend not to subcontract research to universities.

Beyond government and donor research funding, universities in Pakistan have very limited funding streams..

Flow of Research Consulting and Innovation Funds
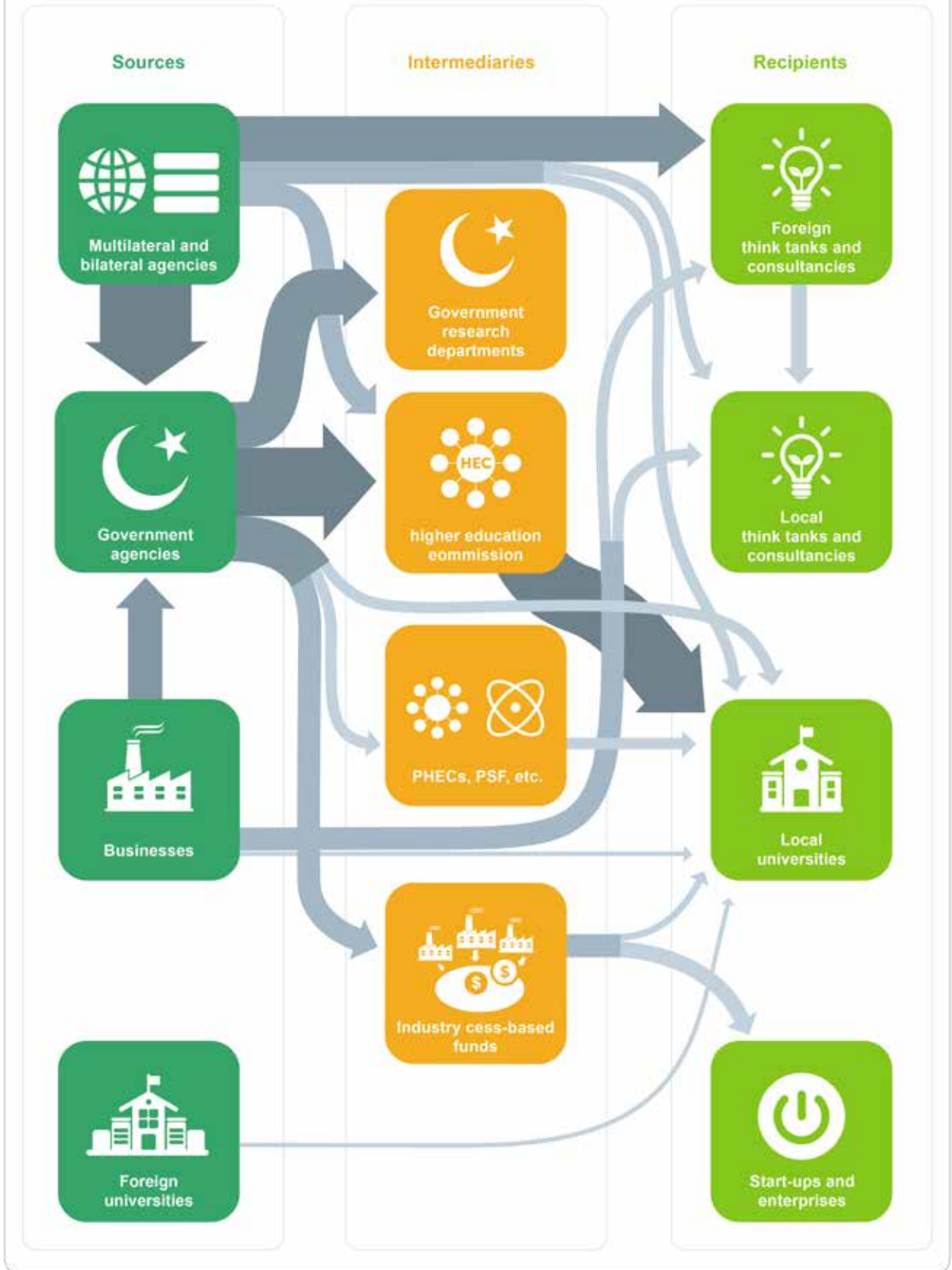
Government-linked research institutes

A substantial portion of government funding goes directly to government institutes, commissions and departments which have mandates that include research and development. There are over 20 major government-linked entities and dozens of smaller agencies and departments with such mandates.

Some of these entities, such as the Pakistan Agricultural Research Council (PARC), the apex body for agricultural research, and Pakistan Atomic Energy Commission (PAEC), the apex body for civil nuclear research, have research facilities that were established long before the creation of the HEC. In other cases, the entities (such as Khan Research Labs and National Engineering and Scientific Commission (NESCOM)) and their research agendas are controlled by the Pakistan armed forces.

By and large, these entities tend to be corporatist, and do not engage substantially with the university sector. Most of the research funding received by these entities is consumed internally and there is hardly any link with universities. (It should be noted, however, that the 'military-controlled' all on one line please entities tend to collaborate with each other and military-linked universities such as National University of Sciences and Technology (NUST)).

> **SELECTED GOVERNMENT COMMISSIONS AND INSTITUTES**
>
> For a list of selected government-linked commissions and institutes and government departments with research mandates see **Appendix 3:** *Selected government commissions and institutes*.

Higher Education Commission

The HEC is the government's principal conduit for funding research by universities and faculty members. The HEC does not break out its budget for all its development activities (which include (1) a major overseas and local scholarship programme, (2) research funding, (3) ICT investments across the university sector, (4) support of universities for capacity and infrastructure development, (5) sports development and (6) accreditation and evaluation). It appears, however, that research funding accounts for under 10 % of HEC's annual development budget.

HEC DEVELOPMENT FUNDING (2016; PKR 20.7 BILLION)

7.3%

92.7%
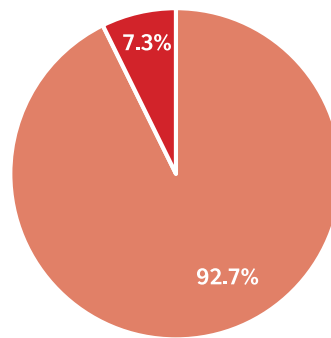
■ OTHER DEVELOPMENT SPENDING   ■ PRINCIPAL RESEARCH SPENDING

Source: Higher Education Commission
Note: HEC Funding for ORICs, incubation centres and library programs not included in research spending

Nevertheless, over the years, government funding for research has grown through increased grants to the HEC. The following chart represents the HEC's actual annual outlays for its principal research funding programme, the National Research Programme for Universities (NPRU).

NRPU FUNDING (PKR)

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
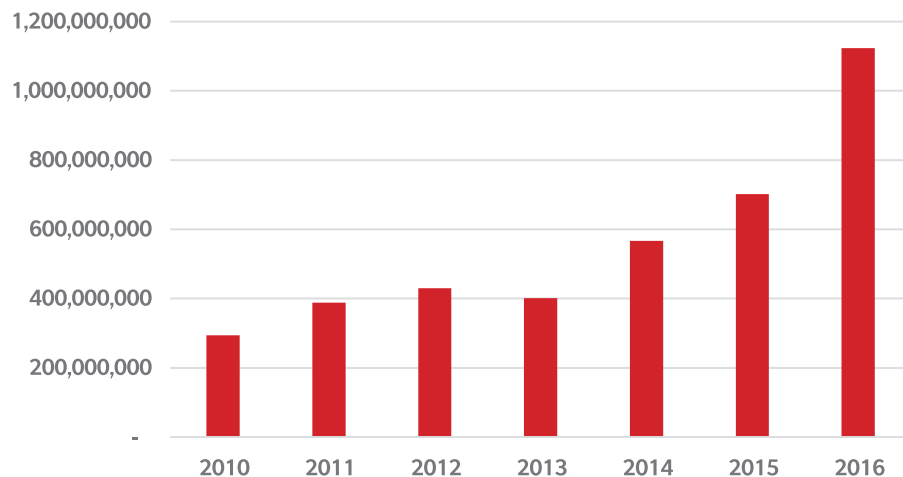
Source: Higher Education Commission

In 2015 – 2016, the HEC spent slightly over PKR 1.5 billion on research-related funding (not including spending on ORICs, incubation centres and library programmes).

HEC Research Programmes (2015 – 2016)		
Research Programmes (with Funding Data (PKR))		
National Research Programme for Universities	1,123,710,000	HEC's major research funding programme
Faculty Start-Up Research Grant	180,000,000	Grants to new PhDs to set up research initiatives
Grant to Organise Seminars, Conferences	115,129,572	Grants for seminars and conferences
Textbook and Monograph Writing Scheme	35,312,000	Support for development of textbooks and monographs
Scientific Instrumentation	15,826,273	Payments to service providers for shared scientific instruments
Social Integration Outreach Programme	9,500,000	Grants to develop relationship between universities and communities
Pak-France PERIDOT Research Programme	8,445,000	Science and technology cooperation between Pakistan and France
Knowledge Economy Partnership	7,760,000	Collaboration between HEC, DFID and the British Council
Patent Filings	6,500,000	Payments for overseas patent applications
Pakistan Programme for Collaborative Research	4,606,000	Funding for overseas research collaboration by Pakistani faculty
Outstanding Research Awards	4,520,000	Awards for outstanding research, innovation and publication
Total	**1,511,308,845**	
Additional research and related programmes (without funding data)		
ORIC Support		Support for universities to build ORICS
Business Incubation Centers		Support for universities to build business incubators
Pak-U.S. Science & Technology Collaboration		Grants for Pakistani and US faculty to build science and technology research capacity
HEC Library		Funding for HEC digital and print library
National Digital Library Programme		Support for national digital library
Source: HEC Annual Report 2015 – 2016		

The HEC's principal research funding programme, NRPU, is open to full-time public or private university faculty members for grants up to PKR 20 million per project (subject to limits based on the applicant's Impact Factor publications). The bulk of NRPU funding tends to go towards research projects conducted by faculty members in universities based in Punjab Province and the Federal territory. (It is noteworthy that institutions in the Federal territory receive roughly the same level of funding as institutions in the entire province of Punjab.) And, generally consistent with prior periods, the bulk of the NRPU research projects approved in 2015 – 2016 were in the biological, medical, agricultural and physical sciences and in engineering and technology: social and political science research projects accounted for less than 5% of approved projects.

NRPU APPROVED PROJECTS (2015 – 2016: 381)

- PUNJAB
- FEDERAL
- KHYBER PAKHTUNKHWA
- SINDH
- AJK
- BALOCHISTAN
- GILGIT BALTISTAN
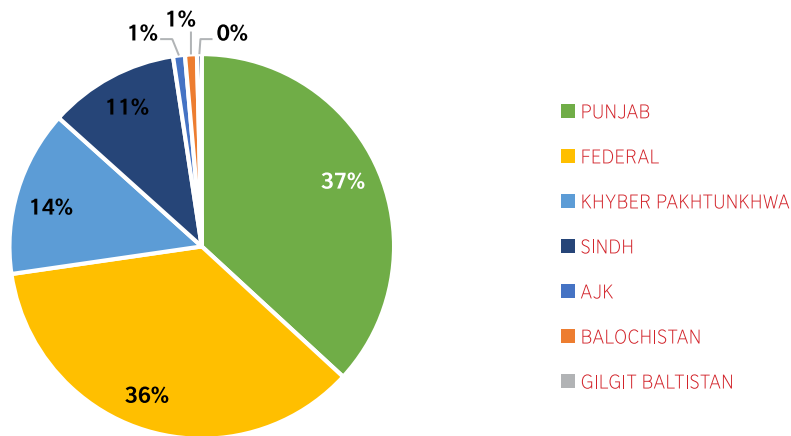
Source: Higher Education Commission

The HEC's Start-Up Research Grant Programme (SRGP) is designed to support recent PhD holders appointed as faculty members in public or private universities by helping them to establish basic research infrastructure and activities. Dr Arshad Ali, previously Executive Director of the HEC, believes that the programme has added value to emerging academic leaders:

"The HEC has nurtured, through its overseas and domestic scholarship programmes, a new generation of well-educated and highly-motivated young scholars. If the HEC can provide this generation with the right combination of autonomy and support that is needed to build confident academics, it can transform the research system in Pakistan. The HEC's start-up grant programme is one such initiative."

The HEC also collaborates with donors (including DFID, United States Agency for International Development (USAID) and the French Ministry of Higher Education, Research and Innovation) to support cross-border and collaborative research projects. In addition, with the support of USAID, four Centres for Advanced Studies have recently been launched as collaborations between Pakistani and American universities. (For a fuller description of these programmes, see 'Donor Funding' below.)

In a major step-up in research funding, and a major move into thematic research, the HEC launched the Technology Development Fund (TDF) in 2016 – 2017 with

the support of the Planning Commission. This fund will, over a five-year period, approve and disburse PKR 2.94 billion for 200 research and development projects with a per-project grant of PKR 14 million. Any researcher at a university (not just a full-time faculty member) may apply with a product development idea in a wide range of fields in which technological innovations may be applied and scaled. The researcher must have an industry partner who can help apply and scale the product innovation. In 2017 – 2018, 35 research projects were approved under the TDF.

TDF APPROVED PROJECTS (2017 – 2018; 35)
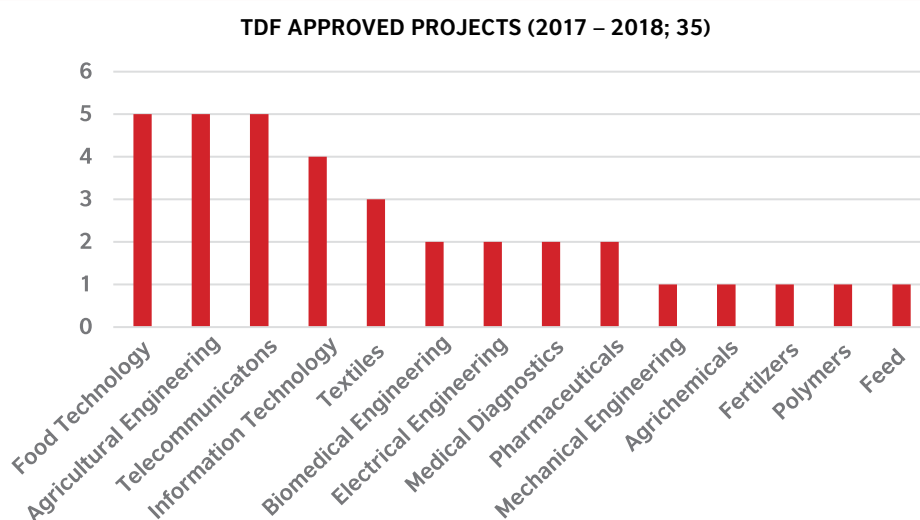
Source: Higher Education Commission

In 2017 – 2018, in an even more significant move towards both thematic and collaborative research, the HEC (with backing from the Planning Commission) launched four national centres designed to build national capacity in emerging areas of science and technology. Investment and focus fostered by these National Centres could create a competitive advantage for Pakistan in Artificial Intelligence; Robotics and Automation; Cyber Security; and Data Analytics and Cloud Computing. To promote inter-university collaboration, these newly established bodies have a national centre for each discipline and series of 'affiliated labs' at a number of universities across the country. The criteria for selection are: demonstrated capability, a problem-solving orientation and a commitment to financial sustainability in three to five years.

The Planning Commission has made a substantial funding commitment to the national centres, which represents a dramatic increase from the HEC's entire disclosed research funding for 2015 – 2016.

Dr Athar Osama (Member Science, Technology and ICT at the Planning Commission) who has played a seminal role in the design and rollout of the

National Centres for technological innovation, notes:

"The national centres are a significant departure from the HEC's established research funding model. We have provided substantial thematic funding around emerging disciplines that could affect almost every economic and social sector. And we are not interested in research publications, we are interested in what problems can be solved. We believe that you cannot solve problems unless people take a commercial orientation and work across disciplines and institutions. We have designed KPIs for the labs that incentivise financial sustainability, industry partnerships and inter-university collaboration."

The Planning Commission is now working together with the HEC to launch three new national centres in:

- Human nutrition

- GIS and space applications

- Nano Science and Technology.

Artificial Intelligence	Robotics and Automation	Cyber Security	Data Analytics and Cloud Computing
National Centers			
NUST, Islamabad	NUST, Islamabad	Air University, Islamabad	LUMS, Lahore
Affiliated Labs			
Medical Imaging and Diagnostics (CIIT, Islamabad)	Robot Maker (NUST, Islamabad)	Cyber Security (AIR University, Islamabad)	Digital Pakistan (NUST, Rawalpindi)
Deep Learning (NUST, Islamabad)	Robot Design and Development (NUST, Islamabad)	Cyber Security (Bahria University, Islamabad)	Distributed Computing (LUMS, Lahore)
Intelligent Field Robotics (NUST, Islamabad)	Human-Centered Robotics (UET Lahore & UCP Lahore)	Cyber Security (UET Lahore)	Language Engineering (UET Lahore)
Smart Cities (NED UET, Karachi)	Industrial Monitoring & Automation (ITU, Lahore)	Cyber Security (UET Taxila)	Exascale Open Data (NED, Karachi)
Neuro-computation (NED UET, Karachi)	MEMs Sensor Design & Testing (AIR University, Islamabad)	Cyber Security (LUMS, Lahore)	Precision Medicine (CECOs, Peshawar & FAST NU, Karachi)
Intelligent Information Processing (UET Peshawar)	Agricultural Robotics (LUMS, Lahore)	Cyber Security (ITU, Lahore)	Video Surveillance (NUST, Islamabad & FAST NU, Karachi)
Intelligent System Design (UET Peshawar)	UAV Dependability (FAST-NUCES, Islamabad)	Cyber Security (AIR University, Islamabad)	Sustainable Energy Informatics (LUMS, Lahore)
Intelligent Criminology (UET Lahore)	Swarm Robotics (UET Taxila)	Cyber Security (UETP, Peshawar & UOTN, Nowshera)	Predictive Analytics (SZABIST, Karachi)
Agent-Based Modeling (Punjab University, Lahore)	Haptics, Human Robotics & Condition Monitoring (NED Karachi & MUET, Jamshoro)	Cyber Security (NUST, Islamabad)	Precision Agriculture & Analytics (UAF, Faisalabad)
	Control Automotive & Robotics (BUITEM, Quetta & MUST, Mirpur)	Cyber Security (PIEAS, Islamabad)	Crime Investigation & Prevention (ITU, Lahore)
	Advanced Robotics & Automation (UET Peshawar)	Cyber Security (PIEAS, Islamabad)	Data Acquisition, Processing & Predictive Analytics (Ziauddin University, Karachi)
			Data Analytics (UETP, Peshawar)

Human Resources

PhDs Currently Employed:	200+
PhDs to be training & supported over 5 years:	500+
MSs to be training & supported over 5 years:	1,000+

Key KPIs

Financial Sustainability — Will your projects and labs be financially sustainable over a 3-5 year time horizon?

Industry Partnerships — Are you working with industry and entrepreneurial partners to develop viable solutions?

University Collaboration — Are you deeply engaged in inter-university collaboration?

THE UNIVERSITY RESEARCH SYSTEM IN PAKISTAN

RESEARCH AND RELATED FUNDING

Pakistan Science Foundation

PSF is the federal government's principal agency dedicated to promoting science research and dissemination. PSF is responsible for funding science research in universities, promoting the popularisation of science, establishing science centres, organising science conferences, arranging science exchanges, supporting scientific societies and awarding science prizes and fellowships.

While PSF does not provide data on its quantum of research funding, It is small in comparison with that of the HEC. PSF has so far funded 1,031 research projects that have resulted in the publication of 612 research papers in national and international journals and five patent filings. In addition, 169 students have obtained MPhil degrees (with a further 115 gaining PhDs) due in part to PSF-supported research projects.

PSF FUNDED ONGOING RESEARCH PROJECTS (94)
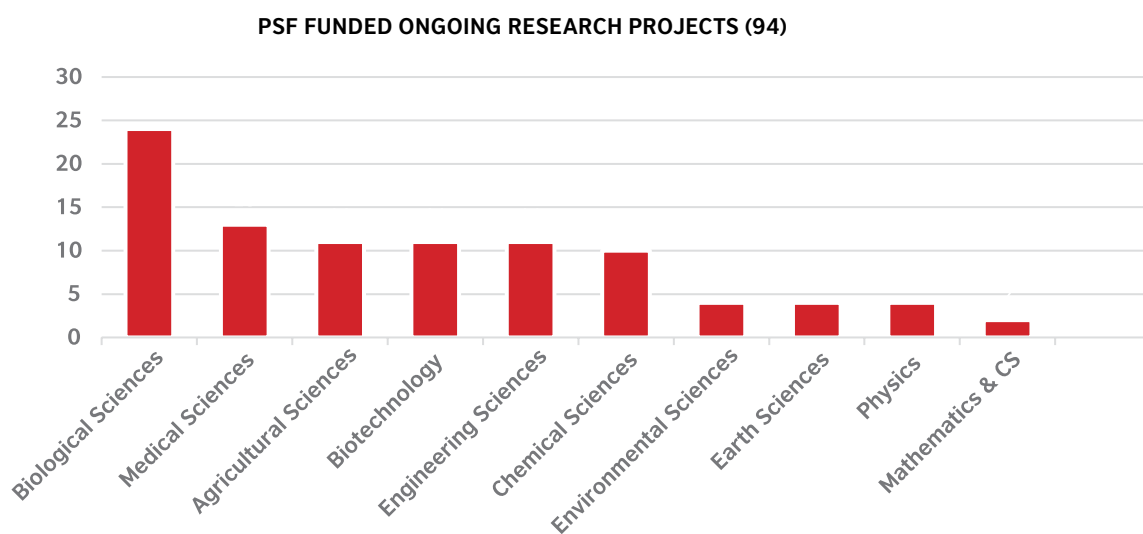
Source: Pakistan Science Foundation

Pakistan Council of Scientific and Industrial Research

The Pakistan Council of Scientific and Industrial Research (PCSIR) is a government-owned science and industrialisation research organisation which mainly focuses on the development of industrial research. Its activities include research publication (the Pakistan Journal of Scientific & Industrial Research), management of research laboratories and HRD centres, research funding, research collaboration and accreditation of material test parameters. At present, it has 43 publicly-announced research projects.

Industry cess-based funds

The Government of Pakistan imposes cesses on revenue or transactions from certain types of industrial activities. Collections from the cesses are meant to be allocated for further development of those industries, including through research and development. While collections from the cesses can be substantial, the Ministry of Finance often releases only a portion of the collections to the entity responsible for managing the allocated funds.

Overview of selected cess funds		
Managing entity	Industry	Comment
Ignite National Technology Fund	Manages funds allocated from a cess on gross revenue from all telecoms service providers.	Ignite is an efficient and effective entity which allocates funds for research that can be commercialised, promotes skills development and new business incubation. Strong relationships with universities.
Export Development Fund	Manages funds allocated from a cess on export revenues of exporters.	Promotes exports and trade fairs and assists export growth. Conducts limited research; minimal relationships with universities.
Pakistan Central Cotton Committee	Manages funds allocated from a cess on bales of cotton used for spinning yarn.	Promotes growing and marketing of cotton. Operates several cotton research centres across the country; limited relationships with universities.
Pakistan Tobacco Board	Manages funds allocated from a cess on tobacco purchased by tobacco companies.	Promotes the tobacco industry and establishes standards. Conducts limited research; minimal relationships with universities.

The entities responsible for managing the allocated funds have reasonable resources (in the Pakistan context) for research and development; however, their research and development efforts have not had very substantial impact to date, and relationships between these management entities and universities have been minimal.

Ignite has changed this dynamic substantially in respect of funds allocated from the telecommunications sector. Ignite is bringing into its relationship with universities a collaborative triangulation of research, innovation and commercialisation. This model could be extended to other cess management funds as well.

Ignite is a company owned by the Ministry of Information Technology and Telecommunication that manages an innovation fund financed through a cess on national telecommunications revenue. Ignite's goal is to promote the commercialisation of research and innovation that leverages Information Technology. Founded in 2007, Ignite initially focused on funding IT research projects at universities as well as IT commercialisation projects led by entrepreneurs. Over time, it found that its commercialisation mandate was being met much more readily through entrepreneurs than faculty members and

universities. Under the leadership of Mr Yusuf Hussain (who joined as CEO in 2016), Ignite has embarked on a dramatic new form of engagement both with the academic and business sectors.

With a thematic focus on ten fields of IT innovation, Ignite is now engaged in three major areas of activity: (1) funding R&D and innovation projects at universities, enterprises and non-profits; (2) building IT skills through scholarships, competitions and a major online Digiskills programme; and (3) sponsoring incubation centres to support Pakistan's fledgling and promising start-up culture.

Ignite's emphasis on commercialisation and collaboration is apparent throughout: faculty members and entrepreneurs are exposed to each other's strengths and weaknesses as they undergo rigorous commercialisation scrutiny to qualify for funding; the Digiskills programme is squarely aimed at skilling one million digital solutions freelancers so they can compete internationally; universities and enterprises compete against each other to obtain support for establishing incubation centres; and the incubation projects themselves are expected to collaborate with each other and raise venture capital funds to take their incubated start-ups to the next level.

Hussain is confident that the Ignite model offers new opportunities for research and innovation in Pakistan: "We have two streams: An R&D stream and a commercialisation stream. While the R&D stream is focused on creating deep tech expertise, IP, and longer term impact, the commercialisation scheme focuses on innovation. The yardstick for innovation is whether an idea or an invention transforms into a product or service that affects society. In the last few decades globally, the organisational unit which has led innovation is the start-up. When we fund innovation projects, usually based on academia-industry collaboration, through our Seed Fund, we ask the question: Will this team be able to build this technology in 'x' amount of time with 'y' amount of money? Simultaneously, we also ask the question: If this technology is built, will people buy it? To answer this second question we engage in due diligence by involving our commercial partners in potential projects. Our Final Year Project (FYP) Fund supports university innovation by final year students. Through our National Incubation (NIC) programme, we incubate start-ups. Our larger mission is to fix innovation in Pakistan and toward that end we also seek to be a catalyst in wider society, where we evangelise the importance of innovation in solving national problems and the need to build an innovation and entrepreneurial ecosystem through incentives, expertise and investment."

Ignite 2018

THEMATIC FOCUS
Concentrate on complementary technologies with transformative impact on sustainable development goals

AI and Big Data	Cloud and Cyber Security	Blockchain	3D/4D Printing

Augmented and Virtual Reality	Neurotech	Wearables and Implantables

Shared Economy Robotics	Internet of Things
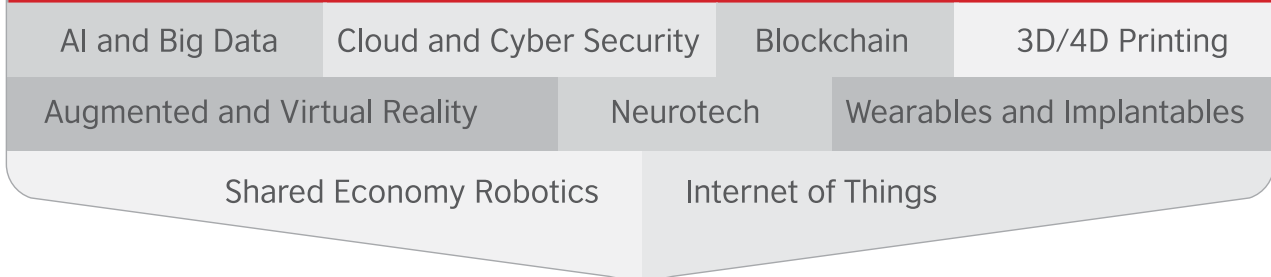
R+D AND INNOVATION
Fund commercially viable high-impact R+D and innovation projects

DESCRIPTION	PROJECTS	VALUE (RS MILLION)
Projects funded since inception	143	2,378
Ongoing technical projects with universities	34	600
Ongoing technical R&D projects with enterprises / universities	44	800
Ongoing technical projects with enterprises / institutions	10	200

TRAINING AND EDUCATION
Develop ICT skills to enable widespread digital transformation

DigiSkills
Online programme to develop digital and freelancing skills of one million students

VUI Virtual University

National ICT Scholarship

National ICT Internship

Balochistan ICT Scholarship

INCUBATION
Incubate start-ups, attract venture capital, connect universities, and enterprises

ISLAMABAD	LAHORE	KARACHI	PESHAWAR	QUETTA
National Incubation Center	NIC LAHORE	NIC KARACHI	NIC Peshawar	NIC QUETTA
Teamup	LUMS		ptcl	
Jazz			UMT	

LEGEND: Universities ☐ Enterprises

Donor funding

To date there have been a limited number of donor programmes aimed at strengthening research capacity in Pakistani universities, and the Pak-US Joint Research Programme identified below is at present not entertaining any new proposals. The upcoming Pak-UK Education Gateway has been designed in part to address this gap and increase the level of UK higher education sector engagement with Pakistan—including the areas of research and innovation.

Collaborative Research Programmes	
Entity	Description
Pak-France PERIDOT Research Programme	This programme supports scientific and technological research collaboration Pakistani and French higher education institutions. The priority areas in 2018 are energy, health, human and social sciences, climate change and IT for peace and conflict resolution.
Pak-UK Education Gateway	A partnership between the HEC and the British Council to develop the Pak-UK Education Gateway and leverage the experience and capacities of the UK education system in order to advance innovative and collaborative research, higher education leadership, quality assurance and standard setting, distance learning and new ways of delivery of higher education, international mobility and transnational education.
Pak-US Joint Research Program	A comprehensive research collaboration programme intended to increase the strength and breadth of cooperation and linkages between Pakistani scientists and institutions with counterparts in the United States.

The UK higher education sector's engagement with Pakistan has been spearheaded by the British Council, which has developed a close collaborative relationship with the HEC that goes back to the establishment of the HEC. Under successive programmes, the parties have worked together to advance research and deepen university research and education capacity in Pakistan and intensify research and education collaboration between Pakistan and the UK.

In addition to these programmes, to strengthen a system of applied research, USAID launched during 2010 – 2015 a GBP 97 million US-Pakistan Centres for Advanced Studies (USPCAS). USPCAS connects three US universities with expertise in energy, agriculture and water with four Pakistani universities. Under this programme, four centres have been established and staffed and have been assured funding for the next few years. At this stage, however, the long-term funding of these centres is uncertain and their impact to date has been limited.

THE BRITISH COUNCIL AND HEC COLLABORATION

Joint Higher Education Links Programme Phase I (2004-2005) and Phase II (2006-2008):

50 research and capacity development links forged and numerous projects undertaken between Pakistani and UK institutions.

International Strategic Partnerships in Research and Education (INSPIRE) (2008-2014):

Jointly funded by the British Council and the HEC. Over 80% of Pakistani VCs visited UK institutions. Over 200 scholar exchange visits. Collaborations involving about 30,000 researchers and 55,000 students.

Development Partnerships in Higher Education (DelPHE) (2007-2013):

Seven grants for research and capacity building collaboration between Pakistani, UK and, in some cases, Bangladeshi universities.

Knowledge Economy Partnership (KEP) (2015-2018):

Mobility grants to senior leaders in universities to work closely with UK partners and develop their strategies for research and capacity building. To date, 16 grants have been given to universities in Pakistan.

Participating institutions			
Countries	Universities	Others	Total
United Kingdom	59	4	63
Pakistan	60	4	64
Combined	**119**	**8**	**127**

Collaborations by provinces (total 140)

- Punjab 40%
- Sindh 26%
- KPK 21%
- ISLAMABAD 13%
- Balochistan 1%

Collaborations by disciplines (total 140)

- Not Specified 5%
- Engineering, IT & Mining 4%
- Energy 6%
- Business & Enterprises 6%
- Agriculture & Fisheries 9%
- Natural Sciences 9%
- Society, Culture & Heritage 11%
- Environment, Waste & Water 11%
- Education 16%
- Health & Nutrition 24%

Principal focus of collaborations (total 140)

- Research 45%
- Capacity Building 50%
- Unspecified 5%

Source: The British Council

Pak-UK Education Gateway (launched 2017):

The British Council and the HEC have now launched a wide-ranging collaboration to cover research, university leadership, quality assurance, distance learning, international mobility, transnational education and universities as change agents. The programme is being designed through a structured series of collaborative discovery and brainstorming initiatives.

For additional information on the Pak-UK Education Gateway, see **Appendix 4:** 'The Pak-UK Education Gateway.'

CENTRES FOR ADVANCED STUDIES

To strengthen a culture of applied research, USAID launched the US-Pakistan Centres for Advanced Studies (USPCAS) in 2015.

The US-Pakistan Center for Advanced Studies in Agriculture and Food Security at University of Agriculture Faisalabad, in partnership with University of California Davis.

The US-Pakistan Centre for Advanced Studies in Water at Mehran University of Engineering and Technology, Jamshoro, in partnership with University of Utah.

The US-Pakistan Centrefor Advanced Studies in Energy at National University of Science and Technology, Islamabad, in partnership with Arizona State University.

The US-Pakistan Center for Advanced Studies in Energy at the University of Engineering and Technology, Peshawar, in partnership with Arizona State University.

The objectives of the centres include the following:

→ Provide revised curricula and other reforms to make university education and research more relevant to the needs of industry and government

→ Facilitate relevant policy dialogue and reforms for each technical sector led by policy think tanks at each centre

→ Develop robust scholarship and exchange programmes

→ Develop strong links to the private sector

→ Construct, rehabilitate, and upgrade world-class research facilities at partnering Pakistani universities.

CASE STUDY: **The US-Pakistan Centers of Excellence**

For additional information on the US-Pakistan Centers of Excellence, see **Appendix 5**: *The US-Pakistan Centres of Excellence.*

Other funding

Universities have almost no endowments and very limited levels of internal funding for research. Public sector universities have minimal discretionary funding; almost all research funding reaches universities through the HEC and other government agencies.

Private sector universities tend to have limited levels of internal budgets for research and departments within such universities may have discretionary funds that may be applied towards incidental research expenses. However, private sector universities tend to obtain good returns on investment on internally deployed research funds because they can be released quickly, create high visibility, generate strong motivational impact and directed more closely by the universities.

Foreign universities are a major net recipient of Pakistani governmental and private sector funding for tertiary education. The HEC funds many overseas scholarships for Pakistanis, but the budget is not publicly disclosed. On their part, foreign universities provide extremely limited amounts of research funding for Pakistani universities and faculty members in connection with specific research collaboration projects.

The business sector in Pakistan provides negligible levels of research funding for universities. There are promising trends, however, in the IT and telecommunications sector, which are beginning to engage with universities on research, consultancy, training and business incubation initiatives. However, even in this sector, there are significant constraints on funding streams.

Pathways to enhanced funding

Almost all members of the research community we interviewed appreciated the expansion of research funding in Pakistan, but shared the perspective offered by Ms Shahnaz Wazir Ali, the President of SZABIST University:

> "While research funding has increased, the total amount of funding, and the amount of funding per project, is very small. There really needs to be a major shift in the state's commitment to research and development, and this has not yet taken place."

Dr Adil Najam, Dean of the Frederick S. Pardee School of Global Studies at Boston University and previously Vice Chancellor at Lahore University of Management Sciences (LUMS), suggests that in addition to increasing the amount of research funding, there should be a strong focus on optimising that which is currently available. He noted that government research commissions, institutes and departments hoard research funding, which could be allocated to universities.

> "It's very difficult to compete with an academic institution on research; there shouldn't be parallel institutions. We should focus funding on universities, trim down government research institutes, and find high-quality, collaboration-oriented people to work in these government institutes. If every government department creates its own research centre, you reduce the quality of research overall."

Dr Sohail Naqvi, Rector of University of Central Asia, Bhishkek, Kyrgyzstan and previously Vice Chancellor of LUMS and Executive Director of the HEC, makes another suggestion on how to improve existing research funding:

> "The government cesses on exports, cotton and telecommunications are intended to promote these industries, including through research and development. But, other than in the case of telecommunications, these cesses are not achieving strong research and development outcomes. We need to examine how cess collections can be optimised for stronger results in research and product development."

