# LUMS
## A Not-for-Profit University

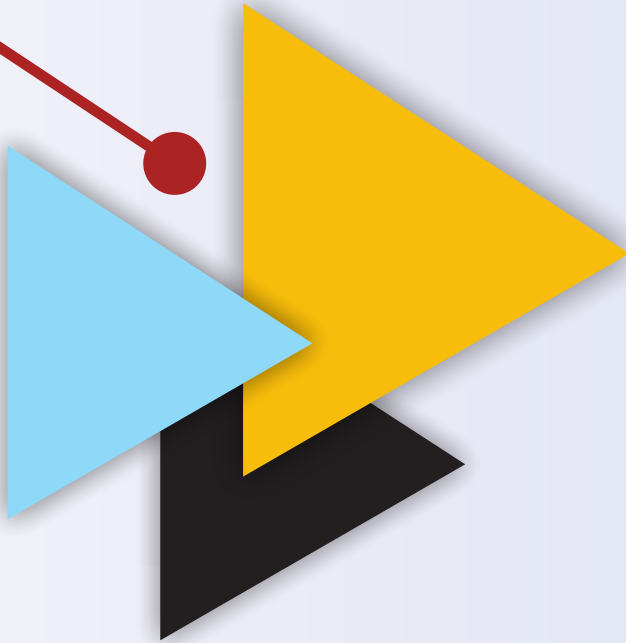Learning *Without* Borders

**Office of Research**

## Annual Report

# Research Portfolio

## 2018–20

# LUMS | Office of Research

# Office of Research (OR)

The Office of Research (OR) is actively pursuing its mandate to promote research culture at LUMS and is acting as a bridge between the LUMS faculty and external funding agencies and managing internally sponsored research activities at LUMS. The aim of OR is to ensure that all submitted proposals conform to sponsor guidelines and LUMS policies, and if funded, the projects comply with sponsor requirements and applicable LUMS policies and procedures. Sponsored research includes, but is not limited to, externally funded research proposals; unrestricted grants; travel grants; sponsored conferences, workshops, seminars; consulting assignments; service activities; contracts; agreements and arrangements related to sponsored and externally funded activities. Moreover, the OR also manages internal grants, which are provided by LUMS including the Faculty Initiative Fund (FIF), Faculty Travel Grant (FTG) and Start-up Grants.

Recently OR has set up a Technology Transfer Wing (TTW) to provide help in filing copyright and patent applications. Through its TTW, formal support mechanisms are established to provide legal, administrative and financial support required in the patent and commercialisation process to the LUMS faculty in order to ensure that their focus remains on the research and innovation aspect, leaving the legal and administrative issues for the TTW team.

# Table of Contents

# Message from the Vice Chancellor



The research carried out at LUMS is firmly aligned with the university's core principle of Learning Without Borders——it is transdisciplinary—— researchers interface across disciplines to create unique strategies. They collaborate with colleagues across LUMS and other institutions in Pakistan and abroad. They also partner with our students to create meaningful work and help them build valuable knowledge and research skills. In this report, you will read about these research projects and significant achievements.

In the last two years, we received a total of 211 grants, amounting to PKR 728 million. This level of funding is increasingly important as we tackle issues like the pandemic, global warming and inequity. Centres based around issues like energy, water, agriculture, urban planning, social justice and entrepreneurship are examples where multiple disciplines, ideas and approaches can make a difference. Other important projects include women's entrepreneurship and improving quality and access to education for women, medical advances, sustainability, and cyber security. This scholarly work is published in respected journals around the world and supports faculty in tenure and promotion.

Research has also made significant headway into policy making. The Office of Research and several prominent experts from various sectors with participation from other universities, chaired by the Vice Chancellor, will be submitting a brief report on intellectual property rights and commercialization. Along with providing insights into the role of applied research in Pakistan, this framework will hopefully create an impetus for commercialization and licensing opportunities for the University.

It gives me great pride to see LUMS set high standards in research and innovation, while making a real impact in the lives of people in Pakistan.