One major issue that surfaced in our discussions with members of the research community is that, until the very recent introduction of the Technology Development Fund and national centres for technology innovation, research funding has by and large not been thematic or focused on solving problems. Dr Pervez Hoodbhoy, Distinguished Professor at Forman Christian College, contends that:

> "Research should either advance the global pool of knowledge or address very specific local problems. Pakistan is contributing a negligible amount to the global advancement of knowledge. At the same time, the current research funding structure does not incentivise faculty members to address problems that are less technically challenging but still important to the daily lives of Pakistan's citizens."

Several faculty members said that, with the exception of the Technology Development Fund, research funding at HEC is not thematically driven. They noted, however, a significant bias towards science and technology research and against social sciences research. When HEC-funded science and technology projects are added to thematic science and technology funds (e.g. HEC's Technology Development Fund, Pakistan Science Foundation, Pakistan Council of Scientific and Industrial Research, COMSTECH Organisation of Islamic Cooperation and Ignite funds), these observations are strongly corroborated: about 3% of approved research projects under NRPU, TDF, PSF, PCSIR, COMSTECH and Ignite funds are a related to social and political science subjects.

ONGOING RESEARCH PROJECTS (NRPU, TDF, PSF, PCSIR, COMSTECH AND IGNITE: TOTAL 601)

- HEC – NRPU SCIENCE & TECH
- HEC – NRPU SOCIAL & POLITICAL SCIENCE
- HEC – NRPU OTHER
- HEC – TDF
- PSF
- COMSTECH
- IGNITE
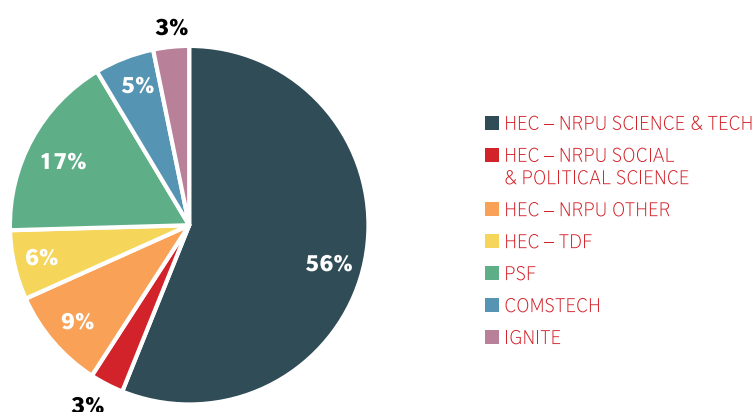
Source: Higher Education Commission, Pakistan Science Foundation, PCSIR, COMSTECH & Ignite
Note: HEC NRPU data is for 2015 – 2016; TDF data is 2016 – 2017; other data is 2017 – 2018

Dr Faisal Bari, Associate Professor at LUMS and Director at Institute of Development and Economic Alternatives (IDEAS), notes:

"While the Government of Pakistan and the HEC are pouring more money into sciences and technology research, they haven't really looked at social sciences in the same way. The social sciences, humanities and arts are continuously disregarded. Even if you look at HEC's Vision 2025, there are only one or two places in which social sciences are mentioned, and that too in passing. Yet, when you think about problem-solving impact, social sciences research can provide incredible returns on investment. Social sciences research is relatively cheap to conduct and, if it informs public policy, can have very widespread impact."

The research community also widely shares the perspective that the prevailing structure of funding individual research proposals has ramifications both for collaboration across institutions and between individuals and the development of strong thematically interlinked research capability. Dr Akmal Hussain, Founding Dean of the School of Social Sciences and Humanities at Information Technology University in Lahore (ITU), explains:

"Individual funding of research proposals enables faculty members to pick research topics that are likely to lead to publication. But if you want to develop a real world class researcher, she or he would need to be part of an environment that is amenable to research. Research is not something that you do sitting alone. You need to have a community of people around you in that university with whom you can interact on a systematic basis. For that you need a minimum number of high quality professors, and you need research funding that incentivises collaborative and thematic research."

The research community generally recognises the national centres for technology innovation as a laudable step in the right direction in terms of both thematic and

collaborative focus. The community also views Ignite, with its focus on commercially viable research and business start-ups, and its insistence on collaboration between researchers and entrepreneurs, as a potential catalyst for greater levels of collaboration. There was more doubt expressed about the US-Pakistan Centres for Excellence in Agriculture, Energy and Water—not because of any issue with the themes, but because the centres may become 'orphan assets' given their limited funding horizon and the deteriorating aid relationship between the United States and Pakistan.

In addition to these 'big picture' perspectives, our interviews also raised several issues and suggestions with respect to the HRC research funding review and approval process.

Issues and suggestions relating to research funding approval process	
Issue	Suggestion
The process is controlled by bureaucrats, not academics.	One consistent and widely supported suggestion was that faculty research councils must be involved in redesigning, implementing and overseeing the research funding review and approval process. We have spelled out the implications of this suggestion in our recommendations below.
Although each proposal is reviewed by three reviewers, it appears that they do not have sufficient domain expertise.	
The research funding review and approval process takes too long.	
Research funding is often arbitrarily cut by half.	
There is often no feedback provided or, when provided, is inadequate.	

While our interviewees pointed out several issues, they had one common complaint: the research funding review and approval process, as are other processes involving the HEC and universities, is a rigid, bureaucratically controlled process that does not align with academic realities and requirements. It is not surprising that, in this area and others, our interviewees came up with one overriding recommendation: allow the research targeting, funding and review process to be controlled by academics, not bureaucrats.

DRIVERS OF
RESEARCH DEMAND

Overview

Demand for research is the lifeblood of a research system. Healthy demand enables:

→ researchers to address intellectually, socially and commercially meaningful problems

→ a virtuous cycle in which research is disseminated, problems are solved, products are commercialised, and new insights leads to new areas of research

→ universities to attract funding and talent and become central nodes in the advancement of their communities.

Our interviewees recognised the challenge of demand as perhaps the central challenge of the university research system in Pakistan. Demand from the government, the business sector and the donor community for research, consulting and related solutions provided by Pakistani universities and their faculties is very low. However, our research provided glimpses of a fascinating series of pathways that could lead to solutions to the demand – supply imbalance.

Government demand

Although the colonial civil service inherited by Pakistan had been founded by administrators with an exceptional capacity for research, our interviewees almost uniformly characterised political leaders and bureaucrats as both uninterested and unschooled in evidence-based policymaking. One of our interviewees at the Planning Commission observed that decision making on energy policy at the Cabinet level is generally made with barely a reference to economic, infrastructure, environmental or social analysis. Similarly, faculty members at the University of Engineering and Technology in Lahore (UET), which has well-established departments in both engineering and urban planning, observed that the Lahore Metrobus system was developed with scant inputs from diverse university research faculty, let alone public discussion and inputs.

Our interviewees noted that not only does the prevailing system of political and bureaucratic decision making offer little room for research-based inputs, but bureaucrats are largely unfamiliar with the design and use of evidence-based policymaking. Historically, the training programmes for civil servants administered by the Pakistan Civil Services Academy have had a relatively low level of emphasis on research and evidence-based policymaking. (To some extent, this gap is now being addressed by a Harvard University Evidence for Policy Design programme for South Asian civil servants funded by DFID.)

HARVARD Kennedy School
Evidence for Policy Design

CERP
Center for Economic
Research in Pakistan

**Harvard Kennedy School, NSPP and CERP work
with the Pakistan Civil Services Academy and
other government agencies to advance
evidence-based policy design:**

Blended learning and
face-to-face
leadership and staff
training programmes

Policy dialogues
among all key
stakeholders

Evidence-based
policy pilot programmes
in policing, healthcare,
and tax collection

While our interviewees recognised the early indications of growth in government demand for research-based solutions, they also indicated two areas of considerable concern. A few interviewees noted that much of government demand tends to be addressed to a very limited number of 'favourite' universities (ITU and LUMS in Lahore and Pakistan Institute of Development Economics (PIDE) and NUST in Islamabad). In addition, some interviewees emphasised government tendencies to prefer private sector consulting firms (such as McKinsey) and non-profit research institutes (such as the Sustainable Development Policy Institute (SDPI)) over university faculty members.

In their own defence, government officials we interviewed made two rebuttals.

First, they argued that the pressure of decision making and administration is so great that they have little time to engage with researchers, review research papers or engage in evidence-based policymaking. A member of the Planning Commission observed that the commission reviews and disposes of over 350 funding proposals each year, ranging from proposals for large national infrastructure projects to small institution-specific IT implementations, in some cases with submissions over one foot high. It becomes almost impossible, he argues, given the executive pressure on government officials, to engage in evidence-based policymaking.

Second, the government officials we interviewed almost unanimously took the view that university-based researchers just don't offer the government information and insights that are relevant to government requirements or that are presented in formats that enable policy formulation. In addition, there is a substantial minority view that the current emphasis on research publications is exacerbating the issue. A member of the Planning Commission noted that while it has historically had a very positive research and policy-based relationship with PIDE, this has deteriorated as faculty members have increasingly focused on research publications.

There are, however, reasons for optimism, especially related to practical, problem-solving rather than policy formulation and review.

In a few cases, government agencies started projects with international consulting firms, but then transitioned over to government bodies and research institutes. For example, in 2013, the Chief Minister's Office in the Government of Punjab established a monitoring unit (now referred to as the Special Monitoring Unit) to provide strategic direction, improve delivery and monitor government performance in the service of health, education, water, clean cities and youth.

Considerable research and analysis went into the design and implementation of the Special Monitoring Unit, with McKinsey playing a leading role. In recent years, the Special Monitoring Unit has collaborated closely with and assisted in developing capabilities within the Punjab Bureau of Statistics and Punjab Economics Research Institution.

In addition, the Government of Punjab, ITU and University of Agriculture Faisalabad (UAF) have developed close working relationships. ITU has designed and implemented IT solutions in education, healthcare, transport and administration that have enabled this provincial government to advance the efficacy of its public services. In one notable crisis-management success, the Government of Punjab worked with ITU and UAF to effectively manage a dengue outbreak that had spread rapidly in Punjab from 2010 onwards.

GOVERNMENT-UNIVERSITY COLLABORATION

CASE STUDY: **UAF and the fertiliser models programme**

Working with the Punjab government and other collaborators, UAF undertook four research and development projects to develop and publish fertiliser prediction models to enable farmers to make informed choices regarding the use of fertilisers.

For additional detail see **Appendix 7:** *UAF and the fertiliser models programme.*

CASE STUDY: **IBA and the consumer and business confidence surveys**

The Pakistan Consumer Confidence Survey (launched in 2012) and Business Confidence Survey (launched in 2017) are published as a joint programme of the State Bank of Pakistan and Institute of Business Administration in Karachi (IBA). The surveys are funded by the State Bank and managed by IBA under a three-year rolling contract. The survey and publication process has been working smoothly although more work needs to be done on dissemination and uptake by the business sector and financial press.

For additional detail see **Appendix 8:** *IBA and the consumer and business confidence survey.*

It is striking that most effective collaborations between government agencies and universities have not involved traditional government departments but relatively specialist or newly constituted departments with well-defined, mission-oriented remits.

A small movement has also been started to create policy-based bridges between politicians and the research community. In 2016, a Green Parliamentarians Caucus (GPC) was jointly established by Heinrich Boell Stiftung, a German foundation, and SDPI, a non-profit research institute based in Islamabad, following a needs assessment for climate change sensitisation among federal parliamentarians. The GPC has been successfully working with parliamentarians on a cross-party basis to develop awareness on environment and climate change related issues of the country.

CASE STUDY: **Educating legislators on the environment**

Heinrich Boell Stiftung and SDPI have launched a programme for climate change sensitisation among federal parliamentarians.

For additional detail, see **Appendix 9**: *The Green Parliamentarians Caucus.*

While our university interviewees clearly emphasised the lack of government demand as a critical problem area for the development of a research system, they had a much less clear view of the role they could play in addressing this situation. Most initiatives in this regard—including Harvard University Evidence for Policy Design program and the Green Parliamentarians Caucus—are driven by donors and consultants rather than universities and faculty.

In addition, universities have a major opportunity to engage intensively with the public on evidence-based policymaking, both as an intrinsic benefit and to build a broad support base for this approach. However, it is evident that both university leadership and faculty maintain a general disdain for public relations, media marketing and public discourse and are not aware of the potential for using external relations as leverage for evidence-based policymaking from the government. When asked to rank the most and least important forums for research dissemination, faculty ranked the press and media as least important by a considerable margin.

SURVEY: **MOST IMPORTANT FORUMS FOR RESEARCH DISSEMINATION**

- RESEARCH PUBLICATIONS
- BUSINESS PUBLICATIONS & PRESENTATIONS
- GOVERNMENT PUBLICATIONS & PRESENTATIONS
- SOCIAL IMPACT PUBLICATIONS & PRESENTATIONS
- PRESS & MEDIA
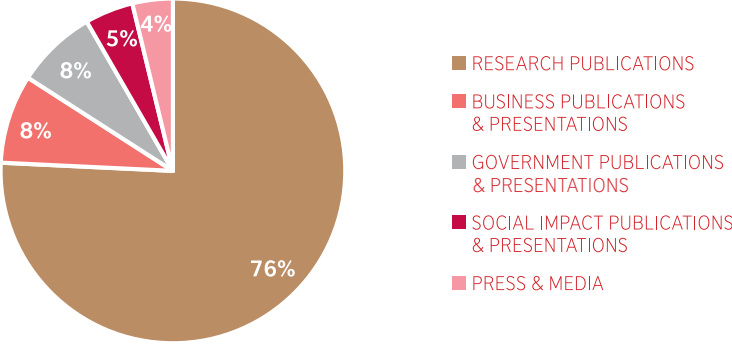
SURVEY: **LEAST IMPORTANT FORUMS FOR RESEARCH DISSEMINATION**

- RESEARCH PUBLICATIONS
- BUSINESS PUBLICATIONS & PRESENTATIONS
- GOVERNMENT PUBLICATIONS & PRESENTATIONS
- SOCIAL IMPACT PUBLICATIONS & PRESENTATIONS
- PRESS & MEDIA
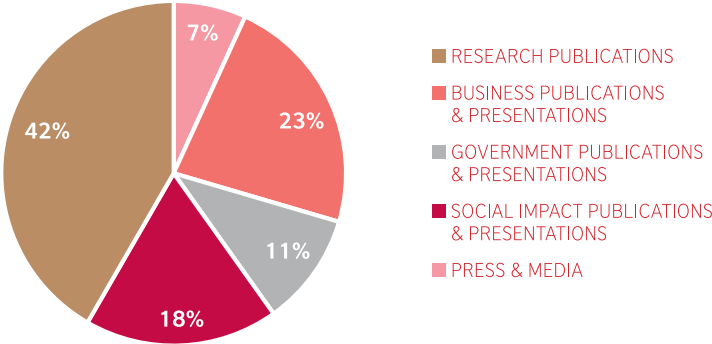
Source: Knowledge Platform Survey

Business demand

Our interviewees expressed almost complete unanimity on the lack of demand from the business sector for university-based research. They characterised the Pakistan business sector as underdeveloped, with minimal research and innovation capacity, principally engaged in producing low-quality and low-value goods and services, and relentlessly focused on driving down costs.

Mr Asif Jooma, the CEO of ICI Pakistan, one of the country's 'blue chip' companies that was sold in 2012 by AkzoNobel to a Pakistani business group, explained the issues facing the sector: "Not only do domestically developed businesses have very limited research and innovation agendas, even multinationals in Pakistan engage in minimal levels of market or product research. For example, Imperial Chemicals has historically produced basic products such as soda ash and polyester staple fibre, while its subsidiary in India has had a much broader and more sophisticated range of products, which has generated considerable demand for research and innovation."

"We avoid paying for electricity, why do you think we will pay for research?"

Anonymous business executive at an industry-university fair organised by the University of Agriculture Faisalabad.

Similarly, business coalitions, such as national, regional, and metropolitan Chambers of Commerce, and industry groups such as the All Pakistan Textile Mills Association (APTMA, which represents the powerful textile industry) and the Pakistan Banks' Association (PBA, which represents the banking sector), are predominantly focused on networking and lobbying and generate little demand for research.

In 2005, 14 leading business groups formed Pakistan Business Council (PBC) as a cross-industry advocacy forum to improve the general business environment of the country. In support of its advocacy mission, PBC publishes a limited number of country studies and reform position papers, and occasionally collaborates with universities such as IBA on seminars but does not commission or catalyse business or economic research.

Mr Jooma informed us that at least the larger 50 – 100 business groups in the country are developing more strategic views of their activities, have substantially increased the quality of their management and are expanding their range of businesses in the country. He notes: "At ICI, we do need to strengthen our research and development capacity. ICI would benefit from more research on strategy, industry dynamics, international benchmarking, and organisational development. For example, we struggle with international benchmarking parameters on organisational productivity."

Mr Jooma affirmed that ICI is very open to working with local universities and cited a strategy development initiative for which ICI opted to work with Karachi Business School of Leadership (KBSL) in combination with a Judge School professor, rather than go to McKinsey. But he raised the issue of whether university professors in Pakistan have the requisite understanding of business needs and engagement capabilities: "About ten years ago, we went to LUMS and suggested that we could support research on polyester tariffs, over which the textiles and polyester industries have been in a protracted battle. We never heard back from them."

Dr Sohail Naqvi concurs on the question of faculty experience:

"At present, the business demand for research is not sufficient. The universities have to put in a lot of effort. We must get the professors out of classrooms, encourage them to visit industry bodies and talk to business people. There need to be a lot of meetings, discussions, things that may well lead nowhere before we get to something substantive. At LUMS, we have some very interesting projects going on with Bulleh Shah Packaging. But Babar Ali [the founder of LUMS *and* Bulleh Shah] pushed for engagement. Now, with LUMS inputs, Bulleh Shah is making commercial products that are good for the environment and more economical. It requires a push, and incentives, to get faculty out."

CASE STUDY: **Research collaboration in the health sector**

Researchers at LUMS are collaborating with Chughtai Labs, a private sector laboratory network, to research antimicrobial resistance across Pakistan.

For additional detail, see **Appendix 10:** *Antimicrobial resistance research.*

Very few universities have relatively continuous levels of research collaboration with industry (a notable exception is the National Textile University (NTU) in Faisalabad, formed originally as a textiles institute by leading textiles industrialists in 1954). Even leading business schools have limited levels of collaboration. Dr Farrukh Iqbal, Dean and Director of the Institute of Business Administration in Karachi (IBA Karachi) reflected on this gap: "Business schools are at a

disadvantage. Until very recently, business schools didn't do any research: the MBA degree is a practitioner degree. The field itself, especially in the United States, has experienced revolutions in ideas on this point. The US evolution has involved a mix of practical teaching through case studies, faculty consulting for businesses, and academic research and publication on business. At IBA, we have several different links with the industry, including with top CEOs. But we have a lot of ground to cover to attain this trinity of case studies, business consulting and business research. Our principal level of engagement with industry is teaching driven–we try to understand deficiencies in our graduates whom we want to place in industry. We are not sufficiently engaged to try to address the business opportunities and challenges industry is facing."

In advanced university systems, engagement with the business sector and the public at large is achieved by a healthy mix of teaching, consulting, research and popular dissemination (through talks, interviews, and magazine, book and blog presentations). In Pakistan, this virtuous linkage by faculty members is not fully achieved due to very low levels of both consulting work and research dissemination. Professors, even business school professors, spend little time trying to understand businesses or winning consulting projects and professors from all diciplines view media and press as the least important forum for publicising their work.

The question of research demand and supply in the context of business and academia is of course a complex one. While certain research disciplines (social science, basic science, environment, humanities and arts) have proved difficult to commercialise, others could prove more successful if there were strong links between business and academia. In some contexts, businesses are more likely to generate demand (in the case of emerging business strategies, organisational and operational requirements, and products and service innovation). In other cases, universities are more likely to generate demand (in the case of large 'blue sky' developments with diverse commercial possibilities, cross-industry metrics and practices and basic research). If there is a virtuous cycle of engagement between business and academia, both sides generate research demand.

DEMAND DRIVERS: BUSINESS AND ACADEMIA

Business

Academia

Strategy and leadership

Organisation and operations

Product and service innovation

'Blue sky' developments

Metrics and best practices

Basic research

THE VIRTUOUS CYCLE OF ENGAGEMENT IN UNIVERSITY SYSTEMS

THE VIRTUOUS CYCLE

THE PAKISTAN EXPERIENCE

DISSEMINATION — TEACHING — CONSULTING — RESEARCH

SURVEY: MOST IMPORTANT FORUMS FOR RESEARCH DISSEMINATIONS

- 76%
- 8%
- 8%
- 5%
- 4%

- RESEARCH PUBLICATIONS
- BUSINESS PUBLICATIONS
- GOVERNMENT PUBLICATIONS
- SOCIAL IMPACT PUBLICATIONS
- PRESS AND MEDIA

SURVEY: FACULTY PROFESSIONAL TIME DISTRIBUTION

- 46%
- 28%
- 8%
- 7%
- 6%
- 4%

- TEACHING AND STUDENT SUPERVISION
- RESEARCH AND WRITING
- FUNDRAISING AND PROPOSAL WRITING
- PROFESSIONAL DEVELOPMENT
- CONSULTING
- OTHER

The China-Pakistan Economic Corridor (CPEC) is one of the most significant developments for Pakistan since 1947: in terms of its sheer size (over GBP 46 billion), diversity of scope and potentially transformational economic and social impact. CPEC will dramatically influence Pakistan's economic prospects in terms of finance, investment, infrastructure, free trade zones, agriculture, manufacturing and commerce. It is a development whose economic and social implications universities could lead in understanding and shaping. Mr Salim Reza, whose career has spanned business (as a senior executive at Citibank), government (as Governor of the State Bank) and academia (as Adjunct Professor at IBA Karachi), notes:

> "It is not too late, but university leaderships need to start taking CPEC as a central, cross-disciplinary thematic focus that will dramatically affect Pakistan's development for years to come. If they do this, they will shape policy and win over government and business as clients. This needs active university leadership and commitment."

The business sector has demonstrated little demand for, and the university sector has demonstrated meagre capacity in generating demand for, basic or applied research. However, an exciting 'supply side' dynamic is developing momentum in the field of telecommunications and computing. Two pioneering initiatives, one led by a government-controlled university and the other by a government-controlled fund, are setting a paradigm for transformation not only for these disciplines but the entire university sector.

The Al-Khawarizmi Institute of Computer Science (KICS) at UET and Ignite both

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owe their success to exceptional leadership, an autonomous and supportive governance arrangement, and a relentless focus on *commercialisation* and *collaboration*.

Founded in 2002, KICS now has over 25 labs, focused on computing, telecommunications, energy and automation and has engaged in over 100 research collaborations with national and international universities, government agencies and businesses. The culture at KICS promotes practical innovation, collaboration and commercialisation. Its innovations include an Urdu language search engine, a grid control-and-monitoring system implemented by utilities in Pakistan and an acoustic surveillance system, which is used by the Punjab Safe Cities Authority.

Dr Waqar Mahmood, who has directed KICS for 10 years, states: "Our focus is to engage, and, if possible, engage commercially, and to innovate without too much regard to publication. For example, we developed a solar lighting system to enable underprivileged students to do their homework at night. It has had very positive impact but didn't generate anything worthy of publication. In one case, we worked with industry to develop an Enterprise Resource Planning (ERP) system, even though the customer did not have money to pay. At other times, we work with international companies and government agencies to deliver solutions that meet their needs, and we make money. Of our total annual PKR 150 million R&D funding, we secure roughly 40% from HEC and generate the rest from other sources. Sometimes, our work doesn't even involve applied research. We manage a large training programme on behalf of Huawei—it is remunerative and it helps our faculty understand and speak to industry priorities. It is less important at this stage in our development to ask whether we are doing research, training or consultancy work: the important objective is to nourish a culture of commercially-oriented, collaborative and engaged problem-solving innovation."

CASE STUDY: **Practical engagement with the private sector**

KICS engages with the private sector on research, but also on training, implementation, events management and other practical matters.

For additional detail, see **Appendix 11**: *The Al-Khawarizmi Institute of Computer Science.*

Donor demand

The huge aid supply chain in Pakistan affects almost every aspect of development in Pakistan.

THE AID SUPPLY CHAIN IN PAKISTAN (2013)

AID ACTORS	**PROJECTS**	**DELIVERY ACTORS**	**GOVERNMENT**
32 Bilateral Agencies	2,094 Projects	100 International NGOs	33 Federal Agencies
12 Multilateral Agencies		200 Consultants	150 Provincial Departments
18 UN Agencies		15,000 NGOs/CSOs	

Source: Faheem J. Khan, The Aid Policy Network in Pakistan, Devpolicy Blog, 2017

At present, donors typically interact with the university system and research community in two ways:

→ occasionally donors have specific small initiatives aimed at strengthening the university sector, including in respect of research capability.

→ the bulk of donor funding is used for research to support ongoing aid projects in Pakistan.

When it comes to actually commissioning and using research as part of their development activities, donors do not tend to engage universities or faculty members. Instead, donors tend to hire foreign consultants, who then sub-contract to local consultants. This tendency to use two tiers of consultants is changing to a degree as donors, such as the United Nations Development Programme (UNDP), acquire greater local expertise, and local consultants (such as SDPI in Islamabad, Collective for Social Science Research (Research Collective) in Karachi, and IDEAS and Centre for Economic Research in Pakistan (CERP) in Lahore) acquire stronger international reputations.

The donor representatives we interviewed (including representatives of Asian Development Bank (ADB), DFID and UNDP) made roughly similar arguments for their preference of consultants over faculty.

The donor representatives noted that much of their work involves project-related research or feasibility studies. They acknowledged, however, that some of their work involves research that could be done in universities and recognised that their project-related research could help improve research capacity in universities. They

also commented that they often work on large-scale projects (i.e., GBP 15 million or more) and need to engage with a limited number of larger entities familiar with their requirements, such as large international consultancies.

Most critically, the donor representatives we interviewed argued that faculty members struggle to understand and address their practical requirements and that universities had limited capabilities in responding to their requests for proposals. Mr Edward Davis, Senior Education Advisor and Policy Team Leader at DFID in Islamabad, elaborated on the reasons for limited engagement with the higher education institutions in Pakistan: "We are a commissioner of services, rather than a funder of institutions. DFID would be happy to partner with universities if they could provide consultancy-based research as well as academic research. Universities are missing this opportunity, especially since is it often the academics from the same universities who join the consortia that provide services for our projects, just under different brands."

Given the size of the aid programme in Pakistan, and the lack of government and business interest in research, the strong donor preference for consultants over faculty has significant implications for the university sector. Not only do universities lose access to funding, faculty members lose the opportunity to gain valuable experience in applied research, and students lose the opportunity to build their research skills. Moreover, faculty members who have successfully transitioned over to consultancies tend to progressively reduce their affiliation with universities. From the perspective of the contributions to Pakistan's knowledge economy, research data and insights generated in the government-donor-consultant paradigm become trapped inside project-specific consultant reports; there is limited scope for faculty and researchers to cultivate an ecosystem of knowledge.

However, two drivers on the demand side may provide opportunities for universities to engage more actively with donors.

First, donors are looking for ways to 'do more with less' and in this respect universities offer competitive pricing relative to consultancies. Second, a number of donors, including The World Bank, ADB and UNDP, are now deeply committed to the evolution of their core missions towards becoming 'knowledge amplifiers' through knowledge transfers, communities of practice, research and analysis and policy formulation. These trends represent modest but important possibilities for a closer alignment of the research agenda of the HEC and the university system and the 'knowledge amplification' agendas of an increasing number of donor agencies.

UNIVERSITY-COMMISSIONED RESEARCH AND COMMUNITIES OF PRACTICE

One of the major thrusts of UNDP in Pakistan in the coming years will be to promote the Sustainable Development Goals (SDGs). The Planning Commission as well as provincial planning and development departments have already established SDG cells which will act as interlocutors with UNDP and other local and international agencies supporting the SDGs. UNDP's work in this area will include assisting the planning agencies in terms of research, measurement, capability development, networking and policy formulation. A small but highly qualified team at UNDP in Islamabad will play a pivotal role in this endeavour.

Because of the high cost implications of consultancy work, UNDP is interested in using universities and faculty members and students in this activity. UNDP has already engaged University of Peshawar on two small projects and is exploring expansion of this research brief.

But UNDP Assistant Country Director Mr Shakeel Ahmad notes that there are a number of ongoing challenges: "When we reach out to universities we appear like a money bank to them, and it's difficult to engage in a substantive dialogue. We recently suggested to them that, on mutually agreed subjects, we can facilitate research by PhD and MPhil students, provide them with data, collocate them in our offices, and expose them to the issues we are addressing.

This should be an exchange of ideas and services and must be seen as a win-win situation, not just a source of funds. We also feel that university faculty members need to produce research to a higher quality before it will be accepted by UNDP. Moreover, university researchers need to acquire a much surer grasp of applied research and policy formulation. While all these issues need to be addressed, we are very keen to work with universities and their faculties and students."

UNDP has also institutionalised the development of communities of practice as a core part of its knowledge creation and dissemination activities. Recently, UNDP collaborated with Dr Akmal Hussain, Dean of the School of Social Sciences and Humanities at ITU in Lahore, to establish a community of practice around promoting sustainable development in Pakistan. UNDP and Dr Hussain brought together ten faculty members and practitioners as the core of the community. UNDP provided logistical support and paid for specific research papers. Mr Shakeel Ahmad observes: "We were very happy with the results, obtained over a six month period. There was a genuine, cross-institutional and cross-disciplinary exchange of ideas, and some high quality research was generated on a cost-effective basis. UNDP looks forward to supporting more such communities of practice going forward."

UNIVERSITIES AND THE CPEC KNOWLEDGE NETWORK

The Asian Development Bank (ADB) is one of the major donors to Pakistan. ADB's principal focus at present is on provision of loans, grants and technical assistance for development of the energy, infrastructure, urban transport and agriculture sectors. ADB also has a secondary but expanding focus on the social sector, in which it provides support for the Benazir Income Support Programme.

Most of ADB's requirements for research and analysis in Pakistan are driven by its projects and programmes. Accordingly, much of this research and analysis comes in the form of project and programme feasibility, monitoring and analysis. But the foundational nature of its support for critical sectors such as energy and infrastructure also generates requirements for data and analysis that have a broader application. In addition, as part of its planned expansion of support for the social sector, ADB has produced reports on health and education in Khyber Pakhtunkhwa, Punjab and Sindh.

ADB's research in Pakistan is supported by ADB's Economic Research and Regional Cooperation Department, a substantial team of engineering experts (and a very small team of economic experts) in Pakistan, as well as locally hired consultants.

In terms of its broader research outputs, ADB produces the seminal and important Asian Development Outlook series, which analyses economic and development trends in Asian countries. In addition, ADBI, a Japanese government-funded unit within ADB, generates high quality regional and thematic research.

Ms Farzana Noshab, Senior Economist at ADB in Pakistan, comments on the institution's developing role in Pakistan: "In recent years, ADB has started to further reinforce its role as a 'knowledge amplifier' in the countries in which it works. This has several dimensions in respect of its work in Pakistan. One dimension is that even though our activity is project and programme driven, we do generate substantial data and insights that have broader relevance to development in Pakistan. Our challenge is how to craft solutions to disseminate this knowledge more effectively. The second dimension is that because of our regional focus we are a central node in the flow of highly relevant domain knowledge as well as cooperation networks. We are actively working on intensifying this network effect."

Mr Guntur Sugiyarto, Principal Economist at ADB in Pakistan, is leading a technical assistance project funded by the UK government that will support the development of Economic Corridor Development (ECD) networks or hubs, in which selected Pakistani universities and/or think tanks across provinces will work together to create and disseminate a dense network of research for evidence-based policymaking in relation to the Pakistan ECD including CPEC. He observes: "CPEC represents an enormous opportunity for Pakistan to develop its ECD and link the country with global production networks and value chains, and we plan to play a supporting role in helping Pakistan to realise this golden opportunity. We have engaged SDPI to help us connect and engage with interested universities and think tanks to start a collaborative dialogue on building a knowledge network in support of the Pakistan ECD. The network will extend to global institutions including those in China and other key partner countries of Pakistan. As part of this initiative, we will also promote the engagement of Pakistani researchers with other researchers and think tanks under the Central Asian Regional Economic Cooperation Programme and beyond to learn about best practices across the region."

Pathways to building demand

The greatest challenge universities face in developing a healthy research system is that demand for their research and related solutions—from government, business and donors—is at an embryonic stage. At the same time, with limited exceptions, universities and faculty have not yet built up the capacity to effectively serve government, business and donors, let alone generate demand. Even though universities offer a large intellectual resource base at very affordable prices, government, business and donors tend to procure research or consulting services from international or domestic consulting firms. Government bodies also tend to farm out research and related work to their affiliated research institutes and departments. If government, business and donors need to build the capacity to *demand* research solutions, universities and faculties need to build the capacity to *supply* research solutions.

Nevertheless, the first levels of engagement between government, business and donors as clients and universities and faculty as solutions providers has commenced. This first level of engagement has specific characteristics—the services that tend to be demanded are relatively basic from an intellectual and research perspective—and tend to be demanded by certain 'early adopter' segments of the government, donor and business sectors. Universities and faculty will need to relentlessly focus on effectively serving the early needs of the early adopter government, donor and business sectors, while at the same time building the capacity to master and cultivate the longer term, more sophisticated requirements of these sectors. Above all, universities and faculty will need to build the capacity to engage, and where possible engage commercially, with the government, donor and business sectors.

Based on our research, we see the following immediate, mid-term and early adopter characteristics of the demand opportunities facing universities and faculties:

Overview of demand opportunities and challenges			
Sector	Early adopters	Immediate opportunities	Mid-term opportunities
Government	→ Specialist departments with substantial data and analysis requirements (e.g. State Bank) → Recently established departments with clear mission objectives (e.g. CPEC-related agencies and SDG agencies)	→ Provision of basic research, data gathering and management solutions → Design of technical products that meet immediate government requirements → Look to local government for ideas for research and seek collaboration even if there is no funding involved	There is a growing need for policy design and implementation to become more evidence-based and analytical Universities and faculty must master evidence-based policymaking and start generating research within their departments to develop the necessary foundation for success
Business	→ Technology and telecommunication firms → Start-ups and Small and Medium Enterprises (SMEs) that are looking to gain an advantage by leveraging intellectual property (IP)	→ Provision of basic research, consulting and training solutions → Design of technical products that meet immediate requirements of start-ups and SMEs → Incubation of new ventures → Look to local business for ideas for research and seek collaboration even if there is no funding involved. The HEC could include this in funding criteria	Universities and faculty are at 'ground zero' as businesses realise that research and development (R&D) will become an increasingly important differentiator Universities and faculty must master business R&D opportunities and processes in advanced and emerging markets and become prepared to enable businesses to establish R&D centres, and to engage with R&D centres to drive research-based innovation Universities and faculty must master the rapidly emerging start-up ecology
Donors	→ Donors that have missions to become 'knowledge amplifiers' → Donors with SDG responsibilities → Donors with limited funding that are willing to leverage the cost advantages of universities	→ Provision of basic research, consulting and training solutions → Assisting donors in gathering data, monitoring and meet SDGs	Universities and faculty must master the donor trend towards becoming 'knowledge amplifiers' and be able to serve donors as effective nodes in knowledge networks Universities and faculty must master SDGs and learn how to serve and advance these goals

RESEARCH INCENTIVES AND MEASUREMENT

Overview

The HEC's most visible and central quantitative research incentive and measurement system involves the measurement of faculty publications in approved journals and treatment of such publications as the core criterion for faculty promotions.
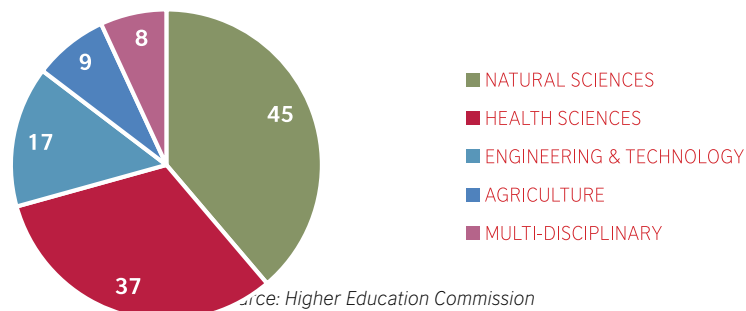
From 2011 to 2016, the HEC published university rankings based on teaching quality, quality assurance measures and research quality (itself based on publications in approved journals). However, in 2018, the HEC abandoned the university ranking system because of the substantial number of complaints lodged by universities.

To date, the measurement of faculty publications in approved journals is principally used by the HEC as a criterion for faculty promotion, although the measure also continues to be deployed for the non-ranked evaluation of university quality and less explicitly as an input in determining research funding for faculty members.

The HEC recognises four categories of academic journals: 'W', 'X', 'Y' and 'Z'. The HEC's 'W' category consists of 'Impact Factor' journals. Impact Factor is a measure of an indexed and tracked journal that reflects the yearly average number of citations to recent articles published in that journal. The list of Impact Factor journals, and the Impact Factor of each journal within the list, is maintained by Clarivate Analytics, a for-profit company. At present, there are over 12,000 journals published around the world with an Impact Factor ranking. The HEC's 'X', 'Y' and 'Z' categories are for Pakistani journals, in descending order of academic quality ranking.

As of June 30, 2018, the HEC recognised 372 Pakistani journals in the 'W', 'X', 'Y' and 'Z' categories (116 in the natural and applied sciences, and 256 in the social sciences, arts and humanities and business studies). Of these, 12 journals—all in Natural and Applied Sciences—have Impact Factor rankings (and therefore an HEC 'W' categorisation), while the others have an HEC 'X', 'Y' or 'Z' categorisation.

HEC-RECOGNISED NATURAL & APPLIED SCIENCES JOURNALS (6/30/2018; 116)

- NATURAL SCIENCES — 45
- HEALTH SCIENCES — 37
- ENGINEERING & TECHNOLOGY — 17
- AGRICULTURE — 9
- MULTI-DISCIPLINARY — 8

Source: Higher Education Commission

HEC-RECOGNISED SOCIAL SCIENCES & HUMANITIES JOURNALS (6/30/2018; 256)

■ SOCIAL SCIENCES
■ ARTS & HUMANITIES
■ BUSINESS
■ MULTI-DISCIPLINARY
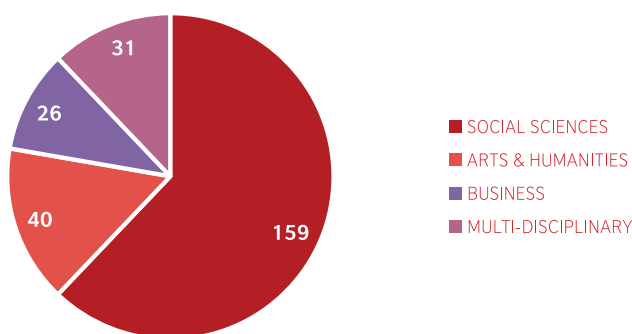
Source: Higher Education Commission

The HEC has two classifications that apply to faculty members employed at public universities: Basic Pay Scale (BPS); and Tenure Track Statutes (TTS). The BPS regime provides for lower pay grades and faculty recognition and benefit levels, while the TTS regime provides for higher pay grades and faculty recognition and benefit levels. The HEC's TTS guidelines for promotion are also followed by private sector universities. The HEC's guidelines for promotions to Lecturer and Assistant Professor do not have requirements as to publications in HEC-recognised journals.

In general, under the HEC's BPS guidelines:

→ promotion from Assistant Professor to Associate Professor requires 15 research publications (with at least four publications in the last five years) in HEC-recognised journals.

→ promotion from Associate Professor to Professor requires 15 research publications (with at least five publications in the last five years) in HEC-recognised journals.

For particular disciplines, there are alternate journal publication criteria, which include journals recognised by leading national professional associations.

By contrast, under the HEC's TTS guidelines:

→ promotion from Assistant Professor to Associate Professor requires 15 research publications (with at least four publications in the last five years) in HEC-recognised journals with an Impact Factor or HEC 'W' categorisation

→ promotion from Associate Professor to Professor requires 15 research publications (with at least five publications in the last five years) in HEC-recognised journals with an Impact Factor or HEC 'W' categorisation.

The HEC guidelines refer to "Internationally Abstracted Journals" (although this term is not clearly defined).

The HEC's focus on publication has resulted in a substantial rise in research publications by faculty from universities in Pakistan.

JOURNAL PUBLICATIONS BY FACULTY IN PAKISTANI UNIVERSITIES
(ESTIMATES USED FOR 2009 AND 2011 – 2014)
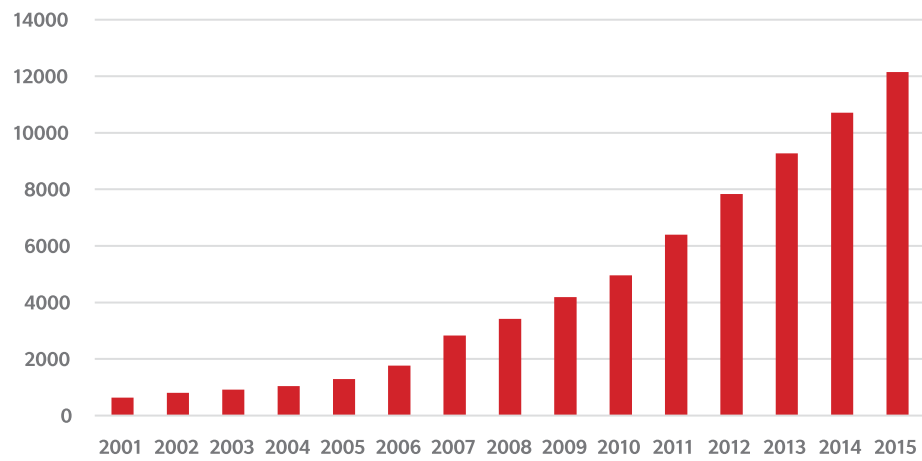
Source: Higher Education Commission

Community perspectives

The HEC's dual linkage, of promotion to publication and publication to recognised journals, has played a pivotal role in shaping research activity and focusing the academic mind in Pakistan. Dr Adil Najam contextualises the impact of this intervention:

"In a low-trust environment, there is a tendency to revert to 'mechanical' measures. For example, I view 'merit' in a brilliant scholar two years out of his PhD in being made a professor. In Pakistan, 'merit' is viewed the senior-most faculty member being made a professor. Similarly, the HEC's '10-and-15' Impact Factor publication rule had proved to be a widely accepted objective measure for promotion. In my first year as Vice Chancellor at LUMS, I heard more about publication and Impact Factors than I have had in 25 years in academia in the United States."

Yet, no aspect of HEC policy comes under greater criticism than its promotion and publication measurement system. While acknowledging that the system has worked in terms of focusing the academic community on research and driving up publication, the researchers we interviewed critiqued the system in terms of:

→ the overall incentives it has created

→ the inappropriateness of the '10-and-15' publication rule

→ the inadequacies of the W', 'X', 'Y' and 'Z' journal categorisation system.

There is a widespread view in the research community that the promotion and publication measurement system has narrowed the core motivation for research to career advancement. Most of our interviewees expressed the view that the system had created a mind-set that the ultimate goal for research was career advancement, as opposed to a means to address local or international challenges, advance the discipline or to achieve personal intellectual satisfaction. Dr Aasim Sajjad Akhtar, Assistant Professor at Quaid-i-Azam University in Islamabad (QAU), notes:

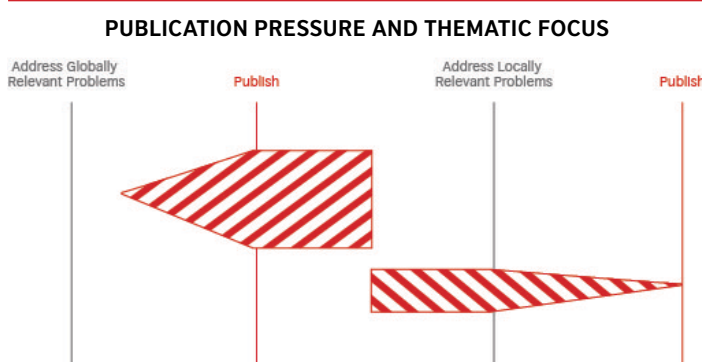"Over the past 15 years or so, the HEC provided incentives to promote research. But from the HEC's twin objectives of spreading the research system and improving research quality, the former took hold at the expense of the latter. The prevailing incentive system has prioritised career advancement and publication quantity over everything else."

Our interviewees also offered diverse critiques of the '10-and-15' publication rule.

Some noted that the uniform quantitative rule does not work because disciplines admit varied levels of publication. An economist corroborated this position, stating that in Pakistan the seminal Economics professor Ronald Coase would have stagnated as an Assistant Professor because he would not have met the HEC's criteria for publications by Associate Professors.

Faculties in the health sciences noted that in many cases applied local research was more important that original research, but that the publication rule discouraged them from pursuing this area of work. Interviewees from diverse disciplines noted that the Impact Factor publication rule drew researchers away from local research towards international research, which was easier to publish in international journals.

They observed that, as international journals are less interested in publishing papers on Pakistani issues, research funding tends to prioritise international issues rather than analysing local problems that are of great significance to the country's well-being. To illustrate his point, one economics faculty member asked why it made sense for a researcher to study the currency options considered by Greece during its financial crisis rather than Pakistan's own pressing currency and fiscal problems.

PUBLICATION PRESSURE AND THEMATIC FOCUS

Address Globally Relevant Problems — Publish

Address Locally Relevant Problems — Publish

The Impact Factor publication rule is constrained by using the number of citations as its principle benchmark. Participants in our study noted that as the HEC did not look at research quality beyond a basic Impact Factor ranking, the system harboured many examples of low quality research.

Dr Muddassar Farooq, Professor and Dean at AIR University in Islamabad (AIR) who has closely studied the publication system, observes:

"By setting a quantitative publication target and a simplistic journal citation ranking system as the leading criterion for tenure, the HEC has created an incentive system for low-quality research. Why would a researcher, looking at a target of ten publications to become Associate Professor, go for high-quality prestigious journals that might reject his or her work if it is not of high scholastic value? He or she would be better off going for lower-quality journals that accept any paper to ensure meeting his or her target."

Several interviewees also pointed out that, after a run of more than 15 years, the current system is being exploited by those faculty members who are disposed to cut corners. As Pakistan's emphasis on research publication has coincided with a similar growth trajectory in a number of other emerging markets, an international network of researchers has developed that compares notes on research gaming strategies.

CASE STUDY: **Improving the quality measurement system**

To provide an example of how quality could be measured more effectively, Dr Muddassar studied journal rankings around the world, developed a system based on Impact Factors plus four additional measures and applied it to Pakistani university publications. The results showed a substantial shift in university rankings.

In a very positive step forward, the HEC has now commissioned a project to develop a similar system that might be applied to all universities. At this stage, the system is being developed. The next question will be whether the HEC adopts the system in lieu of the Impact Factor system.

For additional information, see **Appendix 12:** *Improving the quality measurement system*.

NOTE: **Gaming the Impact Factor system**

Researchers double and even quintuple up as co-authors on research publications to distribute the research work load.
Researchers master the art of making relatively small changes to papers and then rewriting them to expand publication.
Researchers segment their research into discrete papers rather than publish their findings in a single paper.
Researchers cross-refer each other's papers (increasingly on a cross-national basis).
Researchers target weak journals, especially those that publish papers with the implicit expectation that researchers will cross-refer these journals to improve their rankings.
Researchers create journals in which to publish and then get these journals into rankings through contrived citations.

Pathways to quality-oriented incentives and measurements

Our major takeaway from our review of the HEC's dual linkage of promotion to publication and publication to recognised journals is that it has worked as an incentive system. Faculty are focused on research publication, and research publication has steadily risen in Pakistan. The system has also created negative incentives:

→ research is viewed through the lens of promotion and publication

→ the emphasis on individual publication has detracted from the focus on themes of national or even institutional significance

→ there is a preoccupation with quantity not quality of publication

→ a single quantitative target for all tenure-track appointments has disproportionate impact on different disciplines

→ the measure of Impact Factor publications has proved to be an inadequate assurance of publication quality.

The feedback from the research community indicates that improving the HEC's incentive and measurement system will require explorations and reform along three dimensions.

First, the HEC and universities need to step and look broadly at the purposes and priorities of research. Our interviewers have repeatedly brought up the importance of theme-based research. Given limited research budgets, the HEC needs to establish more clearly the purposes and priorities of research and build these into its incentive and measurement system.

Second, the publication criteria for promotion need to be modulated to address quality more squarely, and to refine the criteria for application to different disciplines. To incentivise research excellence outside of publication, an alternative set of criteria need to be developed so that faculty who generate high-impact and commercial research can be assured advancement irrespective of number of publications.

Third, publication measures need to widen beyond Impact Factor publications to include more complex measures that gauge research quality more effectively. In this respect, the HEC's commissioning of a new measurement system is very significant, and this system when developed and refined should be considered for adoption in place of the current Impact Factor measurement system.

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RESEARCH CULTURE AND ITS DISCONTENTS

Overview

There is a broadly held view in the research community that, while the HEC has played a vital role in expanding research in universities, it has done so by bureaucratic and administrative means, not by nurturing a peer network of researchers across the country. In our engagement with faculty, we were provided with many examples of the bureaucratic approach to research, including the linkage of publication to promotion, the quantitative measurement of publication outputs, the inadequacy of peer-based inputs into proposal evaluation, and the inadequate attention to developing an academic discourse across universities.

Several interviewees pointed out that this is not how research cultures were developed in advanced academic systems. They noted the importance of academic debate, of peer recognition, and of academic societies and research councils in determining the quality of research and faculty advancement. Dr Faisal Bari observes:

> "Our definition of research is too narrow. When I am researching something, I always question whether it is engaging me as an academic. I want to know if my peer group is interested in my research, as opposed to where it is published. I firmly believe tenure decisions should be based on peer groups—internal and external. Do they find my work to be engaging and meaningful?"

We believe that the most fundamental question facing the HEC today is whether, having used administrative measures to expand the *volume* of research outputs, it can use nuanced versions of these measures to enhance the *quality* of research across the country. The research community believes that a meaningful, impact-driven research culture cannot be nurtured simply by reforming the HEC's practices, it must facilitate peer-based discourse. Dr Adil Najam recommends:
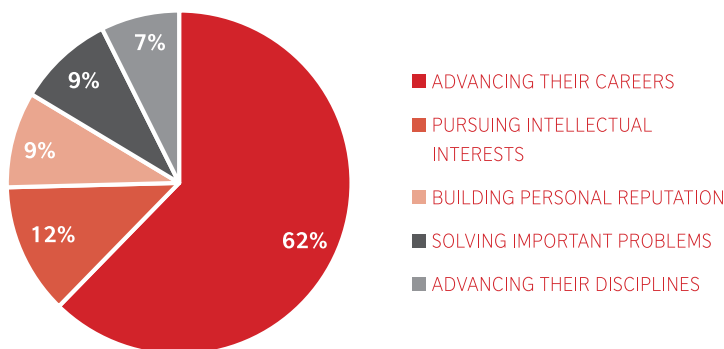
> "You have to create an ongoing system of peer evaluation. We need credible peer networks. Conferences, seminars, etc. All these things then have intrinsic meaning, rather than imposed meaning. You have to create a system of interaction that is driven by peers, not one required by the HEC."

Purposes and themes

While the HEC has taken a bureaucratic view towards research, faculty's attitude has also been mechanistic. There is a widely held view in the research community that faculty primarily engage in research to advance their careers and secure promotions. Dr Pervez Hoodbhoy observes:

> "If you visit any university department at tea time, you will almost never hear anything related to an academic topic. Faculty members discuss only their perks, departmental politics, promotions, and petty matters. Promotion has become a fetish. Prior to the government's new policies (roughly 2002), promotion depended primarily upon years of service. Now journal publications have become all important, even if they contain plagiarised materials or trash. The sole point is promotion; there's no academic culture."

SURVEY: MOST IMPORTANT REASON FACULTY ENGAGE IN RESEARCH (122)

- ADVANCING THEIR CAREERS — 62%
- PURSUING INTELLECTUAL INTERESTS — 12%
- BUILDING PERSONAL REPUTATION — 9%
- SOLVING IMPORTANT PROBLEMS — 9%
- ADVANCING THEIR DISCIPLINES — 7%

Source: Knowledge Platform Survey

The research community also generally subscribes to the view that researchers neither aspire to nor have the capability to conduct research to solve global problems or contribute to the global advancement of their disciplines. Dr Pervez Hoodbhoy notes:

> "Research in the theoretical sciences is tough in Pakistan because one is arrayed against the best and brightest minds internationally. Still, back in the 1950s and 1960s, there was an 'Abdus Salam effect' that lasted through the mid-1970s when

Pakistani researchers had a role model before them. Today, we are at a huge disadvantage in Maths and Physics because we have steadily lost the ability to do good mathematics. Mathematics lies at the core of every science. If I was to count mathematicians who have recognition outside of Pakistan, I can only think of two or three names. If you were to ask about India, there are many hundreds. The same can be said about theoretical physics. Maths and Theoretical Physics are nearly extinct in Pakistan in spite of hundreds of PhDs in these areas."

Similar comments were echoed by faculty members engaged in Chemistry and Earth Sciences, Economics and Engineering.

Our interviewees have strongly suggested that building a strong research culture is intrinsically linked to developing a thematic research approach that is focused on solving nationally significant problems.

Dr Mohammad Nizamuddin, Chairman of the Punjab Higher Education Commission, is one of many strong advocates for thematic research:

"Our biggest weakness is governance, and we have not conducted enough research in this area. We have not seriously researched why extremism is spreading. Since 1990, our population has doubled, but we have barely researched the population crisis. We are an agricultural country, yet we import 100 billion rupees in edible oil every year. Why are we doing this? We need to establish thematic research areas of national significance."

Yet, despite the general support among faculty members for thematic research in respect of issues of national significance, very little thematic research is being conducted on such issues.

The response of the university sector to CPEC provides a good example of the general paucity of research curiosity of the university sector on matters of national significance. Mr Salim Reza observes:

"The first MOU for CPEC, signed in 2013, should have galvanised universities into providing thought leadership

on this critical opportunity. But this has still not happened in any substantial way. Some institutes have been established, some conferences have been held, some papers have been published. And, even though Chinese government departments have produced substantial position papers and Chinese universities have promoted collaboration on CPEC, on the Pakistani side a rich, granular discourse on CPEC between government, academia, business, the social sector and the public has failed to materialise. And Pakistani universities in particular have been laggards in engagement on CPEC."

CPEC: Pakistan Institutes, Research and Publications

Although CPEC was announced in 2013, the level of research and publications on CPEC from Pakistani institutes, centres and universities has been remarkably low. The field is dominated by just one institute, the Centre of Excellence CPEC (CPEC Centre). The CPEC Centre, established in 2017, is funded and driven by the Ministry of Planning, Development and Reform and, although PIDE is a partner, it appears that the initiative is entirely driven by the Ministry. To date, the CPEC Centre has published more than two thirds of the working papers, publications and case studies on CPEC produced by Pakistani institutions and centres.

In late 2017, the HEC announced the CPEC Consortium of Business Schools, which consists of 98 Pakistani business schools. To date, the level of working papers, publications and case studies on CPEC produced by Pakistan's business schools, and more generally by Pakistani universities, has been negligible. CPEC represents a case where, despite government demand and funding, universities have so far failed to respond intellectually.

CPEC Institutes, Centres and Consortia
Government-University Partnership
Centre of Excellence CPEC (Ministry of Planning, Development and Reform / PIDE)
University Institutes / Centres
China Pakistan Management Initiative (LUMS)
China Study Centre (University of Peshawar)
Private Institutes / Centres
Pakistan-China Institute
CPEC Consortium of Business Schools (Pakistani Universities)
Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMS), Quetta
COMSATS Institute of Informational Technology, Islamabad
Institute of Business Administration (IBA), Karachi
Institute of Management Sciences (IMS), Peshawar
Lahore University of Management Sciences (LUMS), Lahore
National University of Sciences and Technology (NUST), Islamabad
Pakistan Institute of Development Economics (PIDE), Islamabad
University of the Punjab, Lahore

PAKISTAN PUBLICATIONS, REPORTS & CASES ON CPEC (TOTAL NUMBER: 46)

- GOVERNMENT SPONSORED
- PRIVATE INSTITUTES / CENTRES
- PAK UNIVERSITY FACULTY
- OTHER
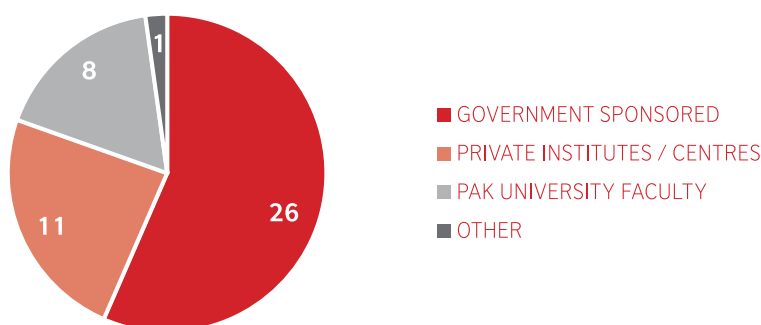
Source: Web Searches

Similarly, even though the war in Afghanistan and successive waves of domestic terrorism have claimed more than 50,000 lives in Pakistan and cost its economy more than GBP 80 billion in lost revenue, there has been surprisingly little research attention given by universities to terrorism, its root causes and pathways to peace. While a number of universities and consultancies have established peace and conflict studies programs, research output remains negligible and is principally led by consulting firms.

CASE STUDY: **Terrorism studies in Pakistan**

Mr Muhammed Feyyaz, Assistant Professor at the School of Governance and Society at the University of Management and Technology (UMT) in Lahore, is a rare individual who has specialised in counterterrorism studies. An ex-military officer, he has published and held workshops on terrorism in Pakistan with domestic and international participants.

For additional details, see **Appendix 13**: *Terrorism studies in Pakistan.*

While a number of universities and consultancies have established peace and conflict studies programmes, research output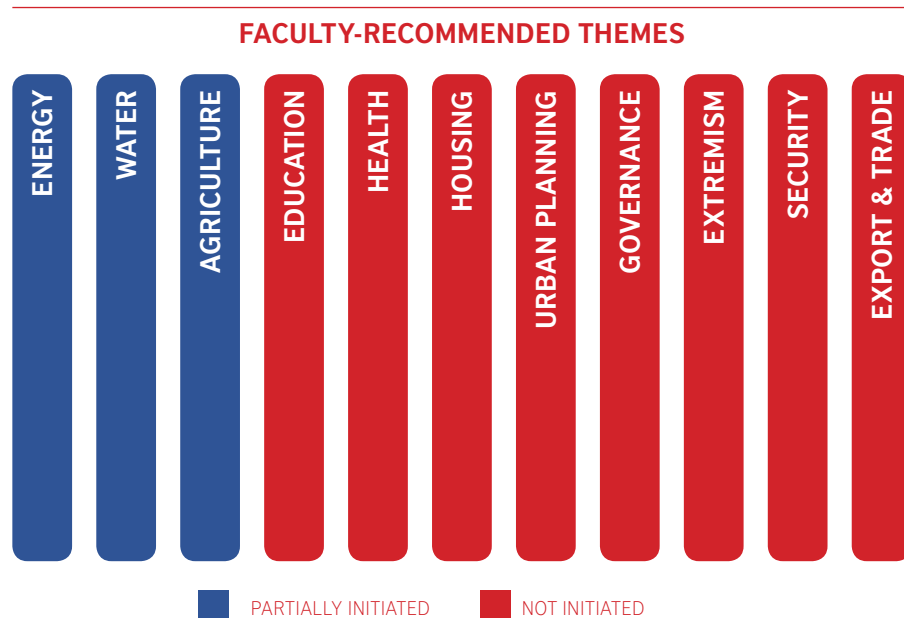 remains negligible and principally led by consulting firms. While applauding the underwriting of thematic research through the Technology Development Fund and the nationl centres for technology innovation, faculty were quick to point out that these were 'horizontal' (cross-industry) themes that cut across specific problem areas. Our interviewees emphasised that specific 'vertical' thematic areas need urgent attention. In this respect, a number of faculty members recognised the USAID-funded Centres for Advanced Studies (on agriculture, energy and water) as good 'vertical' thematic areas, even if these were threatened by funding shortages.

The following chart represents a faculty-recommended list of 'vertical' thematic areas.

FACULTY-RECOMMENDED THEMES

| ENERGY | WATER | AGRICULTURE | EDUCATION | HEALTH | HOUSING | URBAN PLANNING | GOVERNANCE | EXTREMISM | SECURITY | EXPORT & TRADE |

■ PARTIALLY INITIATED   ■ NOT INITIATED

Our interviewees suggested several reasons for the lack of thematic research on national and localised challenges:

→ with the exception of the new technology-related funds and US-sponsored centres, research funding is not thematically directed, and there is little financial signalling for research themes

→ individual faculty members compete against each other for grants, which militates against the development of a research culture in which faculty contribute to a thematically coherent and organically expansive body of knowledge

→ given the pressure to publish in Impact Factor journals, faculty members veer away from addressing local problems and move towards topics that will readily lead to publication

→ Pakistan's deep state has become a major obstacle in supporting research on certain matters of national significance.

NOTE: **Pakistan's deep state and its research system**

Ever since the CIA-supported ruse to vaccinate children in Abbottabad yielded information leading to the killing of Osama bin Laden in 2011, Pakistan's extensive security system has developed considerable antagonism both towards non-governmental organisations (NGOs) and social outreach and research programmes.

Our interviewees, on request of anonymity, made the following observations:

Because of security concerns, Pakistan's security apparatus does not encourage research on, and provides minimal data or insights on, matters such as the military, India-Pakistan relationships, terrorism, FATA, Balochistan and 'disappeared persons'. However, selected researchers and think tanks are supported in their research on such subjects.

Substantial social outreach and research programmes require security clearance, but this requirement and its application is not specified in writing, a number of opaque federal and provincial agencies are involved, there is no clear process to follow and the approval process can take a considerable period of time.

Because of general reputational concerns, government agencies are reluctant to support publications on women's studies, human rights and 'socially difficult' subjects such as sexual diseases, homosexuality and drug addiction.

As one faculty member put it: "How can we solve national problems if we are restricted access to data and prevented from dissemination our findings?"

Research collaboration

The research community uniformly ranks faculty collaboration *within* Pakistani universities and *across* Pakistani universities as very low. In our survey:

→ 54% of respondents rated the quality of research collaboration within their own universities as between 'very weak' and 'moderate'

→ 70% of respondents rated the quality of research collaboration across Pakistani universities as between 'very weak' and 'moderate'.

SURVEY: EVALUATION OF RESEARCH COLLABORATION
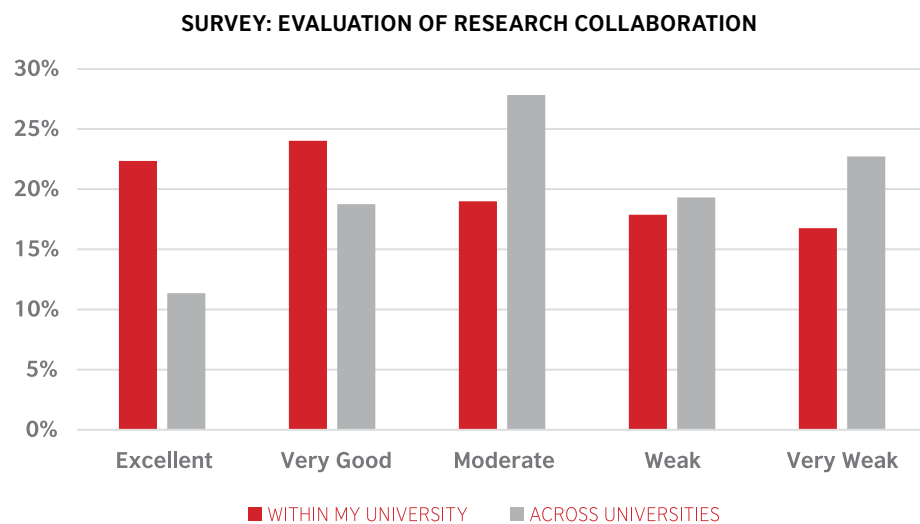
Source: Knowledge Platform Survey

There is similarly a very low level of research collaboration between faculty at universities and professionals and researchers outside universities. The research community consistently observed that there were minimal levels of research collaboration between faculty members and government researchers, private sector researchers, consultants and professionals.

In developed economies, academic and professional associations often play an important role in collaborating with universities and act as a forum for faculty members to develop applied research projects. In Pakistan, academic and professional associations are generally poorly funded and are mainly focused on networking, accreditation and events, with research being a relatively minor area of focus. Indeed, the level of publications by academic and professional associations is decreasing. Dr Adil Najam observes: "Associations such as the Pakistan Engineering Council and Pakistan Bar Council are too political and are intensively focused on elections. The prevailing model in America is a selective franchise, where fellows control appointments within associations and maintain a research and standards orientation. Elevation to leadership of an association should be an academic or professional honour, not a popularity contest."

Selected Pakistani Academic and Professional Associations					
Association / Institute	Academic journals	Research and publication	Accreditation	Standards	Events
Association of Management Development Institutions in Pakistan	3	-	-	-	Regular
Chemical Society of Pakistan	1	-	-	-	Regular until 2016
Council of Social Sciences Pakistan	-	Limited	-	-	Occasional
Institute of Architects of Pakistan	-	-	-	-	Regular
Institute of Bankers Pakistan	-	-	Yes		Occasional
Institute of Chartered Accountants of Pakistan	-	Regular	Yes	Yes	Regular
Institute of Corporate Secretaries of Pakistan	-	Regular	Yes	-	Occasional
Management Association of Pakistan	-	Limited	-	-	Regular
National Academy of Young Scientists	-	-	-	-	Limited
National Centre for Physics	-	Limited	-	-	Occasional
National Council for Homeopathy	-	-	-	-	Limited
Pakistan Bar Council	-	-	Yes	Yes	Regular
Pakistan Council for Architects and Town Planners	-	-	Yes	-	Limited
Pakistan Engineering Council	-	-	Yes	Yes	Regular
Pakistan Institute of Public Finance Accountants	-	-	Yes	-	Limited
Pakistan Mathematical Society	-	-	-	-	Regular Until 2014
Pakistan Medical and Dental Council	-	-	Yes	Yes	Limited
Pakistan Nuclear Society	-	Limited	-	-	Limted
Pakistan Physical Society	-	-	-	-	Occasional
Pakistan Society of Development Economists	-	Limited	-	-	Regular
Pakistan Software Houses Association	-	Limited	-	-	Occasional
Pakistan Veterinary Medical Council	-	Limited	-	-	Limited
Pharmacy Council of Pakistan	-	-	-	-	Limited

Our interviewees observed that research collaboration is not actively encouraged by university leadership or substantially supported by ORICs. Instead, the limited level of research collaboration that does take place happens because of personal contacts. Dr Faisal Bari explains the obstacles faced by calls for collaboration in this environment:

"There is limited institutional collaboration. It is totally individual. No university promotes collaboration. At one time, the HEC

put a lot of pressure on LUMS to start a PhD programme. I proposed a joint PhD programme between LUMS, London School of Economics, Government College University Lahore and one more Pakistani university. LUMS was eager but the other universities said no. They complained that there will be a quality differential, admissions will be complicated, and LUMS will continuously 'bug' the others. It never happened."

In explaining the low level of intra-departmental, intra-university, inter-university and inter-disciplinary research collaboration, our interviewees most pointedly noted the individual-oriented research grant system in Pakistan. Our interviewees also observed that because there was little thematic research addressing actual problems in Pakistan, there was little reason to collaborate with others and to systematically build knowledge around collective challenges.

Interestingly, one area of research collaboration with which our interviewees were generally satisfied is collaboration between Pakistani universities and foreign universities. The HEC encourages such collaboration by making overseas participation in conferences a requirement for funding support. Second, donors often require overseas faculty collaboration with a national university in the lead. Third, faculty members believe that international collaborations could help them improve their skills, gain overseas exposure and possibly lead to publication in prestigious journals.

Dr Ahmad Waqas, Associate Professor of Computer Sciences at Sukkur IBA University (IBA Sukkur), notes:

"We are doing a project in Pakistan with MIT to develop prototypes for wafer chip fabrications. This is the only such project in Pakistan. Our faculty and students are learning a lot, our research costs are being covered, and we are associated with MIT."
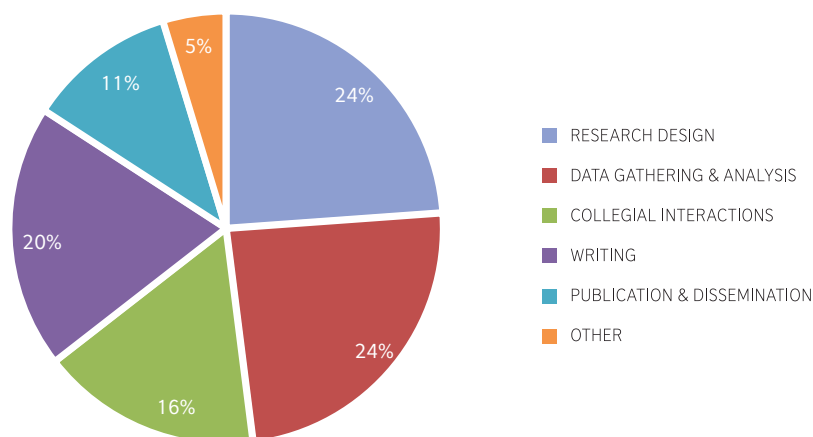
Research practice

When we turn to the practice of research, we find that the community is very clear on the fundamentally collegial character of research. Dr Sohail Naqvi emphasises:

> "Research doesn't occur in isolation. A person, in general, and there are exceptions, cannot just say I'm going to do research. There has to be an ecosystem for research to occur. And research is done when your peer group says it's done."

The research community strongly supports the view that research in Pakistan is practiced as an isolated, atomised activity, with very little critical exchange and peer group socialisation, discussion and debate. Dr Adil Najam notes:

> "There is an emphasis in Pakistan on individual excellence. This doesn't add up to collective excellence. In mature research systems, it is the opposite. Peer groups drive excellence and, indeed, the collective maturity of the system enables even mediocrity to generate acceptable outcomes."

SURVEY: DISTRIBUTION OF RESEARCH-RELATED TIME

- RESEARCH DESIGN
- DATA GATHERING & ANALYSIS
- COLLEGIAL INTERACTIONS
- WRITING
- PUBLICATION & DISSEMINATION
- OTHER

Source: Knowledge Platform Survey

While there are exceptions (mostly at a departmental, not at an institutional level), faculty and PhD and MPhil students within departments do not usually convene regularly through seminars or informal get-togethers to discuss emergent and ongoing research. Some of our interviewees offered the perspective that, even when faculty convene for seminars or discussion groups, there is little genuine

critical discussion that takes place. Dr Rubeena Zakar, Professor of Public Health and Sociology at University of the Punjab, Lahore, observes:

> "Discussion at seminars is not driven from a research point of view. Discussion mostly involves faculty voicing their opinions. … And the main purpose of seminars is awareness, as opposed to critical discussion of ongoing research activities."