Dr. Arshad Ahmad

# Message from the **Provost**

As a young university that was established less than four decades ago, LUMS has made significant strides in establishing a reputation for excellence in teaching and research. The Office of Research (OR) was established in 2010 with a mandate to facilitate research that makes contributions to various academic disciplines and responds to the vital challenges of our time. Within a short period of time, we have seen a solid culture of research taking roots at LUMS. As this report documents, our faculty has successfully competed for international and national grants. Winning grants is an important element of research at LUMS but we also invest the resources of the University to enhance the research productivity of our faculty.
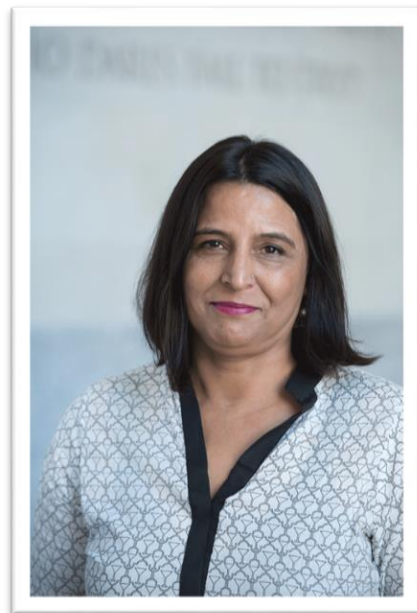
The Faculty Initiative Fund (FIF) enables our faculty to launch promising research projects that may grow into larger collaborative undertakings with national and international research partners. Faculty Travel Grant (FTG) allows our faculty to present their research at international conferences and the Faculty Start-up Grant to all new full-time faculty ensures that their research agenda thrives at LUMS. All these efforts have yielded impressive results in faculty research productivity.

The Mushtaq Ahmad Gurmani School of Humanities and Social Sciences (MGSHSS) faculty have published manuscripts in some of the most renowned academic presses and highly rated journals in humanities and social sciences.

The faculty at the Syed Babar Ali School of Science and Engineering (SBASSE) have made impressive strides in knowledge production in basic sciences as well as application of research in addressing some of the pressing challenges facing humanity. From developing next generation solar cell technology, work on cellular networks that can aid remote surgery to modelling onset and treatment of cancer, the faculty at SBASSE is engaged in innovative research.

The renowned case-based teaching at the Suleman Dawood School of Business (SDSB) has resulted in its ranking as one of the best business schools in the region. Developing case studies to address various issues faced by the business community along with publications in some of the top business and finance journals—50 articles in A-rated journals in 2020—continue to enhance SDSB's reputation in Pakistan and abroad.

The Shaikh Ahmad Hassan School of Law (SAHSOL) merges the vocational and academic content of legal education in a manner that is both informed by and generative of research. The LUMS Law Journal published its 8th volume in 2020 addressing issues ranging from the anti-terrorism act to inheritance laws in Islamic jurisprudence. The faculty at SASHOL has published books and articles in top-rated academic presses.

The Syed Ahsan Ali and Syed Maratib Ali School of Education (SOE) is the newest school at LUMS, created with the aim to make significant impact in shaping the primary, secondary and higher-education landscape in Pakistan. Within a very short time, much of it shaped by the pandemic, SOE faculty and students have engaged in research on equity and inclusion, digital divide, birth-order, family size and impact on educational achievements.

Along with the research accomplishments of our faculty in their respective academic disciplines what distinguishes LUMS is its focus on transdisciplinary research. Our centres are the focal points in addressing some of the central challenges of our time in climate change, green technologies, big data and data literacy and poverty alleviation. The goal of the University in the coming years is to make these centres the hub of transdisciplinary research by enabling faculty members from various schools to bring their disciplinary expertise to engage in these vital challenges of our time. The Technology for People Initiative, for instance, has fulfilled its mission of using technology to improve delivery of service in and facilitate decisions for improved public policy. In 2020, it launched a project to examine the pervasiveness of belief in COVID-19 misinformation in Pakistan.

The pandemic negatively impacted the research productivity of all institutions of higher education in the world and no doubt the number of grants we received in the last year and half may well have been larger if it was not for COVID-19. What is noteworthy, though, is how rapidly our faculty responded to this adversity by forging research projects in areas such as using multidisciplinary approach to depict the immune response to SARS-Cov2 or to map legal and regulatory strategies used in Pakistan to manage COVID-19. Using wearable devices to remotely monitor the vitals of the Corona virus thereby decreasing their exposure to a hospital environment is yet another example of the speedy response to the pandemic.

As a relatively newer presence at LUMS, the Provost Office is dedicated to playing its part in forging greater opportunities for faculty to engage in scholarship and making our centres the hub of transdisciplinary research dedicated to resolving challenges that face humanity.