The writing, circulation and discussion of working papers is similarly not a generalised practice. When completed, these papers are generally not shared and, if they are, they are not published or discussed. Nor is the HEC as an administrative entity adequately prepared to deal with working papers. A faculty member at AIR recounted how, after making public a working paper, he found it supremely difficult to have his final paper pass the HEC's plagiarism check process as the staff did not know how to deal with the matches that came up between his final and working

SURVEY: WORKING PAPERS WRITTEN IN THE PAST THREE YEARS
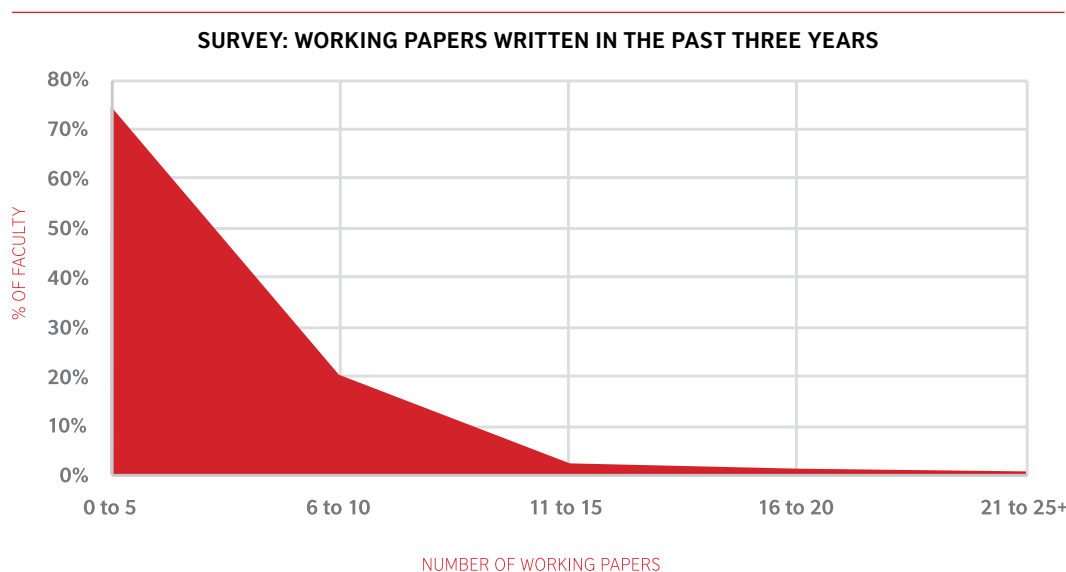
papers.

Source: Knowledge Platform Survey

While seminars and working papers have lagged, the practice of conferences have flourished. Universities convene a good number of conferences, and faculty regularly attend both domestic and international conferences. However, most of our interviewees found considerable shortcomings in domestic conferences as forums to strengthen research quality and peer group collaboration. The

observations on domestic conferences we were offered include:

→ the principal speakers tend to speak and leave

→ there is little genuine debate and discussion

→ the subjects are treated in narrow silos, with few cross-disciplinary treatments

→ post-conference follow-up is almost non-existent.

CASE STUDY: **Healthy collegial practices at NUST Social Sciences**

The School of Social Sciences and Humanities at National University of Science and Technology (NUST) in Islamabad has developed a healthy set of collegial practices.

The faculty of about 40 members have in circulation 30+ working papers at any given time.

Wednesday afternoons are reserved for faculty and senior student seminars.

New or revised working papers are circulated prior to the seminars.

Faculty members and students are encouraged to present research topics and discuss working papers, but are discouraged from simply presenting their papers.

The seminars are open to all interested persons from within and outside the university, but most attendance is from the department itself.

A working paper is considered a draft submission until it is circulated and discussed at a seminar.

After this, the paper is formally considered a working paper. The department publishes the working paper on its website, and tries to circulate hard copies around Islamabad. Working papers are also sent to conferences.

Faculty and senior students find the feedback from the seminar to be helpful to their academic growth and to improving the quality of their research and papers.

Pathways to enhanced collaboration and practice

The research community recognises that nurturing a culture of critical, evidence-based, problem-solving and collaborative research is not a trivial task as this goes against deeply embedded social norms.

Dr Faisal Bari situates the lack of critical thinking and debate in universities in a wider national problem:

> "We need to think about how to create public debate and public space. Do universities take a lead in this? Do think tanks? What can government do to help? Why isn't there active debate on immediate questions? You need to create a space for good debate. This doesn't exist anywhere in Pakistan. More than anything else, this is hampering us. The level of debate is late night talk shows. If you watch one show even once, you will never want to watch late night talk shows again. That is the extent of debate in our society. There is no structure to it, and no relevant issues are discussed."

Dr Arshad Ali notes:

> "Research quality does not occur in isolation. Quality is part of the whole ecosystem: the peer review environment. But, until and unless you are ethically strong, you cannot justify peer review. Faculty are affected by the overall environment of the country. More peer review could also mean more politics and less critical thinking."

Our engagement with the research community revealed five principles around which culture of critical, evidence-based, problem-solving and collaborative research may emerge.

→ *Empower faculty as decision-makers*: a quality and purpose-driven research culture must be substantially driven by faculty.

→ *Select your themes*: an enhanced research culture is most likely to emerge around thematic areas of national significance.

→ *Build practices around stars*: an enhanced research culture is most likely to emerge around stars who can shape themes, inspire colleagues and engage clients and the public.

→ *Select your institutions*: an enhanced research culture has started developing in selected universities and departments and these leaders should be nurtured.

→ *Intensify international collaboration*: researchers have had positive experiences through international collaborations and these collaborations should be intensified.

A number of our interviewees emphasised that the exchange of ideas and sharing of knowledge is founded on shared themes and concerns. They noted that, even in the West, while research is in part driven by a commitment to addressing globally important problems, to critique-driven quality, and to research independence, it is also significantly driven by thematic focus both at a faculty and funding level. Dr Sohail Naqvi builds on this idea:

"Take, for example, tax reform in Pakistan. All financial managers will place this in their top priority items. So the norm in the world is that, to create discourse around this subject, you would … create three centres across the country and get the best people. In order to do that, I would set aside 20 million rupees and … everyone should compete to provide the best proposal. Then you need a mechanism to assess that. Then you would establish these centres, monitor them and support them. The entire UK and US ecosystems function like this."

Our interviewees also came out very strongly in support of a 'star' system. They noted that the star system drives meaningful, top-quality research around the world, and emphasised that the Pakistani higher education system must provide funding, staffing and support to exceptional people who can nurture a culture of research excellence and impact.

Our interviewees are aware of the obstacles in moving towards a 'star' system and identified three obstacles in particular:

→ too much control by university administration and department heads

→ the HEC mode of funding individual research proposals and of distributing funding across many projects

→ the evaluative and political difficulties in promoting 'stars'.

Some of the faculty members we interviewed were in favour of promoting 'stars'

through centres of excellence; others felt this is a bureaucratic approach that has in the past yielded sinecures but not excellence. Some believe that research funding should explicitly flow to 'stars', others are of the view that funding can continue to flow to individual faculty projects but with weightage towards projects that link into a thematic cluster led by 'stars'.

While the operational pathways are not clear, the message is simple: the Pakistan higher education system must build around exceptional people who can nurture a culture of research excellence and impact.

NOTE: **Starry-eyed about stars**

Dr Sohail Naqvi
Research requires a champion, and it requires, for lack of a better word, a customer.

Dr Aasim Sajjad Akhtar
If one really wants to deal with a culture of mediocrity, then there has to be academic freedom and competence has to be awarded. Both these things are sorely lacking. Competent people are seen as a threat, side-lined, not promoted, coaxed out, outcast. We must elevate competent, committed people.

Dr Akmal Hussain
If you have a really world class teacher, or researcher, she or he would want to be part of an environment that is amenable to research. Research is not something that you do sitting alone. You need to have a community of people around you in that university with whom you can interact on a systematic basis. For that you need a minimum number of high quality professors. You need to give them funding, staffing and support.

Dr Shaukat Hameed Khan
Universities should be built around people, not buildings or laboratories.

Dr Qasim Jan
You should have labs allocated to exceptional faculty and build around these people. The culture for pooled resources is everywhere but in Pakistan no one shares.

Dr Pervez Hoodbhoy
You should build the university system around exceptional people, including those who might come from overseas. Most people who are in their fields in the West will not want to come back, but even if 10% do, that's a start!
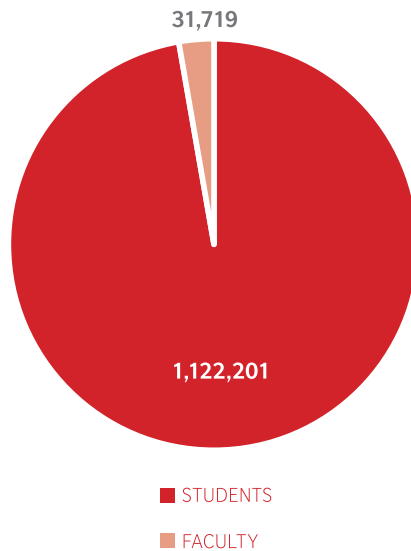
# FACULTY AND INSTITUTIONAL CAPABILITIES

Overview

Most Pakistani universities have a high student-to-faculty ratio: the national average is 30:1, although private sector universities (that serve 19% of the university student population) have much better teacher-to-faculty ratio than public universities. Although different experts have different ideal benchmarks for teacher-to-faculty ratios, in general a teacher-to-faculty ratio of 17:1 or 15:1 is considered a minimally acceptable quality standard.[4]

PUBLIC UNIVERSITIES STUDENT TO FACULTY RATIO (35:1)	PRIVATE UNIVERSITIES STUDENT TO FACULTY RATIO (19:1)

PUBLIC UNIVERSITIES: 31,719 FACULTY; 1,122,201 STUDENTS

PRIVATE UNIVERSITIES: 13,639 FACULTY; 260,612 STUDENTS
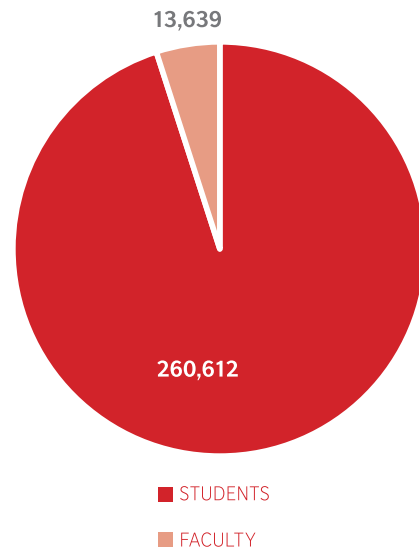
■ STUDENTS
■ FACULTY

Source: Higher Education Commission

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4   The Times Higher Education World University Rankings 2019, which ranks more than 1,250 universities worldwide, indicates that the 98 United Kingdom universities in the ranking have an average student to academic staff ratio of 16.2:1. U.S. News and World Report also maintains rankings of U.S. colleges and universities. Among them are the 222 national liberal arts colleges, which are known for smaller enrolments, more personalised education and individual attention. These schools averaged 11 students to every faculty member in 2016. Many of them have much lower student-to-faculty ratios. Top-ranked Williams College had a ratio of 7 students to each faculty member and most classes had enrolments of 20 students or fewer. Marlboro College in Vermont had a ratio of only 5 students to each faculty member.

ALL UNIVERSITIES STUDENT-TO-FACULTY RATIO (30:1)
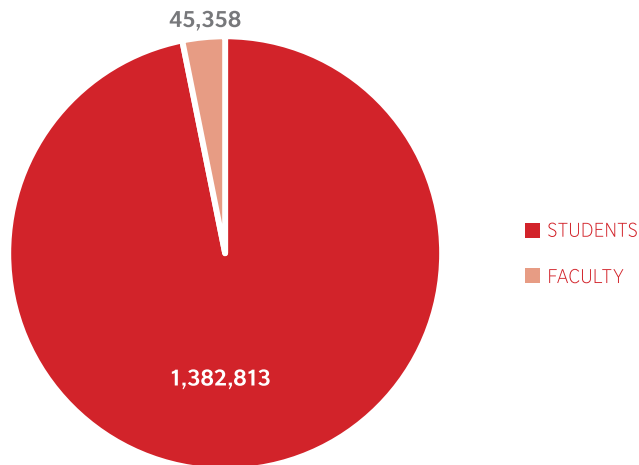
Source: Higher Education Commission

Because of the high student-to-faculty ratio, faculty members at all levels have heavy teaching loads. While some credit is provided for research activities, departmental pressures lead to most faculty members bearing an egregious teaching load.

SURVEY: TEACHING HOURS PER MONTH
(INCLUDING PREP, EVALUATION, ETC.; BASED ON 10-MONTH YEARS)
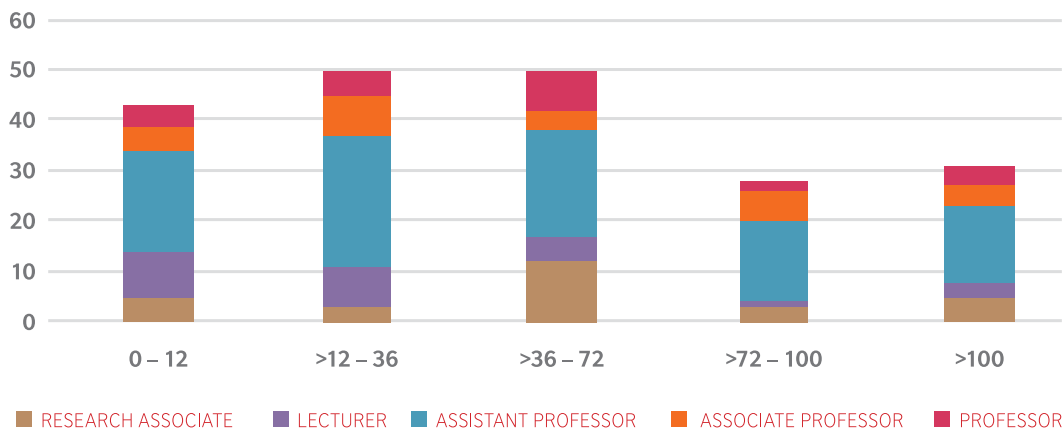
Source: Knowledge Platform Survey

Given the high teaching workloads, it is not surprising that teaching and student supervision constitutes the most significant component of professional workload across all faculty levels.

PROFESSIONAL TIME DISTRIBUTION

- TEACHING AND SUPERVISION
- REASEARCH AND WRITING
- CONSULTING
- PROFESSIONAL DEVELOPMENT AND SEMINAR
- FUNDRAISING, PROPOSAL WRITING AND ADMINISTRATION
- OTHER
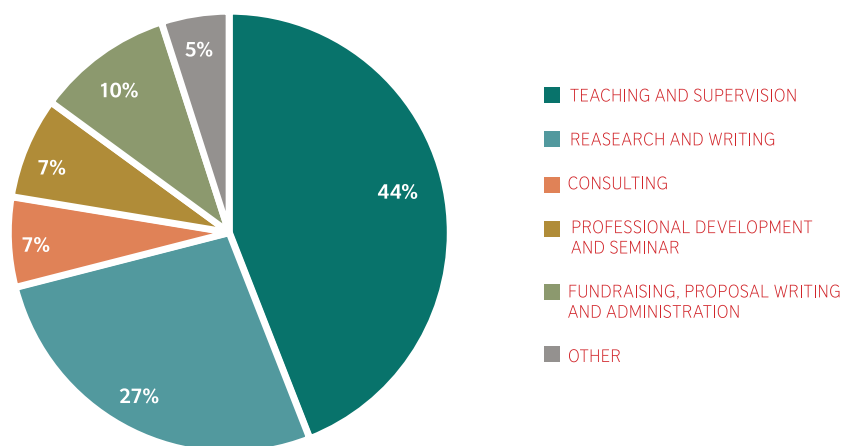
Source: Knowledge Platform Survey

And, while senior faculty levels allocate progressively greater amounts of their professional workload towards research, the ratio of teaching and research professional workload only tilts gradually towards research at senior faculty levels. It should be noted, however, that the first years are formative in terms of developing a research orientation as well as dedicating time and effort to research.

SURVEY: RATIO OF TEACHING AND RESEARCH TIME

- TEACHING AND SUPERVISION
- RESEARCH AND WRITING
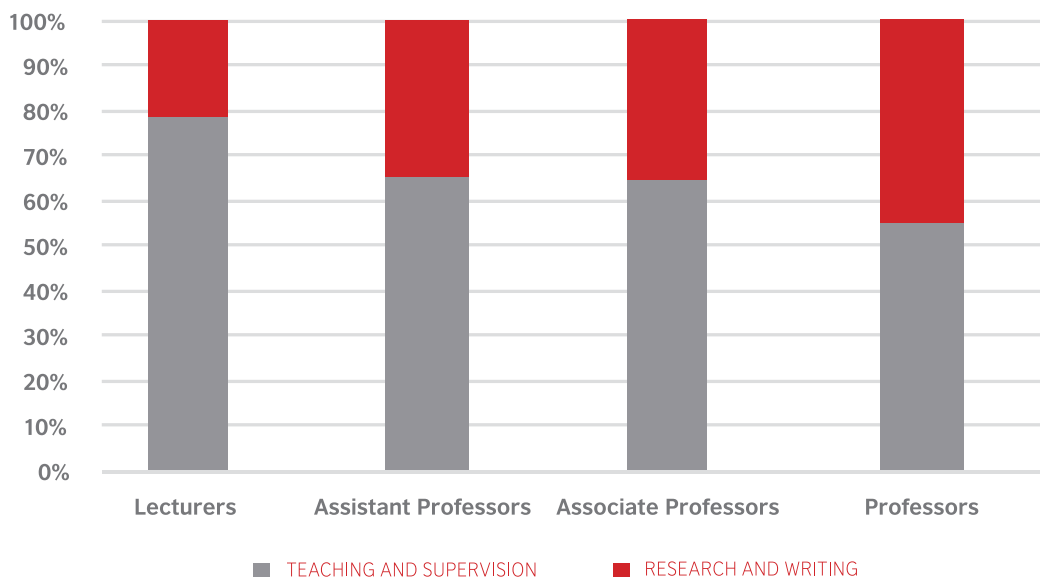
Source: Knowledge Platform Survey

Dr Iqrar Ahmad Khan, Distinguished National Professor and previously Vice Chancellor for UAF, explains this dynamic:

> "As at other public universities, the teaching load at UAF is very high. Most faculty members teach at least three undergraduate courses each semester, and many teach between five and eight courses. Senior faculty members also supervise seven or eight MPhil or PhD theses. Both teaching and research quality gets compromised. Moreover, because undergraduate teaching does not emphasise research and writing, teaching and research do not reinforce each other."

Dr Akmal Hussain acknowledges that while faculty-to-student ratios are better at private universities, he maintains a critical stance on their capacity for research:

> "Most private sector universities are for-profit entities, not private foundations. Typically, a teacher teaches three to four courses a semester. The universities hire a small number of teachers and recruits a huge number of students. Where do faculty members find the time for research?"
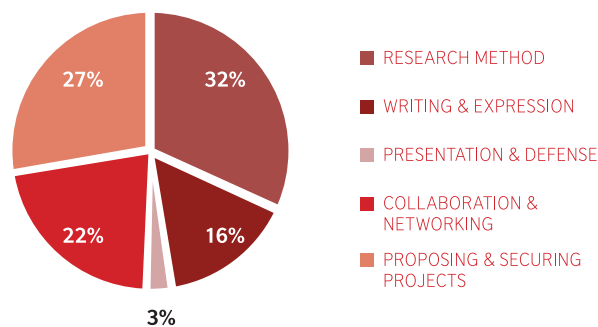
He argues for the need for an institutional solution to this challenge:

> "A university has to be place where research is done. Of course you teach as well, but the principle activity is research, and the teaching should be based on the research. For that to happen, you need an institutional structure within the university in terms of the workload which you provide to the professors."

Faculty capabilities

The research community is generally of the view that, if Pakistan is to migrate to a higher quality research culture, research skills need to be substantially improved. When asked to identify the research skills that most need to be developed, our survey respondents evenly chose all skills other than 'skills in presenting and defending research'.

SURVEY: MOST IMPORTANT RESEARCH SKILLS THAT NEED TO BE DEVELOPED

- ■ RESEARCH METHOD
- ■ WRITING & EXPRESSION
- ■ PRESENTATION & DEFENSE
- ■ COLLABORATION & NETWORKING
- ■ PROPOSING & SECURING PROJECTS

Source: Knowledge Platform Survey

NOTE: **Challenges in the development of research skills**

While there is effective mentoring and collaboration in small pockets, in general, this area is a major cause for concern.

Research methods are rapidly evolving and typically departments are not up to speed with the latest methods.

Literature review is not taken seriously, although this is what stimulates innovative and ground-breaking research.

While digital research facilities have been made available, in some cases availability is granted through the physical library of the university. This restriction makes it difficult for researchers to access content.

In less privileged universities, libraries and facilities often shut down in the afternoon after teaching sessions are completed.

There is a major deficiency in capacity and funding for laboratory technicians, and this seriously affects faculty research capability.

For many faculty members, English language speaking and writing skills need to be significantly improved.

For many faculty members, communication, debating and discussion skills need to be significantly developed.

For many faculty members, skills in the use of online resources and participation in online communities of practice need to be significantly improved.

Our interviews and focus groups revealed challenges in the development of research skills ranging from information access, to technical support, to language problems and, above all, lack of mentoring and collaboration.

Our survey indicated that the research community is unambivalent about the most important sources that have helped them improve research skills: 70% of our respondents cited mentoring and collaboration as opposed to 6% of our respondents who credited traditional or online courses.

SURVEY: MOST IMPORTANT SOURCES FOR DEVELOPING RESEARCH SKILLS

- MENTORS & COLLABORATORS
- SEMINARS & CONFERENCES
- PUBLICATIONS & GUIDEBOOKS
- COURSES
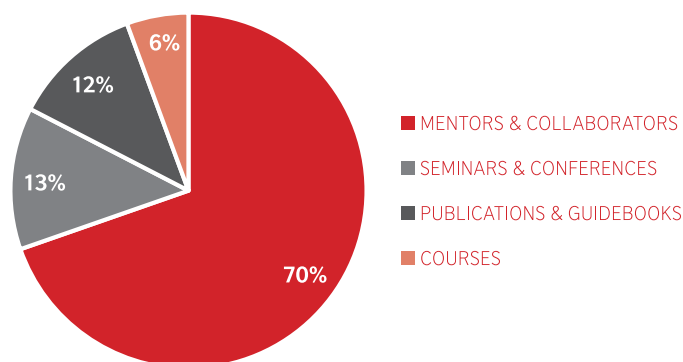
Source: Knowledge Platform Survey

This hierarchy of sources generally holds true when we look at the same issue in terms of Pakistani and international sources. For example, 37% of our respondents attributed their success to international mentors and collaborators, while 33% of our respondents cited Pakistani mentors and collaborators.

The only major discrepancy was in the case of Pakistani and international publications and guidebooks. 10% of our respondents selected international publications and guidebooks as the most important sources that have helped them to improve research skills, while only 2% selected Pakistani publications and guidebooks.

SURVEY: MOST IMPORTANT SOURCES FOR DEVELOPING RESEARCH SKILLS

- MENTORS AND COLLABORATORS IN PAKISTAN
- MENTORS AND COLLABORATORS OUTSIDE PAKISTAN
- COURSES (ONLINE OR FACE-TO-FACE) IN PAKISTAN
- COURSES (ONLINE OR FACE-TO-FACE) OUTSIDE PAKISTAN
- PUBLICATIONS AND GUIDEBOOKS IN PAKISTAN
- PUBLICATIONS AND GUIDEBOOKS OUTSIDE PAKISTAN
- SEMINARS AND CONFERENCES IN PAKISTAN
- SEMINARS AND CONFERENCES OUTSIDE PAKISTAN
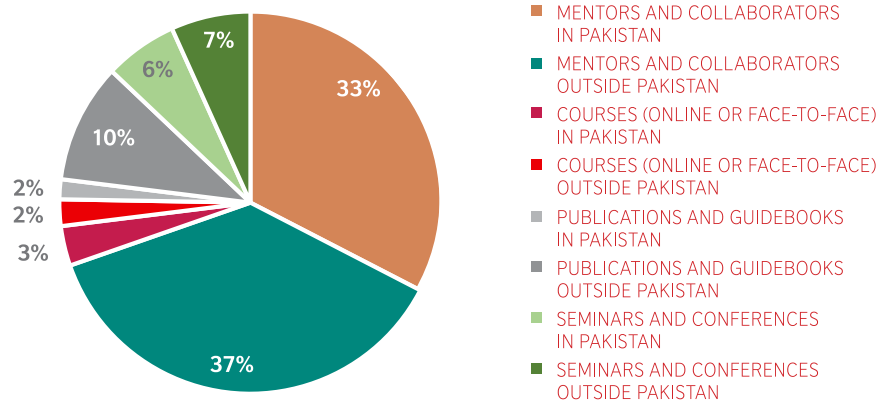
Source: Knowledge Platform Survey

While the research community unequivocally identifies mentoring as the most important source for development of research skills, our interviews and focus groups revealed that the practice is largely observed in the breach. One major factor is, simply, the chronic shortage of senior and experienced faculty members. Both in public or private universities, the ratio of senior faculty (professors and associate professors) to junior faculty (assistant professors and lecturers) hovers around 5.6:1 and the ratio of professors to all other faculty is around 7.2:1.

PUBLIC UNIVERSITY FACULTY DISTRIBUTION

- PROFESSOR
- ASSOCIATE PROFESSOR
- ASSISTANT PROFESSOR
- LECTURER
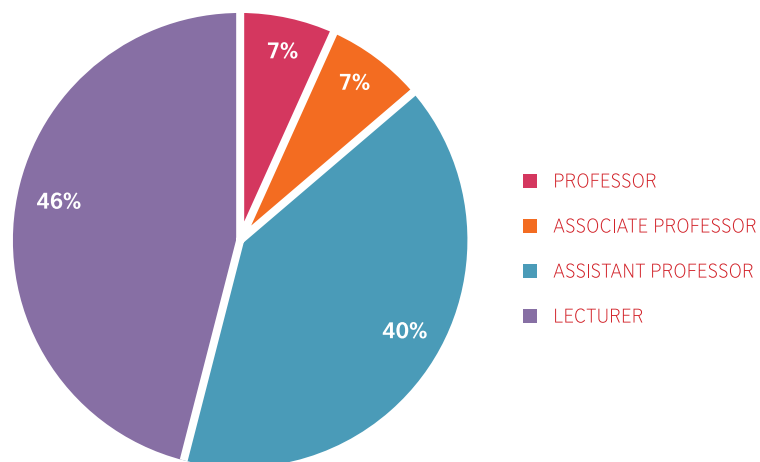
Source: Higher Education Commission

PRIVATE UNIVERSITY FACULTY DISTRIBUTION

- PROFESSOR
- ASSOCIATE PROFESSOR
- ASSISTANT PROFESSOR
- LECTURER
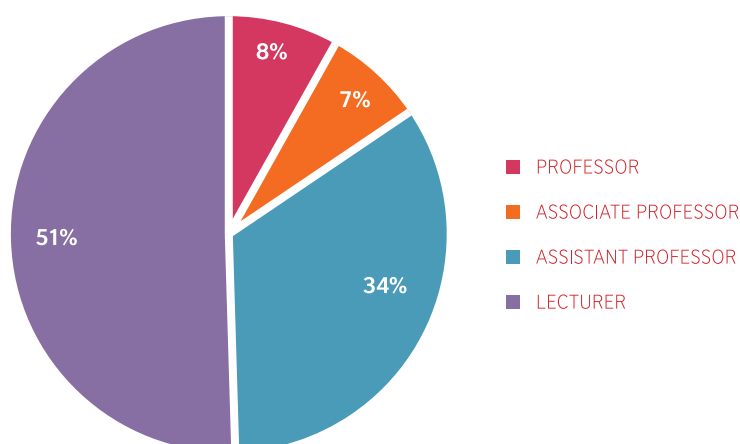
Source: Higher Education Commission

Our interviewees noted that this structural paucity of senior faculty members is exacerbated by academic practices and individual capabilities that strain against a culture of mentoring and nurturing. Dr Adil Najam notes that experience is a major obstacle in development of such a culture:

"In the United States and United Kingdom, the faculty have gone through a process of apprenticeship with senior faculty members. So they have a yardstick and the experience of having gone through the process. There is an internal push to mentor and apprentice. There is, at root in Pakistan, an experience problem. Here, faculty members have not been through that process!"

NOTE: **Challenges in the development of mentoring practices**

Because research funding is generally not thematic, research topics within a department are widely arrayed and often cover areas where senior faculty members may not have expertise.

Senior faculty members are expected to, and often prefer to, devote considerable attention to administrative matters, and, given their teaching loads, have little time left to mentor junior faculty.

In some cases, senior faculty members abuse their administrative power to strengthen their own position by developing a transactional rather than nurturing relationship with junior faculty, and requiring junior faculty to include them as co-authors or assigning research students to their own projects.

In most cases, senior faculty do not have sufficiently developed mentoring skills and have not themselves been through a process of deep apprenticeship.

We have observed that departments in which mentoring has led to a strong research culture, such as the School of Social Studies and Humanities at ITU, Department of Earth Sciences at University of Peshawar, and the US-Pakistan Centre for Advanced Studies for Water at Mehran University of Engineering and Technology at Jamshoro, have tended to have the following characteristics:

→ experienced and academically-driven leadership

→ relatively low ratios of senior faculty to junior facultys thematic integrity in research

→ a culture of collaboration through working papers and seminars.

Gender impact

Our research also covered, at a basic level, perceptions among male and female faculty members on the impact of gender on professional advancement within universities. When we asked in our survey in general terms whether being female had a negative impact on professional careers within the university, the difference between male and female faculty members' perceptions was less than we had expected. (However, it should be noted that 8% of female respondents and only 3% of male respondents felt that being female had a "very negative" impact on professional careers within the university.)

SURVEY: PERCEPTIONS OF PROFESSIONAL GROWTH FOR FEMALES IN ACADEMIA
(1 = VERY POSITIVELY; 10 = VERY NEGATIVELY)

% OF RESPONDENTS

■ MALE FACULTY RESPONSES　　■ FEMALE FACULTY RESPONSES
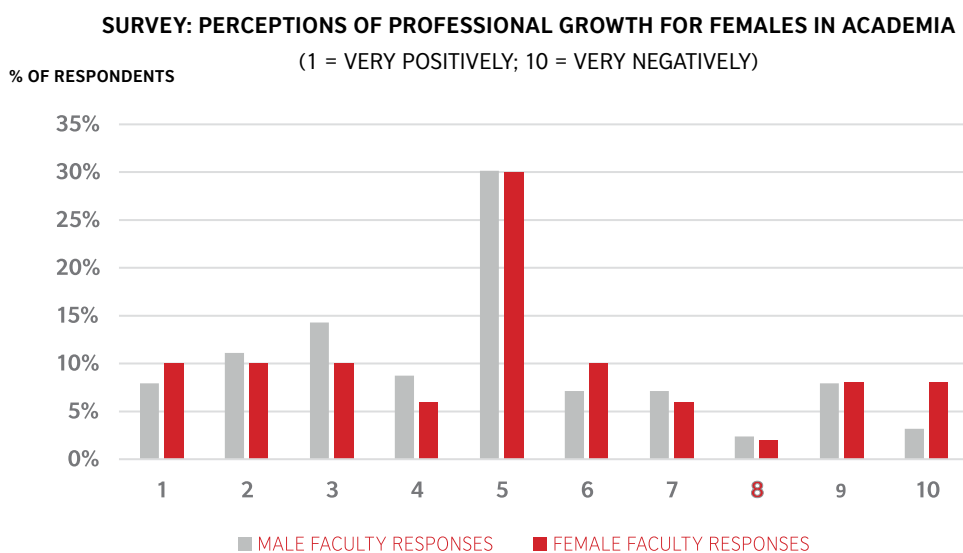
Source: Knowledge Platform Survey

However, when we surveyed faculty members on specific aspects of academic careers, the differences in perceptions were much more pronounced. There was no aspect of academic careers where female faculty members felt that the system was 'in favour of women', while small minorities of male faculty members felt that the system was 'in favour of women'.

And, while the majority of male and female faculty members felt that the system provided 'equal opportunities' or was 'slightly in favour of men', there was a pronounced difference in the percentages of male and female responses on the proposition that the system was clearly 'in favour of men'. In three areas of academic careers, the discrepancy between male and female attitudes on whether the system was clearly 'in favour of men' was most pronounced:

→　promotions and positions within institutions

→　pay and benefits within institutions

→　securing research projects.

Interestingly, there was slightly less of a discrepancy between male and female faculty members in respect of international travel and collaboration. While a considerably greater number of women felt that the system was in this respect 'in favour of men', overall the differences between the genders was less pronounced.

Source: Knowledge Platform Survey

Survey: Male and female faculty perceptions on equality of opportunities										
Bias	In favour of men		Slightly in favour of men		Equal opportunities		Slightly in favour of men		In favour of women	
Gender of faculty respondent	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Promotions and positions within institutions	9%	22%	17%	16%	59%	62%	13%	0%	2%	0%
Pay and benefits within institutions	5%	22%	12%	10%	74%	68%	7%	0%	2%	0%
Securing research projects	6%	20%	21%	14%	62%	64%	10%	2%	2%	0%
Collegiality and relationships with peers	6%	18%	21%	26%	52%	56%	21%	0%	1%	0%
Presentation and dissemination of research	5%	12%	17%	10%	71%	78%	0%	0%	8%	0%
International travel and collaboration	11%	20%	25%	18%	52%	62%	8%	0%	3%	0%

In our discussions with faculty members, we were struck by the very low level of consciousness and debate on the role of gender in career advancement. This is perhaps attributable to the extent to which women's studies has been driven out of university discourse. While, in the 1960s and 1970s, there was a robust level of discourse in universities on gender issues: in one of the many intellectually crushing dimensions of the Zia-ul-Haq era in Pakistan (1978 – 1988), female professors and women's studies programmes were systematically expunged from universities.

Research and action on women's issues, therefore, became divorced from academia and while women's studies began to recover after the Zia interregnum, research still remains largely outside the university sphere. Khawar Mumtaz, one of Pakistan's leading women's rights activists and Chairperson of the National Commission on the Status of Women, observes:

"A lot of research on women's rights continues to happen outside universities. The lawyers, social workers and writers who are advancing women's rights collaborate very little with professors in universities."

Institutional capabilities

In general, strong departments at universities in Pakistan tend to be led by experienced individuals. Even when departments achieve some measure of excellence, they are not able to sustain such excellence when there is a turnover in leadership. Similarly, good quality research by an individual or group of individuals is often not adequately disseminated or commercialised because the institutional capability to carry forward research is limited.

INSTITUTIONAL WEAKNESSES

CASE STUDY: **The rise and fall of the Applied Economics Research Centre**

From 1973 to 1988, the Applied Economics Research Centre (AERC) had become a leading think tank on economic policy and research at the University of Karachi. During this period, AERC was able to develop cluster of competent economists, many of whom continue to function as leaders of the economics profession in Pakistan. Then things fell apart.

For additional detail, see **Appendix 14:** *The rise and fall of the Applied Economics Research Centre.*

CASE STUDY: **Challenges in disseminating wind energy research at UMT**

Researchers at UMT have identified significant wind corridors that could play an important role in addressing Pakistan's crippling energy crisis. But the dissemination of this research has been very limited.

For additional detail, see A**ppendix 15**: *Challenges in disseminating wind energy research at UMT.*

The HEC has strongly supported the constitution of ORICs to address this institutional weakness, and the research community has been very appreciative of the HEC's initiative to constitute and support ORICS. At this stage, about one-third of the universities have operational and certified ORICs.

While we have not formally correlated the constitution and development of ORICs by universities with the level of research quality at such universities, there does appear to be a positive relationship between the two.

Given the HEC's strong support and the universities' growing institutionalisation of ORICs, it is likely that the latter will play a strong role in the advancement of Pakistan's research system. It should be noted, however, that even the most advanced ORICs have been best at playing a functional role (for example, measuring research outputs). All the ORICS have considerable ground to cover in terms of building university capacity for research dissemination and

UNIVERSITIES WITH AND WITHOUT ORICS

Source: Higher Education Commission
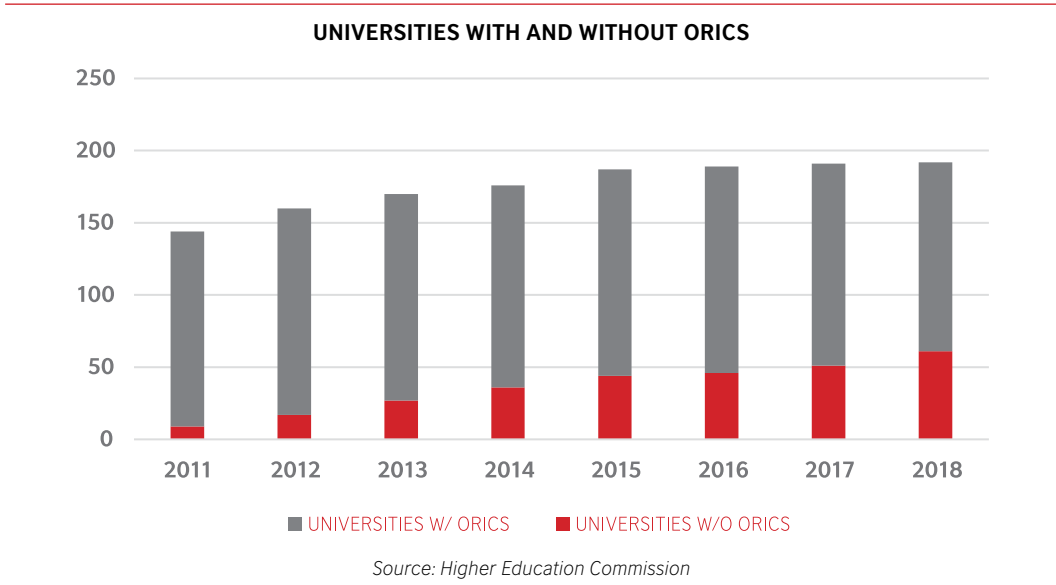
commercialisation. And, in certain areas that require departmental leadership (for example, building a culture of mentorship and collaboration), ORICs can play a facilitative role, but will remain essentially dependent on a broader level of faculty engagement.

ORICs: A performance checklist	
Functions being performed reasonably well by ORICs	Securing patents and other intellectual property rights
	Negotiating contracts and collaborations
	Organising conferences and events
	Measuring and reporting on research outputs
	Assisting in applying for and securing research grants
	Managing intra-university research grants and competitions
Functions that ORICs need to perform better	Disseminating research within the government, donor and private sectors
	Developing pathways to commercialisation of research
	Building relationships with domestic and international universities
	Building relationships with media and publication houses
	Developing and managing professional development opportunities
Functions that ORICs may not be best suited to drive	Disseminating best practices in domain-specific research methods
	Driving a culture of mentoring and collaboration within departments
	Driving a culture of innovation and impact driven within departments
	Building strategic relationships with government, donor and private sector agencies and firms
	Keeping updated on new research opportunities and practices

While the ORICs have very substantial ground to cover, their personnel and financial resources are limited. The HEC provides a subsidy for the ORIC, but its institutional support funding is limited. Moreover, the HEC's institutional support funding is distributed between support for ORICs and QECs, which are responsible for enhancing and monitoring quality in universities. As a result, both departments are under-resourced and trapped in small silos of information and focus.

# Pathways to building faculty and institutional capabilities

While all faculty members have research publication targets for career advancement, the academic community recognises that research skills need development in almost all aspects. Understandably, and indeed admirably, the community recognises that development of such skills hinges on mentoring and collaboration. Herein lies a major challenge. In the West, the culture of mentoring and collaboration was developed over centuries and most senior faculty members have been groomed into this culture over many years. In Pakistan's young and rapidly expanded university system, only a very small group of senior faculty members have been steeped in a culture of mentoring and collaboration.

Similarly, the establishment of ORICS has played an important role in strengthening research capability in universities. However, at this stage, the ORICs are essentially performing functional roles (such as research proposals and measurement) reasonably well and are struggling with performance of outreach roles (such as research dissemination and commercialisation).

Under these conditions, it is unlikely that Pakistan can take the same path to research excellence that has been followed by mature university systems. Our engagement with the research community revealed insights as to how faculty and institutional capabilities may be amplified.

→ *Faculty-driven research councils* that are focused on the direction and quality of research will play an essential role in setting benchmarks, selecting leaders and driving the agenda for development of faculty and institutional capabilities.

→ *Thematic research focus* will enable extremely limited mentoring and collaboration resources to be used to optimal effect to develop research skills across faculty with common research agendas.

→ It is unrealistic to expect rapid skilling of 45,000 faculty members, especially given the limited experience of senior faculty in mentoring and collaboration: *clusters must be created around star mentors and researchers in limited departments and institutions* to create paradigms of research excellence.

→ *Information Technology must be leveraged* so that leadership in research, mentoring and collaboration may be amplified across the research community.

→ The ORICS can play a critical role in driving research excellence but they must be strengthened institutionally. One very promising approach would be to *merge ORICs and QECs so that limited resources may be optimally deployed.*

→ As part of the strengthening of the social sciences, women's studies should be funded and supported.

→ Initiatives to strengthen women's academic careers and increased visibility at leadership level need to be adopted to address systemic and cultural gender inequality.
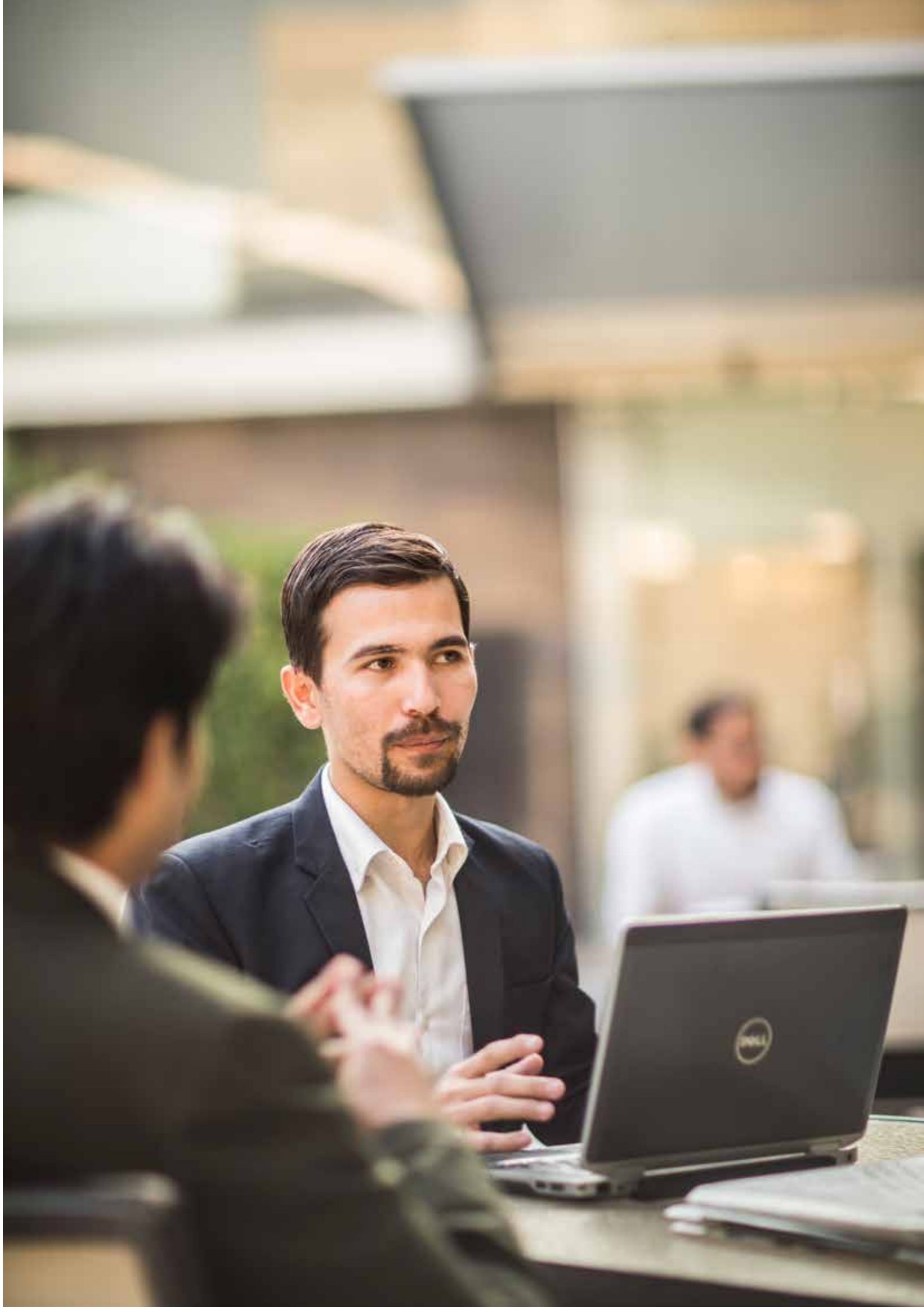
COMPARATIVE
RESEARCH SYSTEMS

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In both well-developed economies (such as the United States and the United Kingdom) and successful emerging economies (such as China), research and innovation has played and continues to play a critical role in development. In these countries, government, the private sector and universities have collaborated to advance research and innovation to address both globally and locally significant challenges and to provide inputs into policy formulation.

In most advanced countries, governments treat research and innovation as a critical national asset that is guided by national policy on research and innovation. Governments in these countries have underwritten most research into basic sciences and social sciences, defence, space, education and health. In the United Kingdom, UK Research and Innovation (UKRI) is a government-funded body which works in partnership with universities, research organisations, businesses, charities and government agencies to create the best possible environment for research and innovation to flourish. Operating across the whole of the United Kingdom with a combined annual budget of more than GBP six billion, UKRI works principally through faculty-led research councils. In the United States, government research and innovation agencies such as National Aeronautics and Space Administration (NASA), National Science Foundation (NSF), National Institutes of Health (NIH) and Defence Advanced Research Projects Agency (DARPA), have been responsible for the development of the internet, computing, artificial intelligence, human genome, nanotechnology, neuroscience and many other advancements of global significance.

In addition, the private sector in the United States and United Kingdom (and to an increasing extent in China) has invested heavily in research and development for product development and typically builds on the foundation of basic research sponsored by government agencies. Most leading private sector companies in well-developed economies have well-funded research and development departments as well as extensive research collaborations with universities and government agencies. In many industries, the level of a company's research and development is an important measure of the potential for product development and market valuation. As an example, Rolls Royce, one of the world's premier manufacturer of aircraft engines, has established an extensive network of research and technology centres with universities.

Rolls Royce Research and University Technology Centres		
Country	Collaborator	Focus
Research Centres		
Germany	DLR	Combustion, noise and aerothermal methods
Germany	Fraunhofer Rwth Aachen	Rotatives repair
Saudi Arabia	KAUST	Founder member of the Industrial Collaboration Programme
United States	Georgia Institute of Technology	Multi-disciplinary design optimisation/systems analysis
United States	Iowa State University	NDE
United States	University of Illinois	High power computing and supersonic applications
University Technology Centres		
Germany	Brandenburg University of Technology Cottbus	Multidiscipllinary process integration
Germany	TU Darmstadt	Combustion and turbine aerothermal interactions
Germany	TU Dresden	Lightweight structures and materials
Germany	Karlsruhe Institute of Technology	Cooling and secondary FI
Italy	University of Genoa	Fuel cell systems
Korea	Pusan National University	Thermal management
Norway	Norwegian University of Science and Technology	Performance in a seaway
Singapore	A-Star	Advanced manufacturing and power systems
Singapore	Nanyang Technological University	Rolls-Royce@NTU – Corporate Lab
Sweden	Chalmers University of Technology	Hydrodynamics
United Kingdom	University of Bristol	Composites
United Kingdom	Cranfield University	Performance
United Kingdom	University of Manchester	Power conversion systems
United Kingdom	University of Manchester	Nuclear engineering
United Kingdom	University of Nottingham	Gas turbine transmission systems
United Kingdom	University of Nottingham	Manufacturing technology
United Kingdom	University of Sheffield	Advanced electrical machines, controls and systems engineering
United Kingdom	University of Strathclyde	Electrical power systems
United Kingdom	Swansea University	Materials
United Kingdom	University of Birmingham	Materials
United Kingdom	University of Cambridge	Materials
United Kingdom	University of Cambridge	University gas turbine partnership
United Kingdom	Imperial College	Vibration
United Kingdom	Imperial College	Nuclear engineering
United Kingdom	Loughborough University	Combustion system aerothermal processes
United Kingdom	University of Oxford	Heat transfer & aerodynamics
United Kingdom	University of Oxford	Solid mechanics
United Kingdom	University of Southampton	Computational engineering
United Kingdom	University of Southampton	Noise
United Kingdom	University of Surrey	Thermo-fluid systems
United States	Purdue University	High mach propulsion
United States	Virginia Tech	Advanced systems diagnostics
United States	University of Virginia	Advanced material systems

In these countries, universities and departments within universities play a critical role in advancing the research and innovation agenda. Universities and departments delineate thematic areas of excellence (both in respect of domains in which they are already leaders and domains which they aspire to lead) and interface intensively with government, the private sector and civil society to advance research and innovation in their chosen fields. In these countries, the

capacity of universities and departments to collaborate internally and with other universities, as well as with government, the private sector and civil society is a critical determinant for the research funding they receive.

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CASE STUDY: **UCL Grand Challenges at University College London**

University College London has established the UCL Grand Challenges as a thematic, cross-disciplinary research initiative that has considerably enhanced problem-solving research across disciplines and has enabled University College London to become a world leader in targeted research areas.

 For additional detail, please see **Appendix 16**: *The UCL Grand Challenges at University College London.*

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COMPARATIVE NOTE: **China, India and the United Kingdom**

For an overview of the university research systems in China, India and the United Kingdom, please see **Appendix 17**: *Research Systems in China, India and the United Kingdom.*

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The following chart provides a brief overview of the principles underlying university research and innovation in China, India and United Kingdom.

Principles Informing University Research and Innovation Policy in China, India and the United Kingdom	
Thematic Research	China, India and the United Kingdom have evolved sophisticated research agendas, which comprise both contributions to the global knowledge pool as well as purposive considerations of local issues. Important segments of the research agenda and research funding are directed towards well-defined thematic research on local challenges that have developmental (i.e. productive, technological, social or demographic) dimensions.

Adequate Funding (China and United Kingdom)	China and the United Kingdom devote substantial funds to research and innovation. China has brought about a gradual increase in its national research expenditure, with any eye to stabilising outlays at 2.5% of GDP. (India is an outlier, and national spending on research and development, at under 0.7% of GDP, has been more or less stagnant for 20 years.) The governments in these countries (including India) have also developed a sophisticated array of tools to encourage private sector investment in research and development, including through legislation, tax incentives and match-funding grants.
Block Funding, Institutional Autonomy and Specialisation	In all three countries, universities receive block funding research grants from the government, which they may allocate towards self-determined projects in areas of comparative advantage as well as in emergent disciplines and specialisations. For example, the majority of the United Kingdom's government funding for research is mediated by the Research Excellence Framework, which provides for long-term block funding grants to universities based on a multi-modal evaluation of research quality by peer-based research evaluation councils. Universities are encouraged to seek specialisations so that domain depth is increased across the country. Universities are also encouraged to collaborate with the private sector to engage in commercially and socially relevant research and obtain additional research funding.
Research Councils	In all 3 countries, using different approaches, the research system is led intellectually by academic councils that evaluate universities and department in terms of research quality, recommend government funding allocations, identify research themes and priorities and communicate the research programme to government, the private sector and civil society. In the United Kingdom, these councils are made up of leading academics who base their funding recommendations on competitive peer review. They establish themes as needed to focus research in specific disciplines. They report on the state of research in their disciplines to government as well as society and leaders of industry. In India, five autonomous councils are responsible for steering research and making funding allocations in medical, agricultural, social sciences, scientific and industrial and basic sciences research. Although there is close state control of the research agenda in China, it seems to have avoided the over-bureaucratisation of research by (1) direct control of the principal national research apparatus by the country's apex policy-making body and (2) the induction of academic-led associations in the research agenda-setting and funding allocation process.
Professional Associations	In addition to research councils, professional associations promote peer review practices and communities of practice in well-defined domains and sub-domains.

Special Commissions	From time to time, governments will also establish special commissions (on a temporary or permanent basis) to address specific questions pertinent to research and innovation. These commissions draw upon academics as well as practitioners to research and publish reports that may lead to legal and regulatory changes. For example, the United Kingdom has a Social Mobility Commission that monitors and promotes social mobility across the country.
Funding Review Periods	Consistent with block funding strategies, universities and researchers are reviewed not on an annual basis but over relatively long periods of time to allow research quality and institutional excellence to mature. The United Kingdom's Research Evaluation Council works on a seven-year cycle to review research quality and research capabilities across universities. In India and China, such evaluations are also undertaken over multi-year cycles.
Star System	As research stars and stellar departments emerge, they are selected and supported as leading exemplars of their disciplines and are provided additional funding. In the United Kingdom, universities submit leading departments for the seven-year evaluation cycle followed by the Research Excellence Framework. In China, leading academics and departments are identified and supported for intensified growth and funding.
Collaboration and Networking	While efforts at dissemination and engagement with international networks of research are encouraged, local collaboration and networking is also very actively promoted. Active seminar series, working paper series and conferences are encouraged across universities and other research organisations. The system works together to develop key themes ideas and messages that resonate domestically and internationally. Well-organised competitive procedures and peer-review whittle down bodies of scholarship to an exclusive cluster of champion researchers and innovators, whose output is then awarded the requisite institutional and monetary support to guarantee its advancement.
Research and Policy Formulation	All 3 countries have in place practices and processes, of varying degrees of formalisation, to ensure that government policymaking is informed by academic research. In China, the apex research organisations have direct reporting relationships into very high levels of government, thereby ensuring a close feedback loop between research and policy formulation. For example, the Chinese Academy of Social Sciences reports directly into the Peoples Republic of China State Council.

RECOMMENDATIONS

Summary

This report makes the following key recommendations to enhance the research system in Pakistan:

Recommendation 1: Implement institutional changes

Recommendation 1.1: Form research councils (consisting of a coordinating research council with discipline-based sub-councils) comprised of faculty members and practitioners to drive the research and quality agenda.

Recommendation 1.2: Create tiers of universities to reduce the research load on some universities and increase research funding for and expectations of other universities.

Recommendation 1.3: Merge Offices of Research, Innovation and Commercialisation and Quality Enhancement Cells to create a single cell within universities that is responsible for strengthening university research and quality and has upgraded capabilities in research collaboration, fund-raising, dissemination and commercialisation.

Recommendation 1.4: Reform faculty promotion and human resource practices to create a wider pool of senior faculty members and recognise and empower faculty 'stars'.

Recommendation 1.5: Launch a world-leading digital communication and collaboration platform to drive research quality and innovation, empower communities of practice and enable research dissemination and commercialisation.

Recommendation 1.6: Deepen research collaboration relationships with international universities to infuse global innovations and best practices into the Pakistan research system.

Recommendation 2: Reform research funding

Recommendation 2.1: Expand the research funding pie by inducting the government, donor and private sectors as research sponsors and clients.

Recommendation 2.2: Implement a Research Excellence Framework programme under which the research councils recommend and evaluate research funding programmes that could either constitute project-specific grants for individuals or block grants for departments.

Recommendation 2.3: Fund thematic research around Pakistan's pressing challenges such as economic development, education, healthcare, environment, water, energy, civil society, governance and security.

Recommendation 2.4: Fund social science research around Pakistan's pressing challenges as this high-impact area of research has been deprived of research funding.

Recommendation 2.5: Reform funding practices for laboratory equipment to eliminate waste by funding shared laboratories and training of neglected technical staff.

Recommendation 3: Reform the research measurement system

Recommendation 3.1: Reform the quality measurement system so that multiple measures are used to measure research publication quality and, in addition, due accord is given to leadership in research, solving meaningful problems, developing research capability, mentoring, collaboration, dissemination and commercialisation.

Recommendation 4: Nurture a purpose and quality driven research culture

Recommendation 4.1: Build academic discourse on tertiary education itself so that the HEC and universities use their own condition as the 'ground zero' for transparent, collaborative, evidence-based policy formulation, implementation and monitoring.

Recommendation 4.2: Promote a culture of research that embraces research practice, collaboration, dissemination and commercialisation as a major change management drive.

Recommendation 4.3: Promote mentoring and other practices to develop research capabilities by explicitly developing and supporting mentoring and collaboration practices and enabling their dissemination through technology.

Implementing Institutional Changes

Research councils. Pakistan's research system is missing a set of actors that have led the drive to quality in systems as diverse as China, India and the United Kingdom: peer-based councils of experts capable of inspiring, directing and evaluating research quality. Our leading recommending is that the HEC take all necessary measures, including promoting the passage of law, to constitute a series of research councils. We believe that the introduction of research councils will be essential to the realisation of the HEC's Vision 2025 goal to transform universities into the driving force of a knowledge economy.

We recommend that the HEC should form a coordinating research council, which in turn forms research councils in disciplines such as:

> → Engineering and physical sciences
>
> → Life sciences and biotechnology
>
> → Medicine and health
>
> → Technology and computer sciences
>
> → Energy, water and sustainable development
>
> → Social sciences and society
>
> → Public policy, law and justice
>
> → Arts and humanities.

The research councils will serve in an advisory and partnership capacity to supplement the HEC's research and quality agenda. The mandate for the research councils should include, among other matters:

> → Evaluate and make recommendations in respect to the direction of research and quality in the university system
>
> → Recommend areas of thematic research and priorities and funding levels to ensure that research is directed towards solving meaningful problems and transforming society and economy;
>
> → Design and lead the implementation of a Research Excellence Framework for allocating research funding and evaluating research quality in the university sector;
>
> → Conduct evaluations of university, department and faculty research quality and recommend research funding grants to universities, departments and faculty members
>
> → Promote events and practices that will drive research excellence,

including working papers, seminars, conferences, mentoring, collaboration, dissemination and commercialisation

→ Act as a 'network amplifier' by creating and sustaining linkages, including fundraising linkages, between universities, the government, donors, the private sector, civil society and international universities and research centres

→ Evaluate and make recommendations in respect to the quality measurement systems and faculty promotion and human resource practices

→ Evaluate and make recommendations in respect to the direction of research and quality in the university system

→ Evaluate and report on the progress of the research and quality agenda.

The research councils should be principally selected from leading academics in Pakistan, but could be reinforced by Pakistani academics in diverse international universities. Because a major goal of the HEC's Vision 2025 is for research to serve Pakistan's development, it will be important to include, to a limited extent within the councils, and more fully through advisory panels, professionals, entrepreneurs, social activists and government officials who will bring to the councils a rich diversity of experience.

Extreme care should be taken to ensure that the governance of the councils represents an exemplary breakthrough away from the tendency in Pakistan towards autocracy and politicisation. The councils should be immunised against arbitrary interference by governance measures that are now well-established, such as long tenure for council members that does not coincide with tenure of the HEC's senior management, self-selection provisions, staggered terms, codes of conduct, use of committees with well-defined mandates and implementation of review mechanisms.

In addition to these constitutional protections, it will be important to recruit members to the councils who have deep experience in sophisticated collaborative decision-making, both in academic settings such as universities as well as in professional contexts such as large international consulting, law and accounting firms.

Moreover, periodic review committees should be established which review and make recommendations with respect to the governance and performance of the research councils. In this way, continuous review and improvement will be built into the system.

To reinforce their autonomy, the research councils should have a well-protected

budget, ideally in the form of an endowed fund. The raising of this fund could itself be used as an opportunity to vest government, donor and private sector into Pakistan's research agenda. Funds could be raised from early-mover donors, who could be given recognition by inclusion in a "Friends of Thinking Pakistan" community, which could act as a networking and fund-raising body for the research council in particular and for the research agenda generally.

A well-researched and carefully designed research council system will act as the engine for the transformation of Pakistan's university system and enable the HEC to focus on expansion of the sector while its partnering research councils focus on driving research and quality.

Tiers of universities. The HEC has already in Vision 2025 conceptualised three tiers of universities. We strongly recommend this action as a condition to improving the research system in Pakistan. The next phase of evolution of the research system will require higher levels of research funding, building of star researchers and departments, and development of the 'soft culture' of discourse, collaboration and qualitative evaluation. It is unrealistic that this will be achieved if uniform expectations are placed on almost 200 institutions and 45,000 faculty members in a rapidly expanding system.

Key elements of a tiered approach to university research expectations will be to eliminate or reduce research requirements at the lower tiers, but to ensure that, to the extent requirements are reduced, research quality expectations are raised and qualitative measurements systems are put into effect. Concurrently, PhD and M.Phil degree programmes should be concentrated in the upper tiers, thereby reducing variation in the quality of future cohorts of faculty.

Moreover, it will be important to replace research requirements with higher teaching expectations. To assist faculty to become better teachers, they will need to be supported by the mentoring and collaboration practices, including online communities of practice, being proposed herein for research. In other words, it will be important that any trade-offs between research and teaching are designed and implemented in an integral manner so that innovations are diffused across all tiers of universities.

A particularly critical aspect of the design of tiers of university from a research perspective is that any elimination or reduction of research requirements is constituted as a 'floor', not as a 'ceiling', for any of the lower tiers of the system. It will be important to nurture talent wherever it may arise, and nurture the aspirations of all faculty members, departments and indeed universities. Accordingly, faculty members and departments at all tiers should be eligible, even if not required, to participate in research programmes and apply for research

funding. If this flexibility and mobility is achieved, it will not only have the salutary effect of drawing talent from all quarters, it will also have a positive demonstrative effect on the lower tiers of the system.

ORICs and QECs. At present, both ORICs and QECs are underfunded and understaffed. And, even though research is an essential component of university quality, the two cells within universities tend to operate in silos. There is a mirrored problem of under-funding, under-staffing and isolation at the HEC supervisory level.

We recommend that the ORIC and QEC functions are merged at both the university level and HEC supervisory level. This will enable more optimal usage of limited financial and human resources and will also draw more senior faculty to lead these functions. A single department will also facilitate the flow of information and insights between the research and quality functions.

At the HEC supervisory level, we recommend that, while the combined research and quality departments should retain administrative control over engagement with universities, their substantive direction should be reinforced by inputs from the research councils.

In addition, we recommend that the capabilities of combined research and quality departments in terms of fund-raising, collaboration, dissemination and commercialisation are reinforced through funding and capability development support. And, to reduce costs and amplify the impact of this support, the combined research and quality departments should be explicitly constituted as communication nodes in an online collaboration platform.

Faculty promotion and recognition practices. There is an acute shortage of professors and associate professors in universities in Pakistan and this creates deep challenges in research leadership, quality, mentoring and collaboration. While the HEC's programme to provide overseas scholarships to increase the level of qualified senior is laudable, this will only lead to increases in the number of senior faculty well beyond the time horizon of Vision 2025.

Moreover, there are no real incentives in the current system in terms of recognising or empowering faculty 'stars' who are capable of creating and driving clusters of research excellence. Even if universities are tiered, research excellence should be expected to be driven by a limited number of individuals. The HEC should develop policies, processes and incentives to recognise and empower these 'stars'.

We recommend a series of human resource changes to address this acute weakness in the system on a fast-track basis.

Recommended actions for expanding the pool of senior and star faculty	
HEC budget	The HEC budget for supporting the hiring of senior faculty should be expanded.
Faculty plan	Each university should develop a plan for senior and star faculty hiring.
Quality metric	The ratio of senior faculty to junior faculty should be included as a quality metric.
Special recognition	Highly qualified professors should be provided named chairs or titles and provided extra spending resources.
Professors of Practice	A new category of Professors of Practice should be created to induct highly qualified and experienced individuals without PhDs or other formal academic qualifications.
International hiring	Foreign faculty should be hired and budget should be made available to do this.
Joint appointments	Joint appointments at different universities (both within Pakistan and outside Pakistan) should be allowed and encouraged. Senior faculty of Pakistani origin at international universities should be encouraged to take an appointment at a Pakistani university.
Retirement age	The faculty retirement age should be lifted from 60 years to 70 years.
Search leadership	The leadership of search and recruitment practices should be in the hands of faculty members with domain expertise, assisted by qualified human resources experts, not bureaucrats.
Search Committees	The practice of proactive search committees (as opposed to the prevailing practice of interview committees) should be developed and encouraged.
Headhunting Practices	In addition to passive advertisement, aggressive head hunting practices should be encouraged and head hunting bonuses for faculty should be budgeted.
Faculty Mobility	Faculty mobility should be streamlined and encouraged.
HR Review Process	There should be a three-year review process to analyse and calibrate human resource practices and results.

Communication and collaboration platform. With a rapidly expanding system of about 200 institutions, 45,000 faculty members and 1.4 million students, and major transformational challenges in terms of research focus, funding, capabilities, collaboration, dissemination and commercialisation, it is highly unlikely the HEC will be able to fulfil its research and quality agenda unless it embraces information technology in a thorough-going fashion.

We are now well into the 21st century. Faculty members across Pakistan use web and mobile technologies as a principal means of communication and computation. To bring about a transformation in research and innovation in Pakistan, we strongly recommend that a web and mobile platform is developed and managed as a principal medium of communication and collaboration.

The platform should serve not only the academic community in Pakistan and overseas, but act as an engine for research collaboration, dissemination and commercialisation by also serving individuals in the government, donor, private and social sectors who have an interest in research and innovation. The platform should serve as means for providing news and opinions, exchanging information,

projecting individuals, institutions, events and institutions, building communities of practice, making inquiries and connections and offering and taking courses. The platform should leverage artificial intelligence to provide customised information feeds, amplify networks and make connections that could lead to deeper insights and more profound innovation.

→ A proactively-managed knowledge network for all participants in research and innovation.

→ A platform to meet people, make social connections and participate in knowledge communities.

→ A platform to project ideas, inquiries, achievements, publications, events and opportunities.

→ A platform to learn about innovations, experts, institiutions, data, publications, events, and opportunities.

→ A service to obtain access to automated, customised feeds on news, publications, events, and opportunities.

→ A service to offer and take self-study and expert-facilitated courses.

→ A service to manage enquiries, profiles, events, and opportunities.

→ A service to establish and run project-specific research and innovation groups.

The platform can easily be designed, developed and continually evolved in Pakistan: there is sufficient resident capability in Pakistan both in terms of web and mobile technology and artificial intelligence for Pakistan to develop a world leading research and innovation platform.

However, the biggest risk factor in such an undertaking will be to treat this as a technology project. This project is at its core an intellectual community and content project. Unless the project has as its beating heart intelligent, expressive and empathic human leadership, the project will fail. We strongly recommend that this project is conceived and commissioned in holistic, human-centric terms so that the best of human leadership and information technology is brought together to serve the cause of research and innovation in Pakistan.

International research collaboration. The HEC has collaboration agreements with China, France, the United Kingdom and the United States. Typically, research collaboration is a subset within a larger collaboration framework. In addition, individual universities have a wide array of research collaborations with international universities. The research community highly values these collaborations, both in terms of research outcomes and skills development. We recommend that international research collaborations are deepened with existing partners and extended to new partners.

In terms of deepening relationships with existing partners, collaboration with China is at an early stage and is far behind the fast-growing involvement by Chinese enterprises and institutions in Pakistan through CPEC. In addition, one major immediate opportunity for deepening foreign collaboration lies in the Pak-UK Education Gateway being planned between the British Council and the HEC. The gateway is intended to bolster collaboration on research and teaching between Pakistani and United Kingdom universities. The design and planning for this initiative has commenced but is at a sufficiently early stage so that many of our recommendations may be considered for implementation within the content of this initiative. We recommend that deepening research collaboration with both China and the United Kingdom be taken as key strategic priorities by the HEC.

In terms of extending international research collaborations, the most important target countries should include Germany and Japan (because of their superb universities and successful mentoring models), India and Iran (because they have managed to create reasonably good research systems and we have most to gain from our neighbours), and Singapore and Turkey (because they have created successful economies from relatively difficult conditions).

In terms of deepening international research collaborations, we recommend that research collaborations are thematically focused in our areas where Pakistan faces

the greatest challenges (such as economic development, education, healthcare, environment, water, energy, civil society, governance and security) as well as areas with disruptive growth possibilities where Pakistan has started to invest research efforts (such as artificial intelligence and big data).

However, international research collaborations will remain under-optimised, for today Pakistan is by and large an 'idea-taker' rather than an 'idea-maker' in crafting international relationships. The HEC, as part of its Vision 2025 aim to create world-class universities, must also develop serious research on the purposes, shape and impact of international research collaborations.

Reforming research funding

The research funding pie. All rupees are not equal. A rupee spent on research by the HEC from the funds allocated to it by the government for the university sector is much less valuable than a rupee spent on research that comes from other government budgets, donors or the private sector. This is because there are a lot more rupees available from these other sources than there are available from the university budget and, even more importantly, because investment in research by these other actors may—if the universities deliver useful results—lead to genuine growth of research demand in the country.

There are a vast number of initiatives that the HEC and any research councils it establishes could take to unlock research funding from the government, donors and the private sector. In many cases, this work of unlocking funding is made easier because it involves redirecting or optimising existing budgetary allocations. In other cases, especially in the case of the private sector, new linkages will need to be developed to unlock funding.

The HEC's success will critically depend on two factors. First, the HEC should create dedicated, high-level capacity to unlock funding. Second, the HEC should develop value propositions for its funding sources so that the bulk of funding is provided as investments that ultimately benefit the contributors rather than as philanthropic contributions to a noble cause.

Ideally capacity development will involve some leadership and administrative support from the HEC, with major networking coming from the research councils and from a panel of faculty members. Contributors could be inducted into an ever-growing "Friends of Thinking Pakistan" community, such that community members draw in others. While establishment of this community may involve some effort, its success will mean that over time the fund-raising burden is shifted away from the HEC.

The principal value propositions that the HEC and research councils may offer to its potential funding partners include:

→ '*Value-for-money*': In so far as government agencies and donors are already spending money on research and consulting, they can derive superior value-for-money from the university sector and, in so far as research spending is new spending, they can obtain very attractive services from the university sector.

→ '*Productive knowledge flows*': Government agencies spend a lot of money on research departments and donors spend a lot of money on consultants. The knowledge outputs from these departments and consultants are typically locked into specific channels and do not

enrich the broader flow of knowledge. Linking up with universities will enrich the flow of knowledge through dissemination, publication and cumulative research.

→ *'Knowledge partnerships'*: the very poverty of research in Pakistan represents the single greatest funding opportunity for university research. The entire private sector is underinvested in research and development, and this investment is an imperative for self-interested enterprise-level growth. If universities develop expertise in the dynamics of enterprise-level innovation, research and development, they can act as knowledge partners that enable enterprises to ramp up their innovation quotient quickly and efficiently.

To forge broader funding partnerships, the HEC should craft into incentive programs the natural advantages that the university sector, and the HEC's positioning as an apex federal government body, has to offer. The following are illustrative incentives that have been successfully used around the world:

→ *University brands*: Many institutions, especially private sector firms, could obtain branding benefits by affiliation with top-tier universities. To the extent that these universities are able to create a connection between private sector projects with international research collaborations, the brand impact is amplified.