Dr. Farhat Haq

# Message from the
## Director, Office of Research



It brings me immense pleasure to present to you the 'LUMS Research Portfolio 2018-20' which is a compilation of the funded research endeavours of the LUMS community in the past two years. The University won 211 external grants during July 2018 to June 2020, worth PKR 728 million. In the same period, LUMS awarded 346 internal grants worth PKR 234 million to its faculty.

Over the years, LUMS has earned the reputation of being an outstanding academic and research institution. We are well-known for our academic leadership across a spectrum of disciplines including Business, Social Sciences, Humanities, Law, Education, Sciences, Technology and Engineering. Many of the accolades that we have received are due to the rigorous, relevant and impactful research of our faculty. The enabling environment at LUMS allows the Schools and the faculty to develop strategic relationships with some of the best universities and researchers around the world. It is heartening to see that this year our collaborative research partners included Oxford, Facebook, The World Bank and Coca-Cola, amongst others. You would also find in the report that we have a strong network of collaborations with local universities, institutions and organisations. This allows us to work on problems that pertain to our country and the society we live in. Hence, our research remains locally relevant yet globally recognised.

It is worth mentioning that the pandemic, for a while, brought all academic and research activity to a standstill. It required a collective response from all segments of society to do whatever was in their power to give back to the collective. It was great to see that our researchers responded to it in an effective way. LUMS faculty members were awarded four projects which address the different aspects of COVID, and will contribute to a better understanding of the pandemic.

There are many other areas of research that are important from a societal perspective which our researchers have made significant contribution to including fields such as energy, water, environmental pollution and artificial intelligence.

In this report, we highlight the excellent accomplishments and achievements of our faculty who through their efforts have made LUMS into an institution which is globally recognised for its contribution to research and scholarship.

Dr. Saad Azmat

# LUMS at a Glance

**5** Schools

**13** Centres

**2** Incubation Centres

**42** Academic Programmes

**200+** PhD Faculty

**5000+** Students

Ranked **#40** on World's Best Small Universities 2020 by Times Higher

Ranked in the **651-700** band in QS World University Rankings 2022

**SDSB** is the **1st** International Accredited Business School in Pakistan

Consistently Achieved **W Category** in HEC's Annual ORIC Performance Review

Linkages with **350+** Local and International Donors

**800+** Research Projects Approved by External Donors (FY2011- FY2020)

**1300+** Internal Research Grants Awarded by LUMS (FY2011- FY2020)

Won Externally Funded Research Grants worth PKR **6.5 Billion** (FY2011- FY2020)

PKR **760 Million** awarded by LUMS internally for research (FY2011- FY2020)

**16** Approved Research Related Policies

State-of-the-art **Makers Lab** for Innovation

**2500+** Publications since 2012 (As per Scopus)

**1.01** Publications per Faculty since 2012 (As per Scopus)

**40+** IP Negotiations Initiated

# About LUMS

LUMS is a world-class academic institution with a proud history of achievement, and aspiring plans for the future. It was granted a Charter in 1985, starting with one programme, its flagship MBA. LUMS now offers undergraduate, graduate and doctoral programmes through its five schools: Suleman Dawood School of Business, Mushtaq Ahmad Gurmani School of Humanities and Social Sciences, Shaikh Ahmad Hassan School of Law, Syed Babar Ali School of Science and Engineering, and Syed Ahsan Ali and Syed Maratib Ali School of Education.

Driven by a philosophy of 'Learning Without Borders' that breaks disciplinary boundaries and bridges the gap between theory and practice, LUMS is home to a dozen transdisciplinary centres.
These centres engage faculty and students and collaborate with external institutions to address society's grand challenges.

With faculty that is dedicated to teaching and creation of knowledge, the University hosts an enriching and seamless experience through multidisciplinary research and teaching, emphasising integrative learning, critical thinking, and creative problem-solving.

# Schools at LUMS

## Suleman Dawood School of Business (SDSB)

SDSB is Pakistan's foremost business school with a reputation that is global and recognised through its accreditation by AACSB International - The Association to Advance Collegiate Schools of Business (AACSB). SDSB helps develop a diverse skill set which helps students to become change-makers.