→ *Qualified teams at low cost*: Low faculty salaries, which may be further leveraged by engagement of stipend-based students, provide a compelling value proposition which may be leveraged in many ways: outsourced research and development programmes; joint ventures to develop research; and placement of students within institutions and enterprises.

→ *Low-cost real estate*. Universities in Pakistan, especially public sector universities, sit upon vast tracts of poorly utilised real estate in a market where space is at a premium and real estate costs are rising inexorably. With appropriate legislative and governance measures to avoid abuse, creative 'space-for-research' relationships could be crafted between universities and the private sector.

→ *Tax incentives*: Countries such as the United Kingdom and United States have creatively used tax incentives to attract private sector funding towards universities. Pakistan would also do well to offer tax credits and accelerated depreciation allowances to attract private sector funding towards universities.

→ *Match funding*: The HEC should also leverage its own research spending, especially for thematic research, by offering match funding opportunities for research investment by the government, donors and the private sector. This model, deployed extensively in Singapore, has resulted in the university sector become the single largest recipient sector of private sector contributions.

Based on the foregoing value propositions and incentives, the HEC should explore all the following research funding sources:

Potential research funding sources	
Government research departments	Substantial government spending goes towards underperforming government departments and commissions. The HEC could unlock funding, land and other resources by facilitating collaboration with the university sector.
Government cesses	With the exception of Ignite, cesses on industries have yielded minimal effective research. Some of this funding (particularly for the Export Development Board and Central Cotton Committee) could be optimised by bringing in universities.
Government early adopters	Smaller government agencies with explicit missions have tended to be early adopters of evidence-based policymaking. These agencies could be systematically canvassed for research funding and projects.
CPEC projects	The HEC should lobby government to ensure that every major CPEC project has a research component that could be shared by Chinese and Pakistani universities.
Donors – Development projects	There are many large donor projects that have research and consulting components. Donors should be lobbied to provide research funding and project opportunities to universities.
Donors – Knowledge amplifiers	Donors such as ADB, The World Bank and UNDP are evolving their role into acting as 'knowledge amplifiers'. Strategic partnerships with these donors could help them advance their missions by leveraging university research capability.
Private sector – Innovation initiatives	The HEC can encourage universities to develop expertise in the dynamics of enterprise-level innovation, research and development. They can act as knowledge partners that enable enterprises to ramp up their innovation quotient.
Private sector – Thematic research	As the HEC turns towards thematic research, it will open up opportunities for research sponsorship by companies in areas such as education, energy, health, technology and water.

Research Excellence Framework. There are a number of important aspects of the Research Excellence Framework as it is implemented in the United Kingdom that will be novel from the Pakistan perspective:

→ A substantial portion of government research funding (approximately 70% in the UK) is implemented through the framework

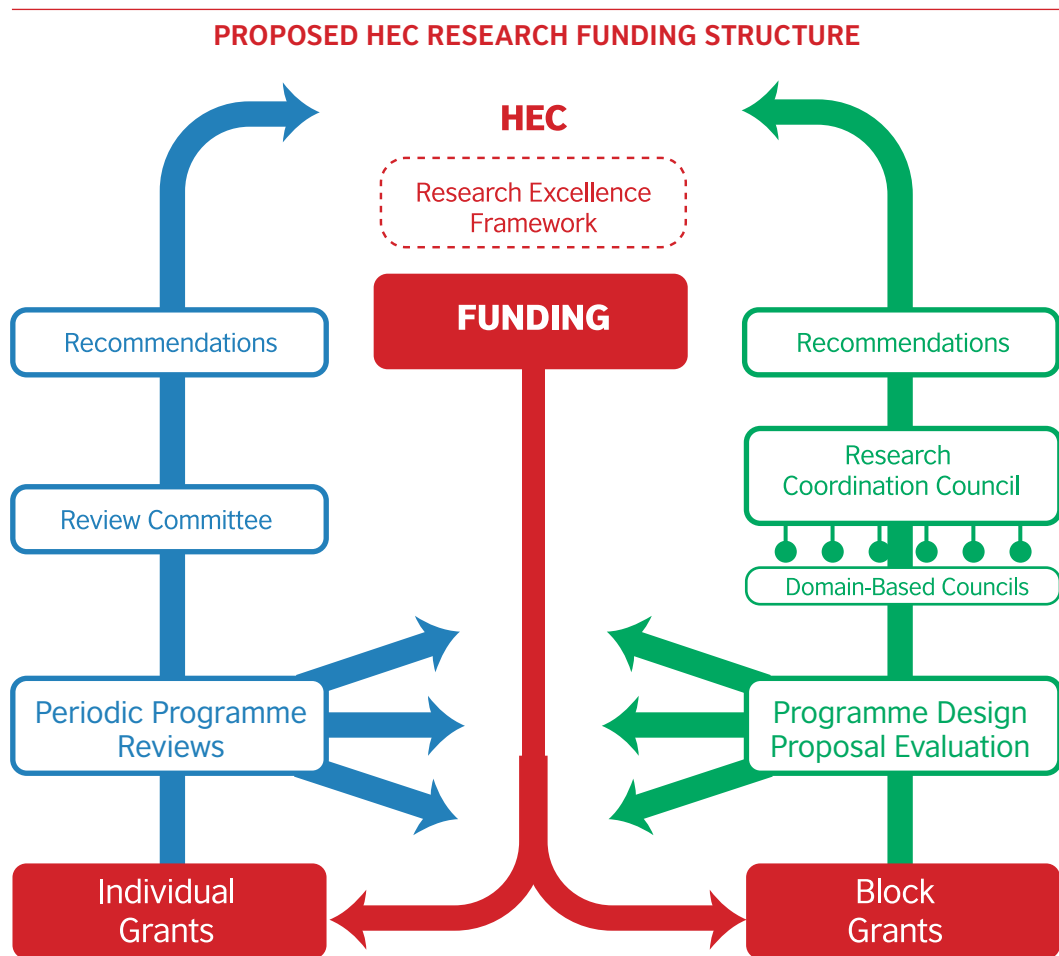→ Research councils comprising senior faculty members drive the review

and funding allocation process

→ Universities submit leading departments and their publications and processes for review

→ The review process is a deep substantive review that actually involves close readings of publications and close evaluation of other aspects of research excellence, including nurturing and development of junior faculty members

→ There is a lengthy review cycle (in the United Kingdom, 7 years) that enables departments sufficient time to mature

→ The funding allocation involves block grants, which are then administered by universities on their own discretion.

We recommend that all the above-referenced features should be considered for inclusion in a localised framework. We recommend that the localised framework is designed and implemented on a fast-track basis. Our recommended components for the localised Research Excellence Framework are as follows:

→ *Research councils leadership.* The research councils should (1) recommend research funding programmes to the HEC, (2) review and evaluate submissions under the research funding programmes and make grant recommendations to the HEC and (3) review ongoing performance of research projects.

→ *Individual and block funding grants.* As it is not feasible to fully embrace block funding until a stronger departmental culture is in place in universities; research councils should have the flexibility to recommend and evaluate research funding programmes that could either constitute project-specific grants for individuals or block grants for departments. Individual and block funding grants could have different funding and review cycles. As experience and performance deepens, the mix of individual and block funding grants could be changed.

→ *Review committees.* Periodic committees should be established which review and make recommendations with respect to the governance and performance of the research councils, including in respect of research funding.

→ *Additional funding sources.* The research councils should also have the flexibility to tap and manage additional funding sources as a supplement to the core HEC funding structure.

The following is a schematic representation of our proposed HEC research funding structure.

PROPOSED HEC RESEARCH FUNDING STRUCTURE

HEC

Research Excellence Framework

FUNDING

Recommendations

Review Committee

Periodic Programme Reviews

Individual Grants

Recommendations

Research Coordination Council

Domain-Based Councils

Programme Design Proposal Evaluation

Block Grants

Thematic research. We have an overwhelmingly positive prescription from the research community that research should be thematically funded around Pakistan's pressing challenges such as economic development, education, healthcare, environment, water, energy, civil society, governance and security. This makes sense at every level—research is directed towards solving meaningful problems, collaboration with an entire range of institutional and business entities becomes feasible, the status of faculty and universities in society is lifted and research funding is amplified.

We recommend that the research councils should play a leading role, through intensive consultation with the HEC, the academic community and funding sources, in selecting thematic research areas and allocating funding against each area. This process could also be widened to begin creating a national public debate on the important thematic priorities facing Pakistan and the role of universities in addressing these priorities. As much as possible, thematic areas should be conceived to facilitate cross-disciplinary research, evidence-based policy formulation and widespread dissemination and commercialisation.

Social science research. Given the low level of funding for, and the high policy impact of, social science research, we also recommend that research funding should be explicitly allocated for social science research. In this connection, guidelines for security clearance around social science research should also be established.

In particular, the social science research agenda should prioritise both public dissemination and policy formulation and priority should be given to research projects that leverage or contribute to data and insights on matters of national importance and involve triumvirates of universities, media, web or publication agencies and government bodies.

As part of the strengthening of the social sciences, women's studies in general and the role of women in academia in particular, should also be funded and supported.

Funding practices for laboratory equipment and staff. All faculty members who discussed equipment funding, including sciences faculty members, were unequivocal in their view that the process is highly wasteful. Too much is spent on buying equipment for single projects that do not have substantial impact. Equipment is not shared, so costs do not get amortised across projects. And, worst of all, laboratory technicians are not properly trained and do not know how to use equipment.

We recommend that the HEC eliminate waste by funding shared laboratories and invest in training of laboratory technicians. As suggested by some of the senior sciences faculty members we interviewed, shared facilities could be established in significant universities in major metropolises.

This shared approach to laboratory equipment will not only reduce research costs, it will also have the positive effect of forcing collaboration between faculty members and universities.

Reforming the Research Measurement System

We strongly support the measure already taken by the HEC to commission a system for a broader measure for publication quality. Under the revised system, Impact Factors would be used on weighted basis with additional measures such as two factors (Eigenfactor and Article Influence Score) used by the University of Washington, Seattle, and three factors (SJR Indicator, H-Index and CD (2 Years Factor that is equivalent of Impact Factor)) determined by Scopus.

While the emergent measurement system will require review, based on our preliminary understanding of the system, evaluation of article influence, as well as longer periods of article impact analysis, will provide a deeper measure of article quality. In addition, as a more complex measure built on a weightage of multiple factors, the measure will become much more difficult to 'game'.

We recommend that this system is reviewed and, subject to any appropriate modifications, is considered for adoption as the measure for publication. However, two additional measurement components will also need to be considered. The deeper evaluation system will necessitate that a simple 'number of publications' standard for faculty promotion will not apply. In addition, differentiated standards will be required for different disciplines. Both these measurement components should also be studied and reformed.

We also recommend that somewhat longer-term analysis also be initiated as to research quality measurement that could take into account leadership in research, solving meaningful problems, developing research capability, mentoring, collaboration, dissemination and commercialisation.

Because of the complex and discipline-dependant nature of the research measurement system, we recommend that the mandate of reviewing and recommending to the HEC the appropriate systems and evolutionary path is given to the research councils.

Nurturing a purpose and quality driven research culture

The discourse on the university system. As mentioned in our literature review, there has been very limited independent research and analysis on the university system in Pakistan. Although the HEC and faculty-members across Pakistan emphasise the importance of evidence-based policy formulation, most policy formulation and decision-making at the HEC or university level occurs mainly through deliberations in small, empowered circles. This enables a free and informal exchange of views, but these consultative meetings are rarely supplemented by formal research and papers or succeeded by accountable follow-on activities.

If the HEC plans on the university system to drive a new knowledge-based economy, then the university system should deploy evidence-based research and policymaking on its own dynamics and infuse its own discourse with the spirit of collaborative but contentious inquiry and debate. It will be difficult for the university system to guide other segments of the polity into a knowledge-based economy if its own direction and dynamics are not informed by the spirit and culture of the innovation age.

To consolidate this recommendation, we advise that the HEC commission research on its Vision 2025 and its own direction and dynamics, on the matters recommended herein and by various other counsels to the HEC, as well on the direction and dynamics of individual universities. (In this respect, we note that the HEC's commissioning of a review and revision of its research measurement system, represents a salient example of the discursive activity we are recommending.)

Research culture. Perhaps the most difficult but essential activity in transforming research in Pakistan will involve promoting changes in orientation, behaviour and capacities in respect of research practice, collaboration, dissemination and commercialisation. Like any change management exercise, this activity will only succeed if it is built on a solid foundation of change management principles:

→ *Lavish and continual publication and promotion through diverse media formats.*

→ *Promotion of early adopters and champions*. The adoption of the new research culture will inevitably result in an adoption curve of innovators, early adopters, 'early majority' adopters, 'late majority' adopters and sceptics. Each segment will need to be separately cultivated and champions will need to promoted who can serve as exemplars and drivers of the change agenda.

→ *Implementation of supporting incentives and policies*. The promotion of the new research culture will require alignment of incentives (including with respect to promotion and funding) and policies (including with

respect to intellectual property rights and freedoms to collaborate and commercialise).

→   *Provision of enabling support*. The implementation of the new research culture will require support in terms of best practice guides and capability development grants.

Based on these principles, we recommend that a change management initiative is launched to create a new research culture that includes the following key activities:

Measures to enhance research culture	
Research Practice	
Named schools of thought	Encourage practice of schools of thought associated with stars and departments. Name schools and theses so that they are identified as lines of thought within discourse.
Working papers	Mandate, publish, discuss and track working papers as part of the research publication process.
Seminars	Mandate, publish and track faculty seminars as part of the research publication process.
Case studies and interviews	Develop and publish case studies series and faculty interview series on best practices in research and innovation.
Promotion credit for research practices	Provide for credit for research practice, collaboration, dissemination and commercialisation in promotion evaluation.
Collaboration	
Professional associations	Sponsor collaborations between professional associations and chambers of commerce and universities.
Government research departments	Sponsor collaborations between government research departments and universities.
Planning Commission councils	Lobby the Planning Commission to launch all-sector councils on thematic areas of national importance such as CPEC, energy, water, etc.
International collaborations	Develop capacity to assist universities in international collaboration including through best practice, contracting and funding guides.
Research and innovation collaborations	Subsidise research and innovation collaborations between universities and the government, donor, private and social sectors.
Dissemination	
National debate series	Launch a televised national debate series on thematic areas of national importance.
Ted Talk series	Launch 'Ted Talk' format series on thematic areas of national importance.
Dissemination capacity	Develop capacity to assist ORICs in research dissemination, including through best practice, contracting and funding guides.
Commercialisation	
Intellectual Property Rights	Enable faculty to own intellectual property rights to research and innovations.
Commercialisation income	Provide guidelines for universities to promote sharing of commercialisation income with faculty members.
Practical commercialisation	Encourage universities to engage in small, practical commercial projects even if this does not result in publishable content.
Business advisory panels	Assist universities in establishing business advisory panels.
Commercialisation capacity	Develop capacity to assist ORICs in research commercialisation, including through best practice, contracting and funding guides

Research skills. The research community has identified weaknesses in almost all kinds of research skills (including in respect of research method, writing and expression, collaboration and networking and proposing and securing projects). The community has also identified mentoring and collaboration as the most important means for enhancing research skills. We recommend that the HEC commission a major programme to develop research skills in which mentoring and collaboration is adopted as the central core, with supporting roles for seminars and conferences, publications and guides, and courses. Given the scale of the research skills challenges facing the university system, this programme should constitute a blended learning programme in which face-to-face learning is judiciously combined with web and mobile learning. To reduce costs and scale rapidly, the programme should involve identifying, empowering and incentivising faculty champions within each university.

Appendices

Appendix 1 **Acronyms**

ADB	Asian Development Bank
AERC	Applied Economics Research Centre, University of Karachi)
AERIL	Alternate Energy Research and Innovation Lab, University of Engineering Technology (Lahore)
AIRL	Artificial Intelligence Research Laboratory, University of Engineering Technology (Lahore)
AKU	Aga Khan University (Karachi)
APTMA	All Pakistan Textile Mills Association
AU	Air University (Islamabad & Multan)
BPS	Basic Pay Scale
BRL	Bioinformatics Research Laboratory
BSc	Bachelor of Science
BU	Boston University (United States)
BUITEMS	Balochistan University of Information Technology, Engineering and Management Sciences (Quetta)
CAREC	Central Asian Regional Economic Program
CAS	Centres for Advanced Studies
CASS	Chinese Academy of Social Sciences (China)
CBER - IBA	IBA Centre for Business and Economic Research (Karachi)
CECOs	CECOS University of Information Technology and Emerging Sciences (Peshawar)
CERAD	Centre for Energy Research and Development, University of Engineering and Technology (Lahore)
CERP	Centre for Economic Research in Pakistan (Lahore)
CIIT or COMSATS	COMSATS University (Islamabad)
CLE	Centre for Language Engineering, University of Engineering Technology (Lahore)
COMSTECH	Ministerial Standing Committee on Scientific and Technological Cooperation of the OIC (Organization of Islamic Cooperation)
CPEC	China Pakistan Economic Corridor
CRSS	Centre for Research and Security Studies (Islamabad)
CSSR	Collective for Social Science Research (Karachi)
CSSS	Centre for Study of Society and Secularism (India)
CVML	Computer Vision and Machine Learning
DARPA	Defense Advanced Research Projects Agency (United States)
DFID	Department for International Development
DSRL	Data Science Research Laboratory, University of Engineering Technology (Lahore)

ECD	Economic Corridor Development
EECL	Energy Efficiency and Conservation Laboratory, University of Engineering Technology (Lahore)
ERP	Enterprise Resource Planning
ESSL	Enterprise Software Solutions Laboratory, University of Engineering Technology (Lahore)
EU	European Union
FAST-NUCES	Foundation of Advancement of Science and Technology - National University of Computer and Emerging Sciences (Islamabad)
FCC	Forman Christian College (Lahore)
FJU	Fatima Jinnah University (Rawalpindi)
GARP	Global Antibiotic Resistance Partnership
GBP	United Kingdom Pounds
GDP	Gross Domestic Product
GPC	Green Parliamentarian Caucus
GSP	Geological Survey of Pakistan (Rawalpindi)
Harvard	Harvard University (United States)
HEC	Higher Education Commission
HEC	Higher Education Commission (Islamabad)
HPCNL	High Performance Computing and Networking Laboratory, University of Engineering Technology (Lahore)
HUTIC	Huawei UET Telecom and IT Centre, University of Engineering Technology (Lahore)
I-SAPS	Institute of Social and Policy Sciences (Islamabad)
IACL	Industrial Automation and Control Laboratory, University of Engineering Technology (Lahore)
IBA	Institute of Business Administration (Karachi)
IBA SUKKUR	Institute of Business Administration (Sukkur)
ICARDA	International Centre for Agricultural Research in Dry Areas
ICI	Imperial Chemistry Industries Pakistan Limited
ICT	Information and Communications Technology
IDEAS	Institute of Development and Economic Alternatives (Lahore)
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
Ignite	Ignite National Technology Fund, formerly the National ICT R&D Fund (Islamabad)
ILO	International Labour Organisation
INR	Indian Rupees

IoT	Internet of Things
IPRI	Islamabad Policy Research Institute (Islamabad)
IPS	Institute of Policy Studies (Islamabad)
IRIL	IoT Research and Innovation Laboratory, University of Engineering Technology (Lahore)
IRS	Institute of Regional Studies (Islamabad)
ISSI	Institute of Strategic Studies (Islamabad)
IT	Information Technology
ITU	Information Technology University (Lahore)
JQRS	Journal Quality Ranking System
KBSL	Karachi School of Business & Leadership (Karachi)
KICS	Al-Khwarizmi Institute of Computer Science, University of Engineering Technology (Lahore)
KPIs	Key Performance Indicators
LSE	Lahore School of Economics (Lahore)
LUMS	Lahore University of Management Sciences (Lahore)
MCL	Motion Control Laboratory, University of Engineering Technology (Lahore)
MIT	Massachusetts Institute of Technology (United States)
MOU	Memorandum of Understanding
MUET	Mehran University of Engineering and Technology (Jamshoro)
MW	Megawatt
NARC	National Agricultural Research Centre (Islamabad)
NASA	National Aeronautics and Space Administration
NCAI	National Centre for Artificial Intelligence, National University of Sciences and Technology (Islamabad)
NCSW	National Commission on the Status of Women (Islamabad)
NED Karachi	NED University of Engineering & Technology (Karachi)
NED UET	Nadirshaw Eduljee Dinshaw University of Engineering Technology (Karachi)
NEECA	National Energy Efficiency & Conservation Authority (Islamabad)
NERL	National Renewable Energy Laboratory, University of Engineering Technology (Lahore)
NESCOM	National Engineering and Scientific Commission (Islamabad)
Neurotech	Neurotechnology
NIAB	Nuclear Institute for Agriculture and Biology (Faisalabad)
NIH	National Institute of Health (Islamabad)
NRPU	National Research Program for Universities

NSF	National Science Foundation (United States)
NSPP	National School of Public Policy (Lahore)
NTU	National Textile University (Faisalabad)
NUST	National University of Sciences and Technology (Islamabad)
NWNL	Next-Generation Wireless Network Laboratory
ORIC	Office of Research, Innovation and Commercialisation
PAEC	Pakistan Atomic Energy Commission (Islamabad)
PARC	Pakistan Agricultural Research Council (Islamabad)
PBA	Pakistan Banks' Association (Karachi)
PBC	Pakistan Business Council (Karachi)
PBS	Pakistan Bureau of Statistics (Islamabad)
PC	Ministry of Planning, Development & Reform (Islamabad)
PCRET	Pakistan Council of Renewable Energy Technologies (Islamabad)
PCRWR	Pakistan Council of Research in Water Resources (Islamabad)
PCSIR	Pakistan Council of Industrial and Scientific Research (Islamabad)
PED	Punjab Energy Department (Lahore)
PEECA	Punjab Energy Efficiency and Conservation Agency
PFI	Pakistan Forest Institute (Peshawar)
PhD	Doctor of Philosophy
PHEC	Provincial Higher Education Commission or Punjab Higher Education Commission
PHRC	Pakistan Health Research Council
PIDE	Pakistan Institute of Development Economics (Islamabad)
PIEAS	Pakistan Institute of Engineering and Applied Sciences (Islamabad)
PITB	Punjab Information Technology Board (Lahore)
PKR	Pakistan Rupees
PMD	Pakistan Meteorological Department (Islamabad)
PNCA	Pakistan National Council of the Arts (Islamabad)
PRC State Council	State Council of the People's Republic of China
PSCA	Punjab Safe City Authority (Lahore)
PSDP	Public Sector Development Programmes
PSF	Pakistan Science Foundation (Islamabad)
PU	Punjab University (Lahore)
QAU	Quaid-e-Azam University (Islamabad)
QEC	Quality Enhancement Cell

R&D	Research and Development
SBP	State Bank Pakistan (Karachi)
SDG	Sustainable Development Goal
SME	Small and Medium Enterprise
SPDI	Sustainable Development Policy Institute (Islamabad)
SRGP	Start-Up Research Grant Program
SSRL	Software Systems Research Laboratory (Lahore)
STEM	Science, Technology, Engineering and Mathematics
SUPPARCO	Space and Upper Atmosphere Research Council (Karachi)
SZABIST	Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (Karachi)
TDF	Technology Development Fund
TIC	Technology Incubation Centre, National University of Sciences and Technology (Islamabad)
TTS	Tenure Track Statutes/System
U.S.	The United States of America
UAF	University of Agriculture (Faisalabad)
UCL	University College London (United Kingdom)
UCP Lahore	University of Central Punjab (Lahore)
UET Lahore	University of Engineering Technology (Lahore)
UET Peshawar or UETP	University of Engineering and Technology (Peshawar)
UET Taxila	University of Engineering and Technology (Taxila)
UGC	University Grants Commission
UGS	University Game Studio, University of Engineering Technology (Lahore)
UK	United Kingdom
UMS	University Management System Laboratory, University of Engineering Technology (Lahore)
UMT	University of Management and Technology (Lahore)
UNDP	United Nations Development Programme
UOP	University of Peshawar)
UOTN	University of Technology (Nowshera)
USAID	United States Agency for International Development
USD	United States Dollars
USPCAS	US-Pakistan Centres for Advanced Studies
VC	Vice Chancellor
WSRL	Wireless Systems Research Laboratory

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Appendix 3 **Selected government commissions and institutes**

Selected Government Institutes, Commissions & Departments	
Entity	Description
Geological Survey of Pakistan (GSP), Rawalpindi	GSP is an autonomous institution under the Ministry of Petroleum and Natural Resources mandated with advancing geoscientific knowledge, undertaking geological studies and preparing official maps and area surveys.
Khan Research Laboratories	Managed and operated by the Pakistan armed forces, Khan Research Laboratories is one of the largest science and technology institutions in Pakistan. It conducts research and development in fields such as national security, nuclear technology, space exploration and supercomputing.
Ministerial Standing Committee on Scientific and Technological Cooperation of the Organisation of Islamic Cooperation (COMSTECH)	The core mandate of COMSTECH is to strengthen cooperation among OIC Member States in science and technology and develop programmes to enhance the capability of the Muslim countries in science and technology.
Ministry of Finance	In addition to national finance management, the Ministry of Finance publishes the annual Pakistan Economic Survey and, together with the Planning Commission, engages in development research and planning.
National Energy Efficiency & Conservation Authority (NEECA), Islamabad	NEECA has been recently constituted under the Ministry of Energy, with a mandate to promote energy efficiency and conservation through pilots, research, training and policy formulation.
National Engineering and Scientific Commission (NESCOM), Islamabad	Under the administrative control of the Pakistan armed forces, NESCOM is a civilian-managed scientific and engineering organisation responsible for carrying out research and development in many areas including Information Technology, fluid dynamics, aerodynamics, aerospace engineering, electrical engineering, mechanical engineering and chemical engineering, with specialties in the design and production of communication systems and aerodynamic vehicles for the Pakistan armed forces.
National Institute of Health (NIH), Islamabad	NIH is an autonomous body affiliated with the Ministry of National Health Services, Regulation and Coordination, with primary responsible for biomedical and health-related research along with vaccine manufacturing.
Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad	NIAB functions under PAEC with the mandate to create and maintain new genetic material for sustained agricultural development and conduct research on agriculture and biology using nuclear and other related technologies.

Pakistan Agricultural Research Council (PARC), Islamabad	PARC is the apex national agricultural research organisation. Its main objective is to strengthen Pakistan's agricultural research system, comprising both Federal and Provincial components. PARC has seven major research divisions that address agro-ecological needs of different regions in Pakistan. Its research covers animal sciences, plant sciences, social sciences, natural resources and agricultural engineering.
Pakistan Atomic Energy Commission (PAEC), Islamabad	PAEC is an independent government body and scientific research institution, concerned with research and development of nuclear power, promotion of nuclear science, energy conservation and the peaceful usage of nuclear technology.
Pakistan Bureau of Statistics (PBS), Islamabad	PBS is the government agency charged with provision of national statistical services and statistical research.
Pakistan Council of Industrial and Scientific Research (PCSIR)	PCSIR is a government-owned science and industrialisation research organisation which mainly focuses on industrial research and development.
Pakistan Council of Research in Water Resources (PCRWR), Islamabad	PCRWR undertakes and manages research on the water sector, including in respect of water management, drainage, replenishment, desertification, rainwater harvesting, quality assessment and monitoring and conservation.
Pakistan Forest Institute (PFI), Peshawar	PFI is mandated to conserve the environment and the natural resources of the country by conducting research on environmental issues and imparting training in the specialised field of forestry and allied disciplines.
Pakistan Meteorological Department (PMD), Islamabad	PMD is an autonomous institution tasked with providing weather forecasts and public warnings concerning weather for protection, safety and general information. PMD is also involved in monitoring and investigating weather phenomena and researching astrophysics, climate change, aeronautical engineering and renewable energy resources.
Pakistan National Council of the Arts (PNCA), Islamabad	PNCA aims to build a robust arts ecosystem by creating an environment conducive to the flourishing of the arts, where the arts are accessible to everyone and artists and art groups have the commitment, financial support and resource to excel at home and on the world stage.
Pakistan Science Foundation (PSF), Islamabad	PSF is the Federal government's principal agency dedicated to promoting science research and dissemination. PSF is responsible for funding science research in universities and other institutions, popularising science, establishing science centres, organising science conferences, arranging science exchanges, supporting scientific societies and awarding science prizes and fellowships.
Pakistan Council of Renewable Energy Technologies (PCRET), Islamabad	PCRET is responsible for research and development and promotional activities in relation to renewable technologies.

Planning Commission (PC), Islamabad	The Planning Commission is a financial and public policy development institution under the Ministry of Planning, Development and Reforms. The Planning Commission undertakes research studies and state policy development initiatives for the growth of national economy and the expansion of the public and state infrastructure of the country in tandem with the Ministry of Finance. The Planning Commission also approves and manages the Public-Sector Development Programmes (PSDP), which fund development projects across the country.
Space and Upper Atmosphere Research Council (SUPPARCO), Karachi	SUPPARCO is responsible for the nation's civil space programme, alongside aeronautics and aerospace research.
State Bank of Pakistan, Karachi	The State Bank of Pakistan is the central bank of the country. It has a wide ranging regulatory and financial management and development role, and also has considerable research operations on economic and financial matters.

Appendix 4 The Pak-UK Education Gateway

The British Council, in collaboration with the HEC, has designed the Pak-UK Education Gateway to assist Pakistan in developing human resource capital.

Pak-UK Education Gateway is a large-scale reform and collaboration programme. Its aim is to improve the quality of teaching and research in Pakistani universities for the benefit of both UK and Pakistan.

To kick off the development of the Pak-UK Gateway, a first consultative workshop arranged in Islamabad, Pakistan on 12 December 2017, which was attended by 15 academic leaders. In addition to identifying the strengths of the UK system and challenges currently being faced in Pakistan, participants worked to identify opportunities that can be enabled by the Gateway in the following key areas:

1. Innovative and collaborative research.

2. Higher Education (HE) leadership.

3. Quality assurance and standard setting.

4. Distance learning and new ways of delivery for HE.

5. International mobility.

6. Transnational education (TNE).

7. Citizenship education and community engagement.

8. The university as a change agent.

As a next step, a first roadshow was organised in London, UK on 29 January 2018 to engage key UK stakeholders. The objective of this roundtable was to share the main outlines of the proposed concept note with the UK HE sector and incorporate their feedback and comments into the Pak-UK Gateway development strategy.

A letter of intent was signed on 3 April 2018 between the HEC and the British Council Pakistan to strengthen cooperation between the two organisations in relation to the Pak-UK Education Gateway.

A session was also organised at Going Global, the British Council's flagship international HE conference, during May 2018 in Malaysia.

A second road show took place in June 2018 in UK where three roundtable conferences were held in Edinburgh, Birmingham and Bath. The objective was to promote the Gateway concept to stakeholders and to introduce UK sector expertise to key Pakistani decision makers to explore possibilities of further collaboration around quality of teaching and research in Pakistani universities. Follow-up meetings with government stakeholders were also held to gauge

government support and cooperation in relation to the Gateway.

In order to ensure the inclusion of the wider UK HE sector, roundtable meetings were also held in Northern Ireland in August 2018.

As next steps:

→	Inception Year Programmes workshops have been organised. To advance these workshops, the HEC is submitting a Public-Sector Development Programme proposal to Planning Commission.

→	An inward mission of UK's Vice Chancellors to Pakistan is planned for end of November. This will create an opportunity for UK universities VCs to have in-depth discussions with their Pakistani counterparts.

While the Pak-UK Education Gateway is still in the design and development phase, its broad, consultative process, with considerable involvement of faculty from UK and Pakistani universities, augurs well for its future success.

Appendix 5 **The US-Pakistan Centres of Excellence**

We are grateful to Dr Iqrar Ahmad Khan, Distinguished National Professor and previously Vice Chancellor for UAF, and Dr Najeeb Ullah, Deputy Director US-Pakistan Center for Advanced Studies in Energy at the University of Peshawar, for their contributions to this case study.

Between 2010 –15, USAID initiated the US-Pakistan Centres for Advanced Studies (USPCAS) to build capacity for applied research in agriculture, energy and water. The programme built partnerships between three US universities and four Pakistani universities with the objectives of modernising curricula, conducting joint research and fostering student and faculty exchanges.

USPCAS was designed by USAID and the HEC over an extended period. In 2011, partnering universities were identified and scoping and feasibility studies were initiated. The following four centres of excellence were then created under this programme:

→ Water at Mehran University of Engineering and Technology in Jamshoro (MUET), which was provided technical assistance by University of Utah (launched 2014).

→ Energy at National University of Science and Technology in Islamabad, which was provided technical assistance by Arizona State University. (launched 2013).

→ Energy at the University of Engineering and Technology in Peshawar, which was provided technical assistance by Arizona State University (launched 2012).

→ Agriculture at UAF, which was provided technical assistance by University of California Davis (launched 2013).

The total funding for the project was GBP 97 million, with about approximately GBP 23 million dedicated to each centre of excellence. In each centre, about GBP eight million was dedicated to the US partner to cover its costs and some GBP four to five million was earmarked for building and infrastructure costs. The rest of the grant was allocated to meet the following objectives:

→ Provide revised curricula.

→ Implement financial management, governance, teaching and other reforms necessary to make university education and research more relevant to the needs of industry and government.

→ Facilitate relevant policy dialogue and reforms for each technical sector led by policy think tanks at each centre.

→ Develop robust scholarship and exchange programmes.

→ Lead networking activities.

→ Develop strong links to the private sector.

→ Construct, rehabilitate and upgrade world-class research facilities at partnering Pakistani universities, including laboratories, classrooms, and libraries.

While there is no formal evaluation as yet of the centres, judging from their websites and some conversations we can say that the centres have achieved varying degrees of success.

→ All centres have developed MPhil and PhD programmes.

→ There have been student and faculty exchanges.

→ A number of publications have been achieved through competitive grant programmes.

→ Several conferences have been held.

→ Several training and capacity building events have been held.

→ Building and facilities have been developed.

→ Faculty development remains thin in most departments.

As can be expected, progress has been uneven. While this is not an evaluation, it seems that the water centre at MUET has been the most successful in terms of faculty development and research output. This statement in no way negates the efforts in other centres.

It appears funding has dried out in the agriculture centre at UAF mainly because of cutbacks in the USAID budget. Other centres are functioning, but all are facing the conclusion of the programme and the end of funding. Sustainability will become an issue if substitute funding is not found. As of yet, limited efforts have been made to address this. The agriculture centre has been waiting for over a year to develop a sustainable financing plan in consultation with the HEC.

It is important to conduct a fuller evaluation to see how these centres have contributed to policy and the challenges of the ongoing shortages in energy and water and the shortfalls in agricultural productivity. Ultimately, the success of such centres has to be measured by the elevation of the societal and policy dialogue in their specialty areas. Moreover, the USAID project must have planned for sustainable centres if it is to be considered successful.

Appendix 6 **Nurturing evidence-based policy-making in Pakistan**

We are grateful to Maroof A. Syed, President and CEO of CERP, and Adil Saeed, Manager Training and Capacity Building at CERP, for their contributions to this case study.

Harvard Kennedy School's Evidence for Policy Design (EPoD) centre engages with policymakers, government servants and practitioners in emerging markets to advance the practice of evidence-based policy formulation, implementation and evaluation. The centre focuses on both research and capacity-building. Its capacity-building initiatives principally consist of:

→ **Capacity building courses** targeted at different levels of decision-makers, including a 'Training of Trainers' approach for scale and adaptability.

→ **Policy dialogues**, which bring together researchers, policymakers and other key stakeholders to develop innovative solutions to jointly-identified policy problems.

→ **Pilot projects**, in which the centre collaborates with policy-actors to design and implement data-driven solutions.

In 2013, with funding from DFID, EPoD partnered with the Centre for Economic Research in Pakistan (CERP), a Lahore-based policy research institute, and National School of Public Policy (NSPP), a Lahore-based government institution responsible for training civil servants, to launch the Building Capacity to Use Research Evidence (BCURE) programme.

With the ultimate objective of building a 'culture of evidence' in Pakistan's civil service, BCURE aims to develop practical skills and frameworks and increase motivation to use data and evidence. Initially targeted at mid-career civil servants, the programme has subsequently been scaled up to serve both entry-level and senior civil servants.

The BCURE training programme is an innovative 'blended learning' intervention in which students take online modules which are then followed up by face-to-face workshops and exercises. The training programme covers six modules: (1) systematic approaches to policy decisions; (2) descriptive evidence; (3) aggregating evidence; (4) impact evaluation; (5) cost-benefit analysis; and (6) commissioning evidence. (A seventh module on using data systems is in development.) As of August 2018, 2,301 civil servants from both the federal and provincial cadres have been trained under this programme and 38 trainers have been trained in a companion 'Train-the-Trainer' programme.

In addition to running training programmes, the consortium has started policy

dialogues with relevant stakeholders on the use of evidence for policymaking. The consortium has also started working with selected institutions such as the Punjab Planning and Development Department to align incentives of civil servants to use evidence in policymaking. Small pilots in evidence-based policymaking have also been successfully conducted in policing, healthcare and taxation.

Maroof A. Syed, the President and CEO of CERP, notes:

"Our capacity in Pakistan has been strengthened to such an extent that recently UNDP and NSPP contracted CERP directly to conduct a long-term sustainability impact programme and to act as the lead provider of pedagogy tailored for Pakistan in collaboration with Harvard EPoD. Our goal is to train every single civil servant going through the NSPP curriculum and drive the culture of evidence-informed policymaking further in Pakistan."

Appendix 7 UAF and the fertiliser models programme

We are grateful to Dr Iqrar Ahmad Khan, Distinguished National Professor and previously Vice Chancellor for UAF, and Dr Muhammad Rashid, previously Director General Agriculture Research Government of Punjab and Subject Specialist at Institute of Soil and Environmental Sciences at UAF, for their contributions to this case study.

Across Punjab, and indeed across the country, the fertility of agricultural soil has been in decline. Farmers rely heavily on fertilisers to address the nutritional deficiency of the soil, but fertiliser prices have risen inexorably and fertiliser impact has diminished considerably. A principal contributory factor has been a gap in actionable data: knowledge about which fertiliser to purchase given targeted crops and soil conditions in specific districts. While, in Punjab, the Provincial Government's Soil Fertility Research Institute Punjab ('SFRI') and other agencies run soil and water testing laboratories in every district, they have historically not been any data based models in the country which predict the actual requirement of nutrients to produce desired yields for targeted crops and soil conditions in specific districts. This gap in actionable data has led farmers to consistently purchase either the wrong types of fertiliser or purchase too much fertiliser.

With seed funding from its endowment fund, UAF initiated a project to develop such actionable data for the Punjab. Over a span of eight years, this initiative expanded into four research, development and dissemination projects funded variously by the UAF endowment fund, United States Department of Agriculture (USDA), the International Center for Agricultural Research in Dry Areas (ICARDA), and the Ignite National Technology Fund. Working with agricultural research and extension employees at SFRI, soil scientists at UAF collected, processed and analysed ten years of fertiliser trials and soil test data from all districts in the Punjab. The project started with data on wheat, and was progressively expanded, for districts where data was available, to rice, sugarcane, cotton, maize, potatoes, tomatoes, carrots, cabbage, garlic and sunflowers. As part of the process, the team also engaged intensively with farmers, vendors and research and extension specialists. In due course, Information Technology specialists at UAF were inducted into the project to construct a data model and a website for dissemination of the data.

Trials on the model were conducted on wheat in most parts of the Punjab, on rice in Northern Punjab, on sugarcane in Central Punjab, and on cotton in Southern Punjab. In most of the wheat trials, the obtained yield was 80% or more relative to the targeted yield. In the case of rice, in more than 50% of the trials, the obtained yield was equal to or better than the targeted yield and there was no instance where the obtained yield was less than 80% of the targeted yield. In the case of sugarcane, in 67% of the trials the obtained yield was equal or better than the targeted yield. In the case of cotton, in 20% of observations, the obtained yield was equal or better

than the targeted yield and in 60% of the trials the obtained yield was in the range of 80 – 100% of the targeted yield. Based on these trials, the fertiliser models were treated as being highly reliable in predicting fertiliser requirements for targeted yields for the selected crops.

The second part of the project involved dissemination of the information regarding fertiliser prediction models among end users. Dissemination activities included advertisement through electronic and print media and farmers' field days. As part of this activity, 13 press conferences were arranged and 17 farmers' field days were held on wheat, rice, sugarcane and cotton in significant districts. SMSes were also sent to over one million farmers. As a result, during the dissemination period, the fertiliser models website attracted 114,060 visits.

Through the engagement process with farmers, the UAF team realised that farmers were reluctant to visit soil and water testing laboratories for soil analysis. To address this challenge, UAF secured additional funding from ICARDA and USDA to engage three private sector service providers to bring soil samples to the laboratories and take soil analysis reports to farmers. From three wheat-growing villages, 4,800 soil samples were collected from 770 farmers. On the average, the farmers saved PKR 2,000 – 3,000 per acre in fertiliser costs. Dissemination meetings were established in which these farmers then shared their findings with fellow farmers and other stakeholders. In addition, videos were developed on the use of fertiliser for wheat, rice, sugarcane, cotton and maize. And, during this phase, SMSes were sent to 3.35 million farmers and more than 29,000 people visited the fertiliser models website during the wheat sowing season.

While collection of soil for testing and use of Information Technology for accessing information on fertiliser models remains a continuous challenge, the project has initiated a data-driven approach to fertiliser selection in Punjab.

One major success factor for this long-term project was collaboration both across departments at UAF and among UAF, SFRI, project sponsors, implementing partners and farmers across Punjab. Another success factor was stable and committed project leadership at UAF. Dr Iqrar Ahmad Khan, Distinguished National Professor and previously Vice Chancellor for UAF, provided overall planning leadership and managed relationships with project sponsors. Dr Muhammad Rashid, previously Director General Agriculture Research Government of Punjab and Subject Specialist at Institute of Soil and Environmental Sciences at UAF, acted as the Principal Investigator for all four projects and handled overall responsibility for agricultural research and field implementation. Mr Ahsan Raza Sattar, Assistant Professor Department of Computer Science at UAF, led Information Technology design and implementation.

Appendix 8 **IBA and the consumer and business confidence surveys**

We are grateful to Dr Qazi Masood, Professor of Economics and Director of the Centre of Business and Economics Research, and Ms Sidrat Asim, Manager of the Centre of Business and Economics Research, at IBA Karachi, for their contributions to this case study.
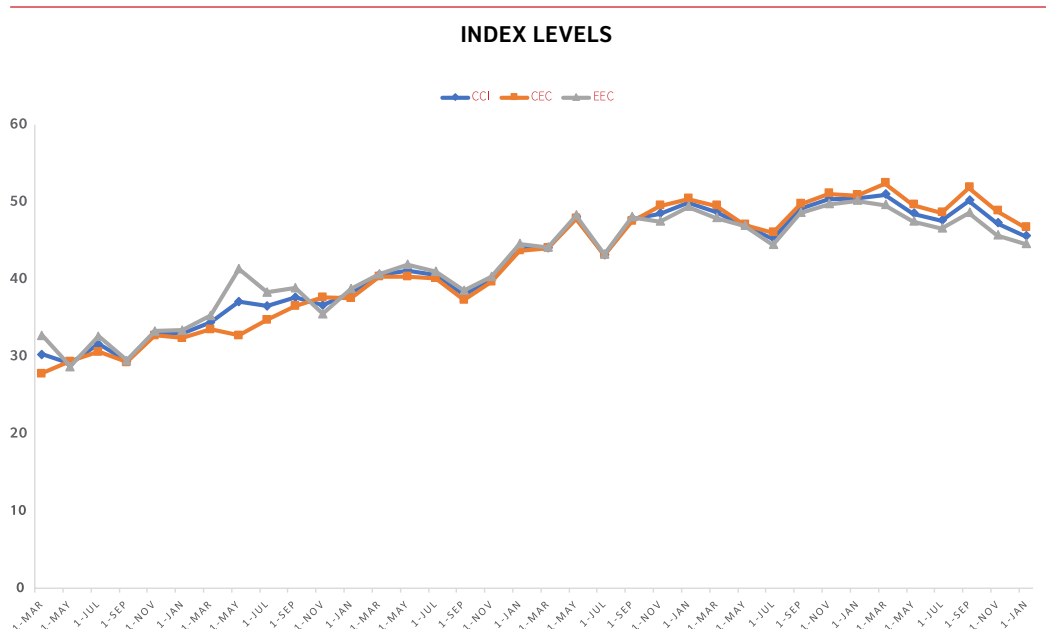
Pakistan is still in the early days of using surveys polls and indices to evaluate opinions, trends and performance. Political opinion polls, reasonably well-established in India, are in their infancy in Pakistan. While Gallup has established a credible presence in Pakistan, its findings are not very widely disseminated. And Pakistan has also been slow to build a culture of self-measurement through national or international tests and indices. For example, Pakistan does not participate in PISA, the education test administered by OECD for 15-year olds. And there are only a few indices developed and managed by universities in the country.

One notable exception is the Pakistan Consumer Confidence Survey and Business Confidence Survey, a joint programme of national telephonic surveys, conducted and operated by the State Bank of Pakistan and IBA Karachi. The Consumer Confidence survey was launched in 2012 and polls 1,600 individuals across the country on a bi-monthly basis. The Business Confidence Survey was launched in 2017 and polls 600 firms on a bi-monthly basis. (The Overseas Investors Chamber of Commerce of Industry has also run a Business Confidence Survey since 2010, and this survey is presently more prominently profiled in the media than the State Bank / IBA Karachi Business Confidence Survey.)

The State Bank / IBA Karachi Consumer Confidence Survey has been modelled under the University of Michigan consumer survey, which is the international benchmark, with respondent population sampling derived from data from the Pakistan Bureau of Statistics. The Business Confidence Survey is modelled from EU Business Tendency Survey. The sample size is fixed at 600 firms, which is larger than the sample size used in many other countries, with sampling based on industry-wise contribution to GDP.

Consumer confidence index

The surveys are funded by the State Bank and managed by IBA Karachi under a three-year rolling contract. The State Bank provides premises as well as call and data management facilities. IBA Karachi manages the entire survey process and provides 20 – 22 students who conduct interviews for each wave. Dr Qazi Masood, Professor of Economics and Director of the Centre of Business and Economics Research, observes: "Our collaboration is quite streamlined at this stage. Using

INDEX LEVELS

Legend: CCI, CEC, EEC

Y-axis: 0, 10, 20, 30, 40, 50, 60

X-axis: 1-MAR, 1-MAY, 1-JUL, 1-SEP, 1-NOV, 1-JAN, 1-MAR, 1-MAY, 1-JUL, 1-SEP, 1-NOV, 1-JAN, 1-MAR, 1-MAY, 1-JUL, 1-SEP, 1-NOV, 1-JAN, 1-MAR, 1-MAY, 1-JUL, 1-SEP, 1-NOV, 1-JAN, 1-MAR, 1-MAY, 1-JUL, 1-SEP, 1-NOV, 1-JAN, 1-MAR, 1-MAY, 1-JUL, 1-SEP, 1-NOV, 1-JAN

Keys	Question	Graph Explanation
EEC	Expected Economic Conditions Index	Level Index Line "Up = Improvement & Down = Decline"
CEC	Current Economic Conditions Index	Level Index Line "Up = Improvement & Down = Decline"
CCI	Consumer Confidence Index	Level Index Line "Up = Improvement & Down = Decline"

State Bank facilities, we train our students and complete each survey wave quite efficiently. Because we use students and don't have to pay for space and facilities, our charges to the State Bank are very low."

While the surveying process is now streamlined and cost-effective, the surveys are yet to be widely adopted by the government, business, media and academic sectors. The surveys are used in State Bank publications, but not very much in other government analysis and policy documents. And, while the surveys are referenced from time to time in English-language media such as *Dawn* and *Business Recorder*, they are rarely referred to by the Urdu language press or by television media. Dr Qazi Masood notes: "We have a distance to cover before consumer and business confidence surveys are adopted by businesses as an integral part of their planning or by media firms as a regular part of their reporting. In the academic field, one Pakistani PhD candidate in a United States university is using our 36 waves of consumer confidence data for her doctoral dissertation. We haven't seen much interest in our data from researchers in Pakistan yet."

One significant constraining factor is lack of funds for dissemination. As a result, the surveys are not adequately supported by a well-developed website, mailing list or social media presence, and there is little coordinated dissemination activity

between the State Bank and IBA Karachi. Dr Qazi Masood is confident that this situation is beginning to change.

"We are planning a series of seminars in major cities using the auspices of Chambers of Commerce and local State Bank offices. And we are starting a dissemination process within academia by sharing data and insights. We need to, and are beginning to, do more on the 'supply side', but there are even bigger gaps on the 'demand' side. Government and business need to become more active consumers of survey and benchmarking data."

Appendix 9 **The Green Parliamentarians Caucus**

We are grateful to Ayesha Qaisrani, Research Associate at SDPI Islamabad, for her contributions to this case study.

Green Parliamentarian Caucus (GPC) was jointly established by Heinrich Boll Stiftung (HBS) and SDPI in September 2016, following a needs assessment for climate change sensitisation among parliamentarians. As part of the initial activities, GPC engaged a dedicated group of parliamentarians to develop their understanding of climate change and its impact on national and Provincial development plans and to enhance their capacities to raise climate change related matters at the floor of the house. The Secretariat of GPC at SDPI, with inputs from parliamentarians, drafted a Terms of Reference for the parliamentarians involved in GPC. The activities indicated a high level of willingness among parliamentarians to learn about climate change and its impact for sustainable development in Pakistan.

The motivation to form GPC comes from the fact that Pakistan needs a platform to involve all the relevant stakeholders for not only addressing domestic issues related to climate change but also to fulfil international commitments with regards to the SDGs and the Paris Climate Agreement. Parliament is one of the primary institutions that can define a vision and leadership strategies at various levels: social, economic and environmental. However, parliamentarians in Pakistan seldom have a support mechanism to keep them up to date with environmental challenges. Most parliamentarians juggle many issues and do not have time to orient themselves with new concepts and tools that will help them lead the transition towards sustainable development and environmentally sensitive policymaking.

The Climate Change Act 2017 has increased the need for parliamentarians to be sensitised on climate change matters. A legal framework is only as effective as its implementation, and parliamentarians can play an important role in holding the executive to account.

GPC was developed to enhance the response capacity of parliamentarians to environment and climate-sensitive development discourse and action in Pakistan. It aspires to achieve this goal through three objectives:

→ To sensitise Federal and Provincial parliamentarians across political parties on issues of environment, climate change and sustainable development in the context of Pakistan.

→ To provide parliamentarians with a platform to hold dialogues on the issues of environment and climate change in the Pakistan context.

→ To engage parliamentarians on discussions around Pakistan's national and international commitments to climate action and prepare them

for a well-informed discussion around the United Nations Framework Convention on Climate Change's Conference of Parties 23 (UNFCCC's COP23).

GPC has held a number of high-level events, media discussions and one-to-one meetings with interested parliamentarians. It has brought together cross-party parliamentarians to deliberate on national environment and climate change-related issues. The former Minister of Climate Change, Mr Mushahidullah Khan extended his full support to SDPI for furthering the initiative. Another noteworthy achievement was that the former Chairperson of National Assembly's Standing Committee on Climate Change (Mr Malik Muhammad Uzair Khan) and the Parliamentary Secretary to the Ministry of Climate Change (Ms Romina Khurshid Alam) took ownership of the caucus and became driving forces behind the success of the caucus activities. The launch of the caucus and planned activities were very timely, as the Standing Committee of climate change in the National Assembly had held its first meeting and the government was preparing for the UNFCCC's COP23. Mr Malik Muhammad Uzair Khan joined the official delegation of Pakistan at COP23.

Appendix 10 Antimicrobial resistance research

We are grateful to Dr Shaper Mirza, Associate Professor of Biology, and Dr Safee Ullah Chaudhary, Assistant Professor in the Department of Biology, at the LUMS for their contributions to this case study.

Dr Shaper Mirza joined LUMS in 2015 as an Associate Professor in the Department of Biology. She has a BSc from the University of Karachi and a PhD from the University of Alabama. She had previously served as an Assistant Professor for seven years at the University of Texas – Houston Health Science Centre.

Dr Safee Ullah Chaudhary has been an Assistant Professor at LUMS' Department of Biology since 2014. He received his BSc in Computer Systems Engineering from Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, Pakistan, and a PhD in Bio & Brain Engineering from Korea Advanced Institute of Science and Technology, South Korea. At LUMS, he established the Biomedical Informatics Research Laboratory, which focuses on research in computational proteomics, systems biology and mobile health.

In early 2016, while establishing pneumonia research at LUMS, Dr Mirza noticed that there was a high degree of resistance in Pakistan to antibiotics. As in other low and middle-income countries, antibiotics are commonly available in Pakistan as over-the-counter drugs. This has led to indiscriminate use and build-up of antimicrobial resistance to pathogens across the country. In order to reduce the burden caused by resistant pathogens, monitoring of drug resistance patterns is necessary but, only a handful of antimicrobial resistance studies have been conducted in Pakistan. The Pakistan Antimicrobial Resistance Network provides data from local healthcare facilities based in Karachi but does not provide a national picture.

To address this challenge, Drs Mirza and Chaudhary launched a programme to construct models for predicting antimicrobial resistance trends and thereby assist healthcare practitioners in making informed decisions at an institutional and patient level. Involving a PhD candidate at LUMS, they began their research by obtaining data from Aga Khan Hospital in Karachi and Shifa Hospital in Islamabad. However, they soon realised that this data was hospital specific and did not portray an accurate depiction of the situation in the country. As a result, the team approached Chughtai Lab (the largest pathology lab network in Pakistan, with 167 laboratories across the country). Chughtai Lab supplied the team with 5,000 data entries, which has provided the foundation for their study.

While Pakistan's Federal health ministry, the Ministry of National Health Services, Regulations and Coordination, had declared antimicrobial resistance a national emergency in the year 2016, the team's preliminary results concluded that Pakistan was still at a very early stage of dealing with antimicrobial resistance.

To address this challenge, Dr Shaper Mirza helped Pakistan become a partner in the Global Antibiotic Resistance Partnership (GARP). GARP, an initiative of Washington DC-based Centre for Disease Dynamics, Economics and Policy, is an eight-country collaboration across Asia and Africa. GARP's mission is to assist governments to develop and implement national action plans. GARP-Pakistan includes a seven-member group consisting of Dr Ejaz Khan (Shifa International), Dr Faisal Sultan (Shaukat Khanum Hospital), Komal Fiza, Dr Sadia Shakoor, Dr Rumina Hasan (Aga Khan University), Dr Shaper Mirza (LUMS), and Dr Ammad Fahim (Shifa International Hospital). GARP is now working with the Ministry of National Health Services to develop a national action plan to minimise antibiotic resistance. As a first step, a situation analysis was conducted in March 2018 during a Medical Microbiology and Infectious Diseases Conference in Islamabad. The situation analysis represents a joint effort of all GARP-Pakistan members to present a holistic view of the current AMR situation in Pakistan both in human and animal health.

One major challenge has been that funding for antimicrobial resistance research in Pakistan is very limited. The Federal government's Pakistan Health Research Council (PHRC) has a complementary research agenda but has limited capacity and funds to actually support research in this area, and the Higher Education Commission (HEC) also has limited funding available. Moreover, until recently, Pakistan was not represented on the resistance map of the world, and the team realised that their work would need to encompass plugging Pakistan into the growing global discourse on antimicrobial resistance. GARP has assisted the LUMS team with situational analysis support, and the team is now working on a grant proposal in alliance with GARP. Through personal contacts, the team also reached out to Dr Muhammad Hamid Zaman, who teaches at Boston University's Department of Biomedical Engineering, and a collaborative effort is now underway.

In Pakistan, collaboration on antimicrobial resistance research between universities and with the government and business sector is at a fledgling stage. There was an antimicrobial resistance research conference held two years ago but information sharing and networking are limited. The team has started a collaboration with Aga Khan University, and plans to engage with Punjab University in the near future. While there has been minimal collaboration with the federal government's health agencies, the Punjab government has expressed interest. And, although the team has reached out to a few pharmaceutical companies, to date the business sector has shown little interest in their work either in terms of substance or financial support.

LUMS has itself been very supportive of the team's work, and has excellent, well-equipped laboratories. However, it has been difficult to secure research funding. LUMS itself has limited research funds, and outreach to other sources—including

the HEC and USAID—have so far not yielded any funding grants. The team is now looking for funding overseas. Despite these constraints, they have made headway on research and are now drafting their first publication.

Outside occasional conferences, there are no real platforms—such as seminar series or web platforms—to disseminate findings on antimicrobial resistance in Pakistan. With the support of LUMS' ORIC, the team recently published a note in the Business Recorder, the country's biggest financial daily, and plans to engage in related dissemination activities. Dr Mirza notes:

"It will be very helpful to our work if there were regular conferences and, more importantly, seminar series or web platforms, as well as media platforms through which we could collaborate and disseminate our findings."

Appendix 11 **The Al-Khawarizmi Institute of Computer Science**

We are grateful to Dr Waqar Mahmood, Professor and Director of the Al-Khawarizmi Institute of Computer Science at UET, for his contributions to this case study.

The Al-Khawarizmi Institute of Computer Science (KICS) at UET was established in 2002 to conduct research and development activities in Information Technology and Computer Science. KICS' mission is to become a leading research and technology organisation in critical areas of national interest and to take the country towards a knowledge-based economy.

KICS is governed by a board of governors chaired by Dr Fazal Ahmad Khalid, the Vice Chancellor of UET, and is administered by a Director, Dr Waqar Mahmood. Within the constraints of a government-funded university, the Chairman and the Board have provided Dr Waqar and his management team with considerable institutional autonomy. Compared with typical government university departments, administrative and reporting burdens on faculty members and researchers have been reduced, and the institute has been accorded considerable autonomy in making procurement, supporting staff and contracting decisions.

Dr Waqar Mahmood has played a central role in building up KICS in the last ten years. Prior to joining KICS, Dr Mahmood served as faculty member at NUST. He previously served as Director Process Development at CIENA Corporation, Maryland. His research interests include optical communications, process technology development, discrete event systems, networking systems, wireless systems, energy optimisation, power systems and renewable energy. He is the founding member and Director for the Centre for Energy Research and Development (CERAD), which is a leading research centre in Pakistan for renewable technologies development, energy systems evaluation, component testing and validation, trainings and certifications. He received his bachelor's degree from UET and master's and PhD degrees from Georgia Tech USA, all in Electrical Engineering. He has published over 80 peer-reviewed papers and has 12 US patents to his credit.

Currently, KICS has the following research staff strengths distributed over 25 research labs:

RESEARCH STAFF DISTRIBUTION (TOTAL 193)

- PHDS & RESEARCH CONSULTANTS
- SENIOR RESEARCHERS & PHD SCHOLARS
- GRADUATE RESEARCHERS
- POST-GRADUATE RESEARCHERS
- INTERNS
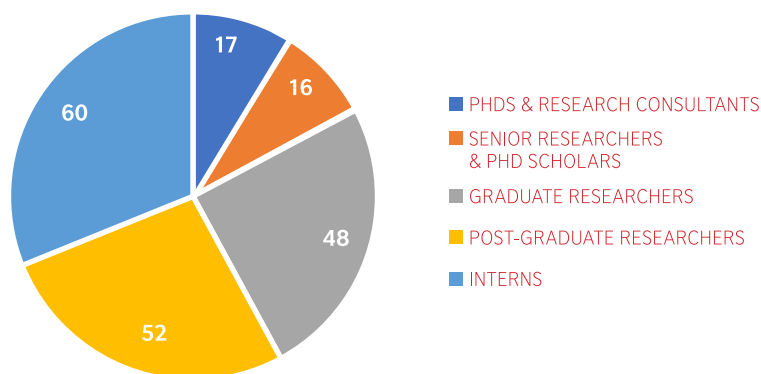
KICS' administrative and support staff comprises 40 members. In the last two years, KICS researchers published over 67 articles in Impact Factor journals and international conference publications. KICS actively encourages its research staff to engage in consulting and collaboration projects and most of the staff is already engaged with government, industry and academic organisations. The Institute organises 40 – 50 seminars every year along with two major international conferences (on the topics of Open Source Systems and Energy Conservation).

KICS has signed MoUs and agreements with more than 100 national and international research and academic organisations, universities and industry for mutual R&D collaborations. Prominent collaborators include Amazon, CISCO, Huwaei, Oxford Dictionary, Mentor Graphics, Microsoft, NOKIA, Pearson VUE, WAPDA, Warid Tel and The World Bank, Broad Institute at Harvard and MIT, Punjab Safe City Authority, Arizona State University and the DFKI Institute.

KICS Research and Collaboration Labs	
High Performance Computing and Networking Lab (HPCNL)	Parallel and distributed computing, virtualisation, cloud computing, big data analytics, performance evaluation and charactersation of high speed networks and multi-core systems.
Wireless Systems Research Lab (WSRL)	Advanced signal processing algorithms for next generation wireless networks including 5G systems.
Next-Generation Wireless Network Lab (NWNL)	Distributed wireless sensor networks, solutions for intelligent security, environment monitoring and energy efficient event-triggered wireless sensor networks.
Enterprise Software Solutions Lab (ESSL)	Automation of power industry in Pakistan, smart grid development, monitoring of generation, demand and distribution.
IoT Research and Innovation Lab (IRIL)	Small energy-efficient platforms to enable Internet connectivity to everyday things, including Internet of Multimedia Things (IoMT).

Motion Control Lab (MCL)	Multidisciplinary/electromechanical systems for precise motion control application in the energy, manufacturing and automobile industry sectors.
Software Systems Research Lab (SSRL)	Software development, customisation of open source software, enterprise level systems, web-based solutions, mobile application solutions, location-based services and network parametric analysis.
UET Game Studio (UGS)	Mobile games for entertainment and edutainment. Expertise include android, iOS and VR based games.
Computer Vision and Machine Learning (CVML) Lab	Image processing tools, computer vision algorithms, natural language processing and computer vision applications.
Artificial Intelligence Research Lab (AIRL)	Fruit-fly detection and structure recognition system for mangoes and citrus fruits. Research collaboration with DAAD, DFKI and TUKL, Germany.
Data Science Research Lab (DSRL)	Structured and unstructured data analytics to perform clustering, classification and association rule mining for textual, web and other forms of data.
National Centre for Artificial Intelligence (NCAI) – criminology lab	NCAI has been established with competitive funding from HEC. NCAI is a state-of-the-art facility for technology development in the AI domain.
University Management System (UMS) Lab	Enterprise Resource Planning ('ERP') and Non-ERP solutions in all UET and affiliated college campuses.
Bioinformatics Research Lab (BRL)	Next-generation chemical and biological databases and front end, electronic notepad development for chemical experimentation.
Industrial Automation and Control Lab (IACL)	IACL executes projects on a turnkey basis, provides consulting solutions and researches new technologies relating to Industrial Instruments and Supervisory Control and Data Acquisition (SCADA) systems.
Energy Efficiency and Conservation Lab (EECL)	EECL focuses on developing industry-academia linkages around energy conservation.
CERAD Innovation Lab (CIL)	Energy related proposals and projects in collaboration with CERAD, UET.
Alternate Energy Research and Innovation Lab (AERIL)	Renewable technologies such as solar energy, wind energy, biomass, energy efficiency, testing, surveillance and remote monitoring and development of energy efficient home and office appliances.
Pearson VUE Testing Centre	Pearson is an International Testing Facility for CISCO, Microsoft, Royal College of Physicians, Saudi Commission for Health Specialists, GMAT, ORACLE, Institute of Internal Audit and others.
Technology Incubation Centre (TIC)	TIC provides students with infrastructure, office space, mentoring and consultancy services to nourish their ideas from seed stage to venture stage.
Centre for Language Engineering (CLE)	Linguistic and computational aspects of languages, specifically Pakistani and other Asian languages.

Huawei UET Telecom and IT Centre (HUTIC)	HUTIC is a pioneering, state-of-the art centre, and has the largest training facilities in the region for telecommunications and data communications. The centre has two training facilities, with equipment worth USD eight million installed by Huawei. For over ten years, certified HUTIC instructors deliver courses at the centre on advanced GSM Technology and on IP Network (Router and Switching) to over 1,000 trainees annually. In a recent event in Shenzhen, one of the HUTIC instructors was declared the world's best instructor. The centre itself gained the world's best network academy award in May 2018 from among 60 academies around the world.

KICS has succeeded in expanding its funding base apart from the HEC. At this stage, KICS total research and funding revenue is above PKR 200 million a year, out of which approximately 35% comes from the HEC as recurring grant.

KICS FUNDING SOURCES

- HEC RECURRING GRANT
- NATIONAL FUNDED RESEARCH (GOVERNMENT)
- NATIONAL FUNDED RESEARCH (BUSINESS)
- INTERNATIONAL FUNDING
- TRAINING
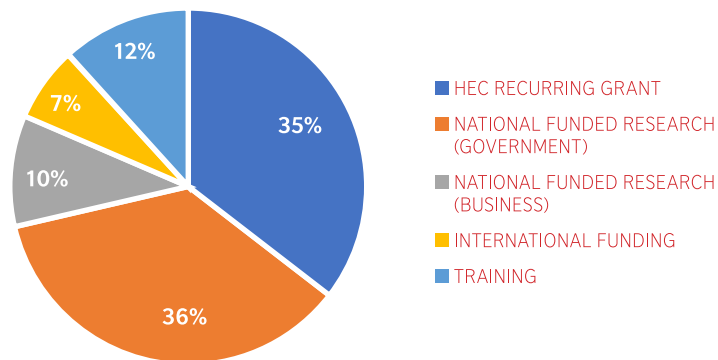
The following is an overview of three significant research and collaboration projects led by KICS:

KICS Illustrative Research and Collaboration Initiatives	
Conservation in Punjab	In 2013 – 14, KICS supported the launch of the Chief Minister's Ujaala project, the first major solar energy project by Punjab Energy Department (PED). KICS assisted the PED in the preparation of technical specifications for a solar home solution (SHS), in prototype testing and in contract award. In 2016, KICS conducted validation of project execution, Terms of Reference and functionality of distributed systems. The validation process involved collection and analysis of feedback from 30,000 direct beneficiaries.
	KICS has also supported PED with technical assistance for various other projects including the 100 MW Quaid-e-Azam solar park, solarisation of 50 government offices, basic health units, and off-grid schools.
	KICS has also acted as a supporting partner of Punjab Energy Efficiency and Conservation Agency (PEECA) since its establishment in 2016. KICS has supported PEECA in equipment requirements design and evaluation, staff trainings and public awareness development. KICS teams have conducted walk-through audits and provided retrofitting recommendations for various commercial sector buildings and submitted detailed analysis reports to PEECA for further processing. Significant consumption saving potentials has been identified in active loads during these audits. KICS has also conducted 28 commercial level-1 energy audits for PEECA for major infrastructure facilities such as the Lahore Ring Road and major buildings such as the Children's Library and Children's Hospital.
	At present, KICS is executing energy audits of public sector buildings including university campuses, hospitals, medical colleges and other government institutions.
	KICS also co-manages two testing facilities at the UET-KSK campus: a PV testing facility and a luminaire testing facility. These facilities have performed qualification and standardised testing for a number of government and university buildings, as well facilities in other provinces.
Urdu Search Engine	Research indicates that indigenously developed search engines are more successful in helping communities to access localised content, primarily because they offer language and culture specific services. For example, as of 2012, Google had only 8%, 22% and 31% share of the search market in South Korea, China and Japan respectively, which was a considerably smaller share than the search engines developed locally.
	In a project funded by Ignite, KICS successfully developed an Urdu search engine to address national and linguistic requirements. The project involved high performance distributed computing, content search optimisation and local content management. Applications were developed for crawling, filtering, indexing and summarising search results. In the first effort to analyse global web data for Urdu language content, the project analysed common crawl data on Amazon web services of more than 100 Terabyte using hadoop clusters.

Acoustic Tracking and Surveillance System for Punjab Safe Cities	KICS has been working with the Punjab Safe City Authority (PSCA) to provide a citywide acoustic surveillance solution.
	KICS has designed an audio surveillance solution for 300 camera sites spread throughout the city, which provides continuous audio surveillance and event notifications at each camera location.
	KICS designed customised dedicated hardware as well as a centralised server application software. The design and manufacturing of the solution has been completed and the solution has been deployed at more than 200 sites. The software application providing the main features has been deployed at PSCA command and control centre.

Appendix 12 **Improving the quality measurement system**

We are grateful to Dr Muddassar Farooq, Professor and and Dean at AIR University in Islamabad, for his contributions to this case study.

Dr Muddassar Farooq is Dean at AIR University in Islamabad. From 2013 to 2017, he served as Dean of the Institute of Space Technology in Islamabad. He is a leading advocate for the reform of the journal ranking system and publications quality ranking of universities used by the HEC and has developed deeper quality metrics for adoption by the HEC.

After exhaustively researching new quality benchmarking approaches used around the world, Dr Farooq settled on two factors (Eigenfactor and Article Influence Score) used by the University of Washington, Seattle, and three factors (SJR Indicator, H-Index and CD (2 Years Factor, which is equivalent of Impact Factor as determined by Scopus)) used in SCImago, a journal and country ranking portal that uses journals included in the SCOPUS database developed by Elsevier, an information solutions company.

| Proposed Factors	
Eigenfactor	Developed by two professors at the University of Washington, *Eigenfactor* uses recent advances in network analysis to develop novel methods for evaluating the influence of scholarly periodicals, for mapping the structure of academic research, and for helping researchers navigate the scholarly literature.
Article Influence Score	The *Article Influence Score* determines the average influence of a journal's articles over the first five years after publication.
SJR Indicator	*SCImago Journal Rank (SJR indicator)* is a measure of scientific influence of scholarly journals that accounts for both the number of citations received by a journal and the importance or prestige of the applicable journal.
H-Index	The *H-Index* is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The index is based on the set of the applicable individual's most cited papers and the number of citations that they have received in other publications. The same measure may be used for a journal as well.
CD (2 Years) Factor	The *CD (2 Years) Factor* is based on the number of citable documents published by a journal in the SCOPUS journal database in the previous two years. This is the same as Impact Factor but citations are computed from the SCOPUS database.

Using these factors, Dr Farooq devised a system which he has named the Journal Quality Ranking System (JQRS) and which he has now brought on to the web. JQRS enables the ranking of a journal by each of these five factors and then generates an aggregated and averaged score. This system provides a much deeper insight into the quality and prestige of a journal in which an author has published his article.

In 2015, Dr Farooq took the JQRS to the HEC, which provided him with data on the

12,000 articles published from Pakistani universities in that year. Dr Farooq ran the data through the JQRS system and aggregated the results for each university. He then published his findings on the web through a platform named Publications Quality Ranking Framework for Universities (PQRFU).

Even allowing the prevailing HEC ranking system to provide 50% weighting in a composite score, and Dr Farooq's system to provide 50% weighting in the composite score, the results are quite dramatic. For example, in 2015, COMSATS published 1,300 articles and LUMS published 140 articles. COMSATS was at the top of the HEC rankings and LUMS was far below. But when the rankings were adjusted for the quality factors used by JQRS, LUMS rose significantly in ranking and in comparison, COMSATS dropped significantly in ranking.