Suleman Dawood School of Business continues to strive for the finest educational experience in business. More than eighty percent of the faculty at SDSB are PhDs from the world's leading universities, complemented by top executives from the industry. SDSB is a partner case study contributor to Harvard Business Publishing, a testament to leading-edge research from the School. Internships and student involvement across various sectors are also maintained, in addition to special sessions, in which students connect with industry leaders. SDSB's research activities and investments in modern pedagogical tools ensure that the School excels in advancing business concepts and practice. It also continues to mobilise platforms for debate, policy discussions, and student engagements to positively advance business practices and social change.

## Mushtaq Ahmad Gurmani School of Humanities and Social Sciences (MGSHSS)

The leading humanities and social sciences programme in the country with an established reputation of training graduates who have become leaders in understanding and shaping society. Since its founding as an independent School in 2012, MGSHSS has remained dedicated to the advancement of knowledge through excellence in teaching and research. It currently consists of two departments: Economics; and Humanities and Social Sciences (HSS). It also houses three Centres—the Mahbub Ul Haq Research Centre, the Saida Waheed Gender Initiative, and the Gurmani Centre for Languages and Literature. The School offers majors in: Anthropology and Sociology; Economics; Economics and Mathematics; English; History; Political Science; and Politics and Economics. In addition, there are minors offered in: Comparative Literary and Cultural Studies; Gender and Sexuality Studies; Philosophy; Psychology; and Religious Studies.

Over the decades MGSHSS has earned an international reputation in the field of humanities and social sciences. A community of world-class scholars, the vibrancy of the teaching, the quality of the research, and an outstanding curriculum—all combine to produce an undergraduate programme of the highest international standards.

The School strives to inculcate in its students the capacity to explore widely and deeply, think creatively and critically, and express ideas clearly and effectively. By realising their full intellectual and personal potential, students are equipped to contribute to the betterment of society in Pakistan and the wider region. MGSHSS aims to nurture individuals to be principled, intellectually engaged, and socially responsible members of society who aspire to change the world around them through inspirational leadership and transformative community participation.

# Syed Babar Ali School of Science and Engineering (SBASSE)

The Syed Babar Ali School of Science and Engineering (SBASSE) at LUMS is making significant strides in the experimentation of teaching and learning, while celebrating the novelty of research. SBASSE, through innovative and impactful contributions to science and technology, is nurturing future leaders with the potential to impact society.

All students at SBASSE are involved in the quest to probe into some of the deepest and most pertinent issues and questions facing humanity—from the structure of matter to problems of water, energy, environment, sustainability and healthcare. The School's programmes are designed to develop a creative and dynamic research perspective to the student learning experience. The experiments conducted in the teaching labs have been adopted by many universities across Pakistan. The School continues to emphasise the importance of well-equipped experimental labs and an active learning environment as an integral part of a multidisciplinary science education.

SBASSE offers undergraduate, graduate and doctoral degrees in a wide range of disciplines. The MS programmes at SBASSE are rigorous and designed to impart specialised professional and research-oriented training to students. The SBASSE PhD programmes prepare students to think scientifically and conduct high-quality research independently.

# Shaikh Ahmad Hassan School of Law (SAHSOL)

The Shaikh Ahmad Hassan School of Law (SAHSOL) offers a five-year BA-LL.B (Honours) degree, fully recognised by the Pakistan Bar Council and the Higher Education Commission (HEC) as a qualifying law degree. LUMS has been offering the BA-LL.B since 2005, and provides a world-class legal education with a primary focus on Pakistani law.

SAHSOL offers a diverse and innovative learning environment. Students are taught critical thinking by employing the Socratic Method, an interactive mode of teaching, where instructors keep you engaged in lively and dynamic classroom discussions.

Students are given plenty of opportunities to undertake legal internships, contribute to the LUMS Law Journal, participate in national and international moot court competitions, assist with faculty research, undertake pro bono work, and study clinical courses. Some students opt to conduct weekly hour-long interactive sessions with local high school students from lower income backgrounds, to impart knowledge of the workings of law and legality in Pakistan, known as the Street Law Programme.

The latest addition to the School facilities is the Centre for Chinese Legal Studies. Set up in collaboration with Wuhan University, China, it serves as a hub for research in, and the promotion and teaching of Chinese legal studies in Pakistan.

# Syed Ahsan Ali and Syed Maratib Ali School of Education (SOE)

The Syed Ahsan Ali and Syed Maratib Ali School of Education (SOE), the fifth school at LUMS, continues the University's tradition of academic excellence and world-class facilities. It offers an Undergraduate Minor in Education, and an MPhil in Education Leadership and Management (ELM). The most recent addition is the weekend based Executive MPhil in Education, Leadership and Management.

The School aims to produce a new class of leaders as educators, entrepreneurs, policymakers, researchers and reflective practitioners, equipped with the ability to give strategic direction to the fast expanding education sector. SOE fosters an inclusive learning environment that focuses on developing a critical understanding of new and old education practices and ideas. It consists of rigorous academic coursework with in-depth practical training to produce education leaders who are strongly rooted in research policy and practical thinking.

# Centres at LUMS

## Rausing Executive Development Centre (REDC)

The Rausing Executive Development Centre imparts executive education with the aim to enable managers to progress into leaders, following both case-based teaching and hybrid pedagogies. The Centre is recognised for its transformative learning experiences impacting individual and organisational performances.

## Centre for Business and Society (CBS)

The Centre for Business and Society is a platform for debates, policy discussions, student engagement and events to engender positive societal impact. This impact is created by providing a critical forum for discussion on focus areas vital to Pakistan's social and economic sustainability.

## National Centre in Big Data and Cloud Computing (NCBC)

The National Centre in Big Data and Cloud Computing partners with 11 universities working on big data across areas of agriculture, industry, energy, health, multimedia and local languages. The Centre also hosts Pakistan's open data portal and focuses on human resource development in the specialised field of big data and cloud computing and its practical applications.

## Centre for Water Informatics and Technology (WIT)

The Centre for Water Informatics and Technology conducts research and works closely with industry and the government on developing technologies to improve irrigation efficiency and introduce sustainable agricultural practices.

## LUMS Energy Institute (LEI)

The LUMS Energy Institute works with the energy and power sector of Pakistan. It provides interdisciplinary research and shares capacity building practices, which support power and energy planning, renewable energy technologies, and grid modernisation.

# Technology for People Initiative (TPI)

The Technology for People Initiative was established to explore and enhance sustainable, innovative and low cost technology. It aims to make government institutions in Pakistan as informed, inclusive and responsive as possible to achieve good governance.

# Mahbub Ul Haq Research Centre (MHRC)

The Mahbub ul Haq Research Centre supports interdisciplinary research, scholarship and teaching on issues of human development, social exclusion and inequality across South Asia.

# Saida Waheed Gender Initiative (SWGI)

The Saida Waheed Gender Initiative leverages research, teaching, and praxis related to gender at LUMS. It encourages research and resource development supporting pedagogy in the area of gender studies. The initiative hosts events that bring together scholars, students, and members of the broader community.

# National Incubation Centre Lahore (NICL)

The National Incubation Centre Lahore has a focus on contributing to Pakistan's economic development by promoting innovation and entrepreneurship in high impact areas. It inspires and facilitates problem-solvers in agriculture, education, environment, financial inclusion, healthcare, and applications utilising artificial intelligence and machine learning.

# LUMS Learning Institute

The LUMS Learning Institute transforms learning and teaching practices by utilising modern technologies and innovative teaching tools. It also connects students with faculty to establish valuable pedagogical partnerships. The Centre has been instrumental in developing LUMSx - the new digital platform for open courses, encouraging inter-institutional collaboration, and national and regional partnerships.

# Gurmani Centre for Languages and Literature

The Gurmani Centre for Languages and Literature was established in 2010 for the advancement of South Asian languages and literature. The Centre achieves this aim through language teaching, research and publications, as well as cultural programming.

# Centre for Continuing Education Studies (CES)

The Centre for Continuing Education Studies offers courses that develop the professional expertise of students, professionals and non-traditional learners. Its courses are designed and delivered by highly acclaimed industry experts and academics.

# Centre for Chinese Legal Studies (CCLS)

The Centre for Chinese Legal Studies promotes the teaching of Chinese laws in Pakistan. It aims to become a regional hub for shared legal resources between Pakistan and China. Academics, students, and legal and business professionals in both countries are facilitated to exchange knowledge and build capacity and legal expertise through the Centre.

# Office of Research

The Office of Research (OR) was established on August 6, 2010 with the aim to promote a research culture at LUMS and since then it is actively pursuing its mandate by making sure that the LUMS research community is facilitated as much as possible. OR acts as a bridge between the faculty and external funding agencies. However, OR does not just limit itself in facilitating the faculty members with their external grants. It also manages the internal grants sponsored by LUMS for its faculty members and students. The Office is responsible for ensuring that all submitted proposals conform to sponsor guidelines and LUMS policies and once funded, the project complies with sponsor requirements and applicable University policies and procedures.