COMSATS INSTITUTE OF INFORMATION TECHNOLOGY, ISLAMABAD - 2015
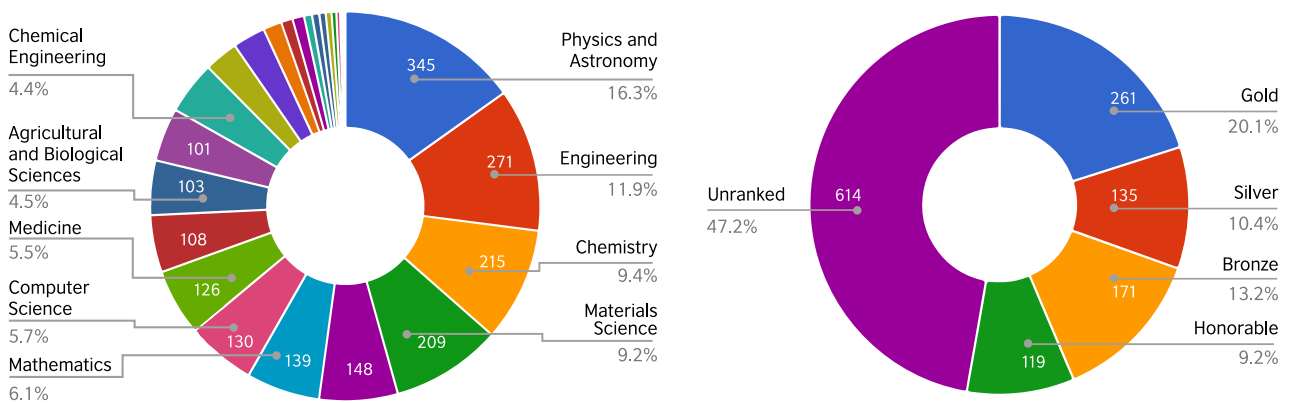
LAHORE UNIVERSITY OF MANAGEMENT SCIENCES, LAHORE. - 2015
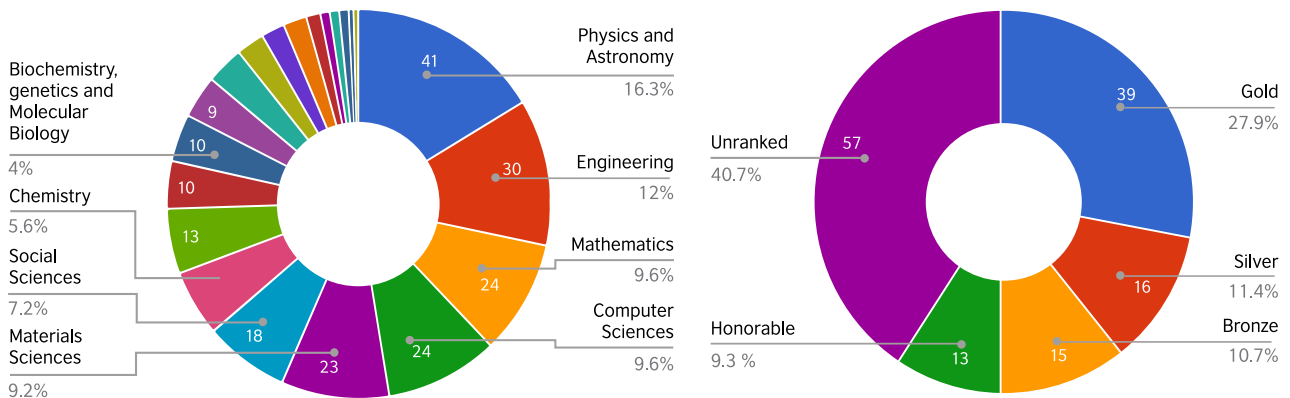
In 2017, the HEC decided to construct its own improved ranking system based on Dr Farooq's research, and floated a tender for a company to build and manage the

new ranking system. The contract has been awarded and a new ranking system is now being developed.

Even after this new ranking system is developed, there is the further question of whether the system will serve as a supplementary ranking system or whether it will be taken up as the method used by HEC for evaluating researchers and universities.

In the meantime, Dr Farooq is working on an even broader evaluation system that takes into account faculty activity in terms of: (1) patents; (2) conference papers; (3) workshops; (4) start-ups; and (5) consultancies. This evaluation system focuses the impact that a faculty member has created on society by looking at his or her contributions in a number of domains: teaching, research, consultancy, intellectual property, research funding, and start-ups. Using this system, he led a committee of eminent university professors that has proposed a new promotion framework for granting tenure to faculty members. The HEC is still considering whether or not to adopt this system.

Dr Farooq strongly believes that until the HEC makes its promotion criteria and university ranking system more rigorous (i.e. something more sophisticated than its current focus on "Quality Research" and "Impact on Society"), it will be impossible to reverse the prevailing trend of publishing large numbers of papers in junk publications which have no relevance to national problems.

Appendix 13 Terrorism studies in Pakistan

We are grateful to Muhammed Feyyaz, Assistant Professor at the School of Governance and Society at UMT, for his contributions to this case study.

Pakistan has suffered greatly from terrorism at a human, economic and existential level. By some estimates, since September 11, 2001, terrorism has claimed more than 50,000 lives in Pakistan and cost the economy more than GBP 80 billion. While the scourge of terrorism has given rise to a few individual experts, typically non-academic, in the country (most notably, Mr Ahmed Rashid, who has authored international bestsellers on the Taliban and Central Asia), it has engendered little systematic, institutionalised study at the academic level.

Mr Muhammed Feyyaz, Assistant Professor at the School of Governance and Society at UMT, is a rare individual who has jumped into counterterrorism studies. Previously an infantry officer in the Pakistan Army, his interest in terrorism studies grew while he was stationed in North Waziristan in 2006. He holds an MPhil in Peace and Conflict Studies from the National Defence University and a master's degree in War Studies from Quaid-e-Azam University, both in Islamabad. He also earned diplomas in Infantry Tactics from the US Army Infantry School, Georgia, and Conflict Management from the Modern Institute of Informatics and Management, Islamabad. In 2018, he will be taking a sabbatical from UMT to do his PhD in terrorism studies from Queen's University Belfast.

Mr Feyyaz has published papers on multiple dimensions of terrorism in Pakistan in prestigious international academic journals, including an interesting publication in Journal of Strategic Study entitled "*Why Pakistan Does Not Have a Counterterrorism Narrative*". He has also organised and taught several courses on counterterrorism, including *Understanding, Managing and Resolving Terrorism*, in which international experts on counterterrorism, strategic communications and political violence participated as faculty. His most recent course on counterterrorism had about 50 students, of whom 35 were serving officers in the military and two were generals. He noted: "UMT has been very supportive of my work and the army has been equally supportive. [Chief of Army Staff] General Bajwa personally led the support of the military for my course."

Mr Feyyaz is only aware of four individuals who are working in Pakistan and have a PhD in this field of study. Two of them - Dr Khuram Iqbal at the National Defence University in Islamabad and Dr Dayyab Gilani at Punjab University in Lahore – are presently in the academic sector and incorporate terrorism studies into their coursework. "There is a drought in the academic study of terrorism despite its massive social, economic and political impact," he notes. "For instance, in a two-day international seminar on countering terrorism in Pakistan organised by the National Counter Terrorism Authority in Islamabad in 2018, there were

no well-researched or academically grounded perspectives on terrorism or counterterrorism offered by Pakistani scholars from this field."

One factor, Mr Feyyaz believes, why there is such minimal interest in counterterrorism studies is that the social sciences are critically underdeveloped, and there is little capacity in the discipline to give rise to rigorous research-based discourse on the social and political challenges facing Pakistan. He identifies another factor as the complete lack of interest of the civilian government. "In the West, Singapore and other advanced countries, government demand as well as support has led to the phenomenal growth of terrorism literature, terrorist study consortia, research journals and degree programmes. In Pakistan, not only does the civilian government have little interest in promoting terrorism studies, it tends to treat terrorist violence as a generalised form of violence. For example, the government has apprehended many terrorists, who are either hung or locked away. There is no institutionalised or systematic attempt to understand these people from a psychological, social or political perspective, or engage with them to obtain perspectives that will help make society safer and less violent."

Mr Feyyaz plans to return to UMT after he completes his PhD to drive a broader counterterrorism studies initiative at the university. "This is my life's work," he says. "We are not going to be able to eliminate terrorism if we don't acquire a deep understanding of its causes and social dynamics as well as the internal functioning of terrorist organisations."

Appendix 14 The rise and fall of the Applied Economics Research Centre

We are grateful to Dr Kaiser Bengali, Professor of Economics and Dean of the Economics Department at SZABIST Karachi, for his contributions to this case study.

From 1973 to 1988, the Applied Economics Research Centre (AERC) at the University of Karachi was a leading national think tank on economic policy and research. Under the leadership of Dr Hafiz Pasha, and later Dr Salim Chishti, AERC was able to develop a cluster of competent economists, many of whom continue to serve as leaders of the economics profession in Pakistan.

Sajjad Akhtar	Chief Statistician Pakistan Bureau of Statistics (2016 – Present). He has been a consultant at DFID, ILO, UNDP, USAID (2010 – 2015), as well as Director Centre for Research on Poverty Reduction and Income Distribution (2004 – 2007).
Shahid Alam	Professor at Northeastern University and author of several well-regarded economics books and journal articles.
Anjum Altaf	Economist at The World Bank, he has also served as Dean of the School at the Lahore University of Management Sciences and Vice President and Provost of Habib University Karachi.
Kaiser Bengali	Professor of Economics and Dean of the Economics Department at SZABIST Karachi. Formerly Director of the Social Policy Development Centre, he has also held several other academic positions in Pakistan and internationally.
Hanid Mukhtar	Successful academic career which included a long stint as a Macroeconomist at The World Bank (1990 – 2014).
Hafiz Pasha	Founder of AERC. He remains a leading economist in the country. He was Assistant Secretary General UN and Director UNDP (2001 – 2007) and has served as Federal Minister for Finance and Economic Affairs, Deputy Chairman Planning Commission and Minister for Education.
Hafeez Shaikh	Successful career at The World Bank. He has also served as Federal Finance Minister (2011 – 2013) and Federal Minister Privatisation and Investment (2003 – 2006).
Shahid Zahid	Successful career at the Asian Development Bank (2000 – 2013).
Asad Zaman	One of Pakistan's leading Econometricians, he is Vice Chancellor at the Pakistan Institute of Development Economics.

From 1973 to 1988, AERC was a leader in applied economic research. High-quality papers were produced by the faculty on important areas such as agricultural pricing and productivity, econometrics modelling, housing, local government, public finance, urban planning and water pricing.

Sadly, AERC's success was not sustainable. In the 1990s, it lost human capital as well as its leadership position—blows from which it has not recovered. The reasons for its decline are instructive, especially as they seem to be common to the decline of many potential centres of excellence:

→ **Sponsor withdraws and is not replaced.** In the mid-1980s, AERC lost its principal sponsor, the Ford Foundation, when the foundation withdrew

from Pakistan. No domestic support either from the government or the private sector was available. As a result, cutbacks in faculty and programmes became necessary.

→ **Bureaucracy takes over.** AERC was situated in the University of Karachi as an independent think tank with its own board of directors. In the 1980s, for political and administrative reasons, its independence was withdrawn, and it was made part of the university. Given the difficult financial situation and the distant and more bureaucratic administration system, the centre struggled to entice its accustomed calibre of leadership. For these reasons, the Director's position remained vacant for extended periods of time. For the periods 2007 – 2009 and 2013 – 2016, AERC was managed part-time by the Dean of the Faculty of Arts at the University of Karachi.

→ **Institutional and environmental pressures degrade quality and integrity.** Once a part of the University of Karachi, AERC became embroiled in local politics at both university and city level. To accommodate factionalism, standards were lowered and malpractices such as plagiarism and cheating went unpunished. Meanwhile, growing violence in the city spilled over into the university and the centre, making both the university and the centre unattractive academic institutions.

→ **Brain drain.** As the centre deteriorated, talent that had been assembled began to leave for lucrative international assignments while their replacements could not be found as AERC retained neither the profile of a centre of excellence nor could it offer career incentives expected by outstanding academics.

The story of the decline of AERC is quite familiar in Pakistan. Pakistan Institute of Development Economics in Islamabad, Government College in Lahore, Quaid-i-Azam University in Islamabad and other academic institutions have briefly blossomed before becoming lingering bureaucracies. The pattern remains the same.

Some clustering of good people occurs thanks to some enlightened leadership which has been given autonomy and funding (usually by an external donor). As the donor withdraws, domestic funding is stringent and comes with tight bureaucratic strings. Local bureaucracy places excessive constraints, making the place unattractive for assembled and aspiring talent.

A brain drain ensues, as talented people leave such institutions to go overseas or even to local donor offices. A vicious cycle of decline sets in and the glimmerings of intellectual vibrancy fade into a distant memory.

Appendix 15 Challenges in disseminating wind energy research at UMT

We are grateful to Dr Sajjad Haider Shami, Professor and Chairman of the Electrical Engineering Department at UMT Lahore, for his contributions to this case study.

In 2016, Renewable and Sustainable Energy Reviews, an international journal with an Impact Factor of 9.1, published a paper entitled Evaluating Wind Energy Potential in Pakistan's Three Provinces, With Proposal for Integration into National Power Grid. The authors of the paper were Sajjad Haider Shami, Jameel Ahmad, Raheel Zafar and Muhammad Haris, faculty from UMT in Lahore, and Sajid Bashir, faculty from NUST in Islamabad.

The paper noted the country's crippling electricity shortage: the installed power generation capacity of 22,800 MW (principally a mix of hydro, thermal and nuclear capacity) would in trough periods hit a low of actual power generation capacity of 9,000 MW. It noted that in 2013 the country suffered a power shortage of more than 5,000 MW during peak demand months. The paper sought to investigate how wind power, which had been estimated to have a gross potential installable capacity of 349,000 MW (with readily realisable capacity of 133,000 MW) across the country, could be harnessed to address this huge national challenge.

Drawing on data from the Pakistan Meteorological Department (PMD) and data and wind maps from the National Renewable Energy Laboratory (NERL), a US organisation that had worked in Pakistan with USAID funding, the paper noted that the Provinces of Balochistan, Sindh and Khyber Pakhtunkhwa had particularly abundant wind power potential, while Punjab had some limited potential in confined areas. According to Dr Shami, the paper represented a seminal nationwide study of the practical potential for exploitation of the country's abundant wind power potential.

The paper focused in particular on Balochistan, which it estimated to have the potential for generating 64,000 MW of cost-effective and reliable wind power generation. Based on a study of wind speeds and seasonality, it identified Jiwani, a sparsely populated area in Balochistan, as a particularly high potential but entirely undeveloped region for wind power development. It then delineated infrastructure development in terms of rail linkages, transmission linkages and power conversion systems that would need to be undertaken to exploit the wind power potential of Jiwani and integrate its power generation capacity with the national grid. The paper concluded by noting that proper exploitation of the country's wind power potential would enable Pakistan to solve its electrical energy crisis using a renewable resource at a very low production cost.

After publication, the paper was disseminated within UMT to considerable acclaim. The university provided a small cash award to its contributing faculty members

and bestowed on the paper the Best Research Publication Award for 2016. A small group of faculty members came together at a university research club meeting to form a small dissemination and consulting group to promote wind power development as outlined in the paper.

The group contacted some overseas wind power suppliers, who demonstrated an interest. A couple of faculty members also presented the paper's findings to a senior official at the Punjab Information Technology Board (which has a reputation for piloting and driving innovations and runs Plan 9, a technology enterprise incubation hub), who promised to take up the matter with the office of the Chief Minister of the Punjab. But, despite follow ups by the faculty members, the matter was not pursued further by the official.

With the untimely passing away of one of the members of the UMT dissemination group and the press of responsibilities on other group leaders, the cause of wind power at UMT is in a lull and has not been interlinked with other potentially interested actors across the country. So far, no linkages have been established with government actors such as the Alternative Energy Development Board or the Balochistan Government or with media firms or business groups in Pakistan. Linkages with other universities—despite the participation of a NUST faculty member in the original paper—have also been minimal.

Dr Shami notes: "Much of the dissemination effort regarding this nationally significant research has depended on the limited resources of individual professors, with the full encouragement of the university. We would really benefit from platforms—both face-to-face and online—that would encourage discourse between academia, government, media and business."

Appendix 16 The UCL Grand Challenges at University College London

We are grateful to Professor David Price, Professor and Vice-Provost (Research) at University College London, and Dr Ian Scott, Director of UCL Grand Challenges & Cross-Disciplinary Development at University College London, for their contributions to this case study.

In 2009, University College London (UCL) made a major commitment to thematic, cross-disciplinary research by establishing the UCL Grand Challenges.
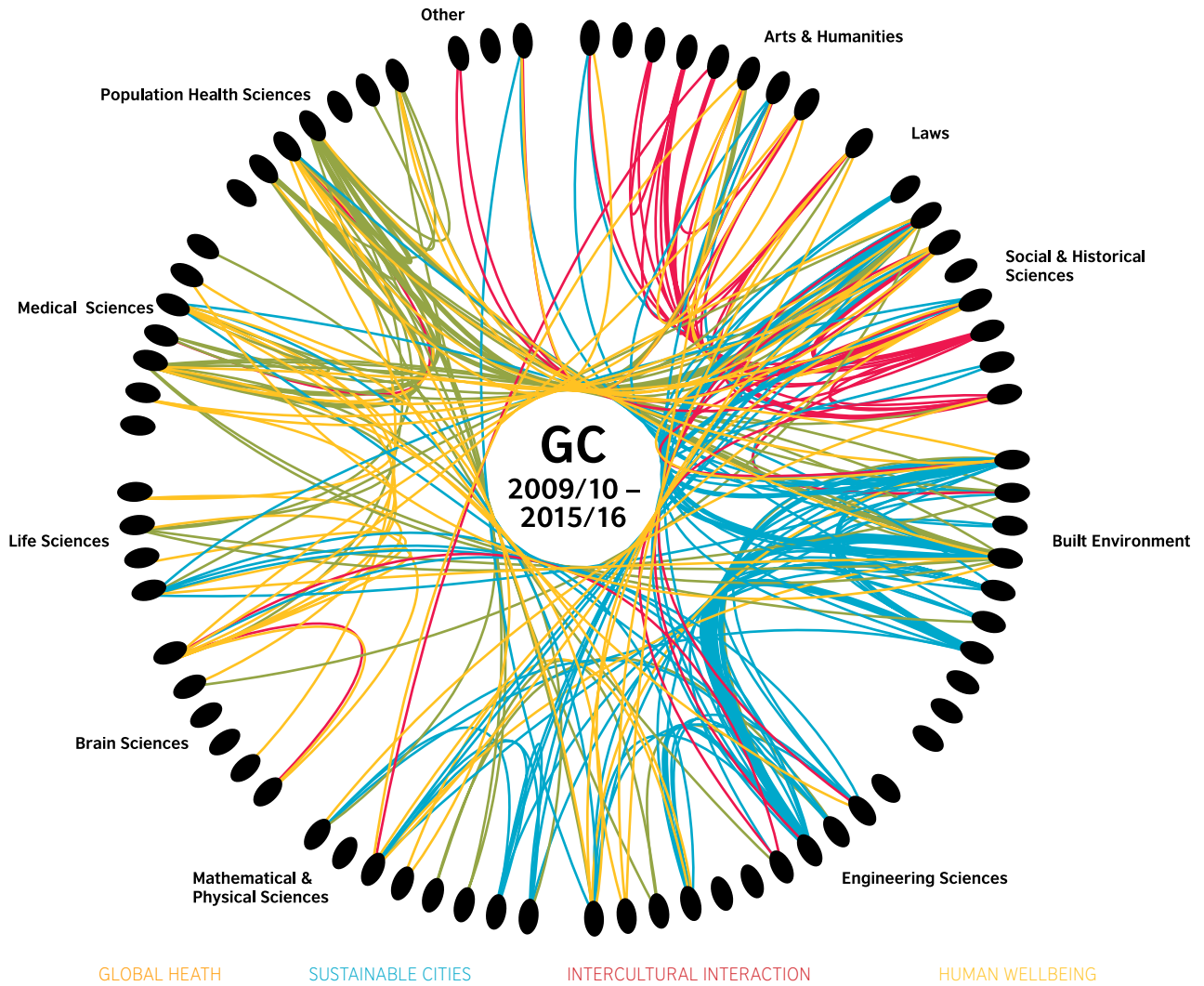
The UCL Grand Challenges advances UCL's commitment to research that has impact, which is defined as the beneficial application of expertise, knowledge, analysis, discovery or insight, primarily delivered through scholarly outputs, education, public engagement, translational research, commercial and social enterprise activity, and influence on, public policy and professional practice.

The UCL Grand Challenges aims to bring together researchers from within and outside the university by providing: (1) small grants to UCL researchers; (2) funding for major UCL research projects; and (3) funding for research-related events led by UCL academics.

Complementing the UCL Grand Challenges are Research Domains, inter-disciplinary research communities designed to help academics from different subject areas collaborate to consider a common theme. The current Research Domains are:

→ Neuroscience

→ Personalised Medicine

→ Populations and Lifelong Health

→ Environment

→ eResearch

→ Cancer

→ Collaborative Social Science

→ Food, Metabolism and Society

→ Space (to be launched)

→ Microbiology (to be launched).

Professor David Price, Vice-Provost (Research) at UCL, notes: "We encourage tying grand challenge questions to thematic areas of interest (e.g. transport, water) and regions. For example, we brought together colleagues from different disciplines at UCL to conduct research on 'the effect of climate change on global health'. This resulted in cross-disciplinary papers and conferences, and we are now a world

UCL GRAND CHALLENGES SMALL GRANT-ENABLED INTERDEPARTMENTAL COLLABORATIONS (2009/10- 2015/16)

Other
Arts & Humanities
Population Health Sciences
Laws
Social & Historical Sciences
Medical Sciences

GC
2009/10 –
2015/16

Built Environment
Life Sciences
Brain Sciences
Engineering Sciences
Mathematical & Physical Sciences

GLOBAL HEATH SUSTAINABLE CITIES INTERCULTURAL INTERACTION HUMAN WELLBEING

leader on this topic."

Professor Price also notes: "For thematic areas, we use three layers of research segmentation: foundational; application; and social impact. This ensures that some funding is directed towards and focus is given to all three layers."

The focus on research on selected themes, and on three layers of thematic research, has spawned a considerable degree of collaboration across departments. The diagram above visualises cross-disciplinary research stimulated by selected UCL Grand Challenge themes.

The research program at UCL balances a complex set of factors. The emphasis on research with impact constitutes an overarching orientation for research. Segmentation of research funding under the UCL Grand Challenges into grants for small initiatives, major projects and events enables funding of a range of initiatives. Segmentation of research funding into foundational, application and social impact research layers ensures that all levels of research are being addressed. And the identification of research domains and cross-disciplinary themes allows for breakthrough, meaningful impact.

Appendix 17 **The research systems in China, India and the United Kingdom**

China

China is acutely aware of the developmental imperative of a well-conceived national R&D programme that cultivates academic research as a collective social instrument—all the more so given its impending macroeconomic shift from an export-led to domestic demand-led, productivity-oriented growth model. It has steadily increased research spending as a percentage of GDP from 0.5% in 1996 to 2.1% in 2015, in view of a target 2.5% by 2020. Consequently, the country has witnessed a metastasisation of domestic patent applications, alongside a flourishing of journal-based academic scholarship.
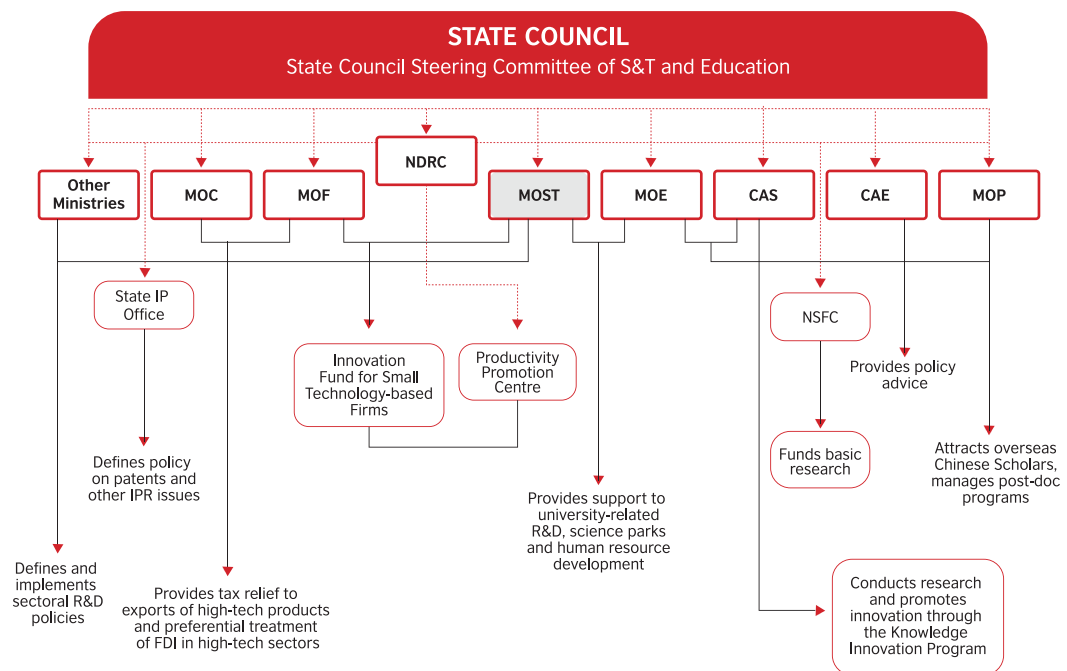
In spite of such cosmetic ferment, however, McKinsey's *The China Effect on Global Innovation* (2015) notes that the research initiatives and policies heretofore implemented have 'yet to give China a lead in science-based innovation.' Nevertheless, China is closing this gap with a manifest ardour. The Chinese national research system, not unlike most national programmes in China, has been conceived purposively as a constitutive element in the country's cosmological economic project. In the research planning process has been enumerated many themes of immediate importance to the expansion of national productive capacities.

Perhaps the most notable element of the Chinese system is its social and political

valorisation of academic research, by way of the latter's institutional centralisation in the orbit of major state organs. The major bodies for research funding and regulation—The Chinese Academy of Social Science (CASS) and the National Natural Science Foundation of China (NSFC)—both report directly to the State Council of China. The State Council is the foremost governmental policymaking body in China and has ultimate prerogative over science, technology and innovation policy. The Steering Committee of Science, Technology and Education of the State Council is another major actor, serving as a coordinator of decision-making amongst the matrix of governmental bodies.

The National Development Research Council (NDRC) determines the country's long-term development strategy. The NDRC, in coordination with the Ministry of Science and Technology (MOST), particularises the nation's research and development agenda and integrates it into the country's national five-year economic plans.

NSFC administers the National Natural Science Fund received annually from the central government, distributing funds on the basis of a 'rigorous and objective merit-review system,' in accordance with 'the Government's strategies and plans for the development of science and technology.' Several independent scientific associations—China Academy of Sciences, China Academy of Engineering, and China Academy of Science and Technology—play important roles in developing professional research networks and offering managerial guidance to academic institutions. More broadly, the NSFC is responsible for making effective use of the national natural science fund to 'support basic research and stimulate free exploration, identify and foster scientific talents, as well as to promote progress in science and technology and the harmonious socioeconomic development of the nation.'

With respect to the social sciences, all research programmes are guided by the Chinese Academy of the Social Sciences (CASS), an organisation with a mandate to 'encourage advancement and innovation in the scientific researches of philosophy, social science and social policy.' CASS comprises many research centres, across which it distributes, on the basis of a competitive grants programme, an annual budget disbursed to it by the National Social Sciences Fund. Of late, it has established an Academy for Social Sciences Evaluation (ASSE) bureau, which aims to formalise the competitive grants process.

Three important points, then, emerge in understanding the Chinese approach to research.

> → Between the substantive academic realm and the major policymaking bodies there is nothing in the way of mediation—an unencumbered

vent runs directly from academic practitioners to policymakers.

→ As well as the centralising and subsuming tendencies of a research programme constituted principally with a view to develop national productive capacities, the sheer number of institutionally decentred research networks means that the Chinese system is becoming more dynamic.

→ Regional bodies are largely self-regulating.

→ The system fosters competition through a performance-based hierarchical taxonomy of 'champions', all of whom are granted further funding and other privileges. China has also changed its patent laws in line with the US Bayh-Dole Act (1980) to allow researchers to commercialise research that they may have developed with the support of public funds.

Finally, it is worth noting that, as with everything else in China, change is constant. At the time of writing, a World Bank mission is documenting a dramatic expansion of MOST, to the effect that it will evolve into a much more dominant actor in the Chinese research and innovation landscape. In addition, a new public policy/social science think tank is being planned, which will operate in tandem with the NDRC.

India

India is home to one of the largest and most dynamic education and research systems across the developing world, due to the vast networks of indigenous research associations that were established during the colonial era. After Independence, domestic leaders cultivated these arrangements as a commanding catalyst of modernisation.

India's more than 800 state universities (in particular the widely acclaimed IIT cluster), over 130 independent institutes and over 280 think tanks (the fourth-largest number of national think tanks the world over) are well known in international academic communities.

In spite of the evident breath of the Indian system, only 0.63% of GDP is spent on Research and Development, ranking the country 37th globally in terms of gross R&D expenditure.

Five autonomous bodies drive India's R&D system:

→ The Indian Council of Medical Research, set up in 1949 and tasked with the formulation, coordination and promotion of bio-medical researches.

→ The Indian Council of Agricultural Research, set up in 1929 and tasked with the coordination and management of agricultural and horticultural research studies.

→ The Indian Council for Social Science Research (ICSSR), founded in 1969 by the Government of India to promote research in the social sciences.

→ The Council of Scientific and Industrial Research, established in 1942 as India's largest R&D organisation, has a wide remit encompassing aerospace engineering, structural engineering, the life sciences and the environment.

→ The Tata Institute of Fundamental Research, a private sector research body set up in 1945 by the Tata Group and funded principally by the national government. Based in Mumbai, it is dedicated to basic research studies in mathematics, technology, computing and basic sciences.

Research funding is mediated by these councils. Governmental ministries, especially those cognate to the natural sciences, do unilaterally initiate certain thematic subjects to be pursued by the councils, and occasionally also call for proposals from the broader public domain without the ambit of the councils.

Each of these apex bodies have a number of associated research centres across India. They allocate funds across these centres on the basis of competitive grant applications, and also seek out associations with international bodies to garner additional funding and managerial techniques.

Funding for natural science research in India originates in the 'Science Budget' component of the annual national 'Union Budget.' In that budget, governmental ministries delineate detailed spending plans, organised thematically into subjects considered to be of national social and economic import. For example, the 2018 – 19 budget mandated an allocation of INR 30.7 billion for artificial intelligence, cyber systems, robotics and the Internet of Things. In the same 2018 – 19 budget, the Department of Space, given that it is gearing up for its second moon mission in 2019 and is working on a project to study the sun in 2019 – 20, received an 18.5% increase in its budget to INR 107.8 billion, whereas the Ministry of Science and Technology received only an 8.5% increase.

The Planning Commission of India operates as the major financing agent for the social sciences. Some of the ICSSR's constituent institutes are closely associated with national and state level planning development agencies and have thereby strengthened the links between academia and policymaking. With regards to governance, both the ICSSR and its institutes are headed and staffed by

academics—discipline-specific academics in the case of the institutes.

Although no formal evaluation system for research exists, the councils do periodically engage in review of their work by independent commissions consisting of well-known academics. In addition, the government has set up specialised commissions to produce retroactive scholarship on the state of social science research in India. Already, a strong bias against social science research, with respect to the allocation of finances, has been noted.

Thematic research in India emerges naturally from the division of scholarship among the councils' constituent institutes. As discussed above, unilateral initiatives also prevail, in particular at the annual interfacing of policymakers and academics in the constitution of the national science budget.

India also has a vibrant, financially autonomous, private sector research landscape which includes institutes such as the Indian Council for Research on International Economic Relations (ICRIER), National Council of Applied Economic Research (NCAER)and Centre for Study of Society and Secularism (CSSS), all of which have been accreting in importance in recent years. Here, independent inquiry predominates to quite fastidious effect, with the institutes exercising acute discernment as to the perennial possibility that their prerogative be arrogated to national organs.

Hundred flowers do not as yet bloom, however. The evaluation system in particular is mired in a staid overuse of quantitative metrics as average and cumulative Impact Factors. In the same vein, the exaggerated importance attributed to gross number of publications, irrespective of their substantive contents, has given rise to a veritable ethical crisis in scholarly communication and competition. The general impression is that despite much verve, the Indian system falters when it comes to translating research efforts into a stable R&D policy regime. The system seems overly bureaucratised, lacking in quality consistency, unable to engage policy-makers and, therefore, in its totality, fledgling with respect to its existence as a catalyst of social advancement.

United Kingdom

In 2014, a UK government-commissioned independent evaluation of the state of British research noted that the UK 'punches above its weight,' representing, globally, just 0.9% of the total population, 2.7% of R&D expenditure, and 4.1% of researchers, yet accounts for 9.9% of downloads, 10.7% of citations and 15.2% of the most highly-cited articles the world over.

At the apex of the system is the Department for Business, Energy and Industrial Strategy (BEIS). BEIS allocates funding across its three constituent institutional pillars.

First, four regional bodies, each comprising governing councils of academics drawn from a variety of disciplines, provide block grants to research institutions with the intention of supporting 'basic research infrastructures' and 'discretionary research.'

Second, in addition to the regional bodies, nine research councils specialising in particular domains of inquiry across both the natural and social sciences fund discipline-specific research through peer-review. A 2017 act corralled all the councils under the preserve of UK Research and Innovation (UKRI). With an operating budget of over GBP six billion, UKRI 'connects the best researchers and innovators with customers, users and the public' via the expert councils. All councils consist of an executive chair and between five and twelve ordinary members drawn from the relevant academic communities. Given their reliance on public-financing, the councils are held accountable to Parliament for their investment expenditures.

Research Councils distribute funds to individuals and groups on the basis of decentralised grant applications, whereas the higher education funding bodies distribute funds to institutions on the basis of broad research performance. Research Councils generate lead research in their areas by providing funding to researchers working in emergent lines of inquiry. The system allows thematic research to at first arise by way of the volition of independent researchers, and thereafter bolsters its chances of fruition through targeted monetary and infrastructural support.

This structure enables the realisation of a superlatively dynamic approach to research.

In particular, it encourages innovation, problem-solving and multidisciplinary research. It also foments relationships between academia and non-academic social stakeholders to seek 'solutions to the world's problems.' The natural consequence is to 'build bridges between academics and charities, lobby groups and local authorities,' with a view to innovation and solving pressing problems through academic expertise and research.

Finally, the pioneering research evaluation system known as the Research Excellence Framework (REF) supplies the system with a rigorous approach to evaluation that takes into account research quality, impact and innovation. The REF was first carried out in 2014 by the four higher education funding bodies as

a barometer to gauge whether the system was indeed delivering 'a world-class, dynamic and responsive research base across the full academic spectrum within UK higher education.' The objectives of the REF are threefold: 1) to assess the gross net returns to 'public investment in research'; 2) to benchmark innovation and 'establish reputational metrics for use within higher education and for public information;' and 3) to 'inform the selective allocation of funding for research.'

As articulated by the REF itself, it is a process of expert review carried out by expert panels for each of the 34 subject-based units of assessment (UOAs), under the guidance of four main panels. Expert panels are made up of senior academics, international members, and research users. For each submission, three distinct elements are assessed: the quality of outputs (e.g. publications, performances, and exhibitions), their impact beyond academia and the environment that supports research.