Moreover, OR works tirelessly to make sure that all the funding opportunities are identified and availed by faculty members/researches, whenever and wherever needed. This pathway is broadly classified into four steps:

Support in IP management and commercialisation of research products

**Commercialisation**

**Preparation/ Identification**

From identification of funding opportunities to proposal submission

**Post-Award**

**Award**

Management of financials and reporting and post-award changes

Contract review, negotiation & finalisation
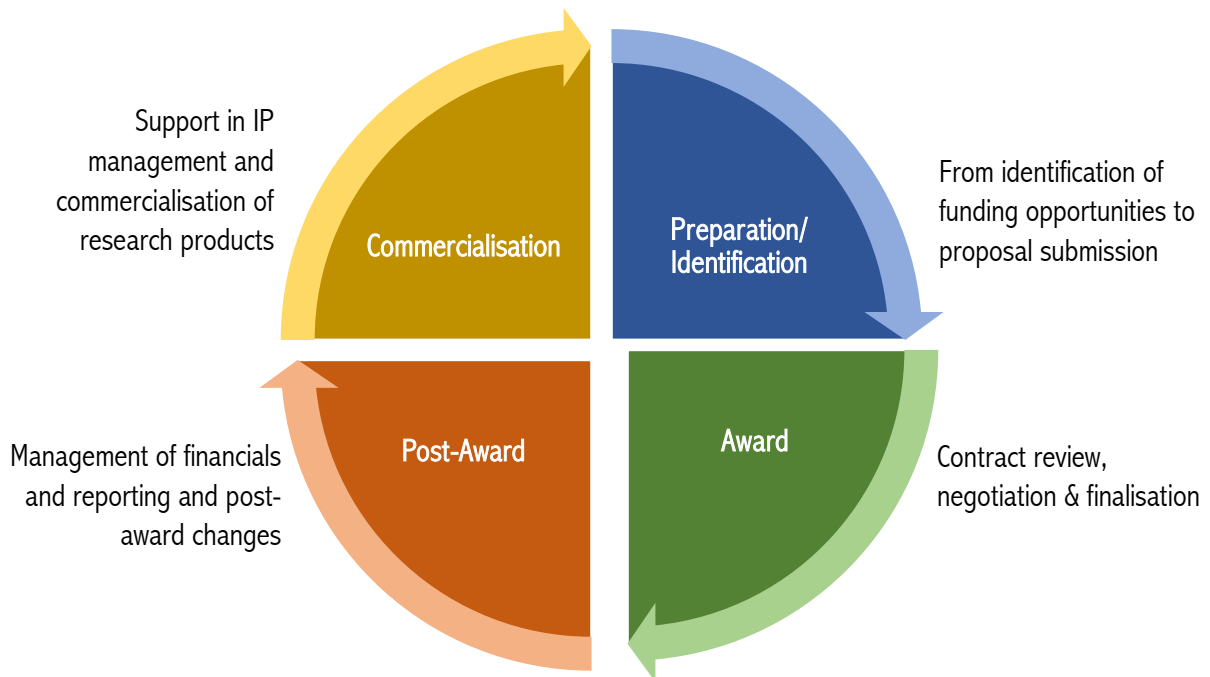
OR ensures best project management protocols and has deployed the SAP Grants Management Grantee Module (GM-GTE) for efficient reporting and control of sponsored grants. GM-GTE is being managed through a centralised resource, deployed at OR.

# Technology and Innovation Support Centre

In April 2009, the World Intellectual Property Organization (WIPO) initiated a pilot project designed specially to help innovators in developing areas access local based, high-quality technology information services. This project was titled as Technology & Innovation Service Centres (TISCs). The commencement of these centres was a success and therefore, currently there are 500 TISCs operating globally.

Out of these 500, 23 TISCs are operating in Pakistan. LUMS being a proponent of such science and technology related initiatives is one of these 23 institutional bodies. LUMS, signed a MoU with WIPO, HEC and IPO on December, 12th, 2017 thereby, laying a foundation of TISC at LUMS.

Access to online patents and non-patent resources

Assistance in searching and retrievnig technology informaiton

Training in database search

On-demand searches (novelty, state-of-the-art and infringement)

Monitoring technology and competitors
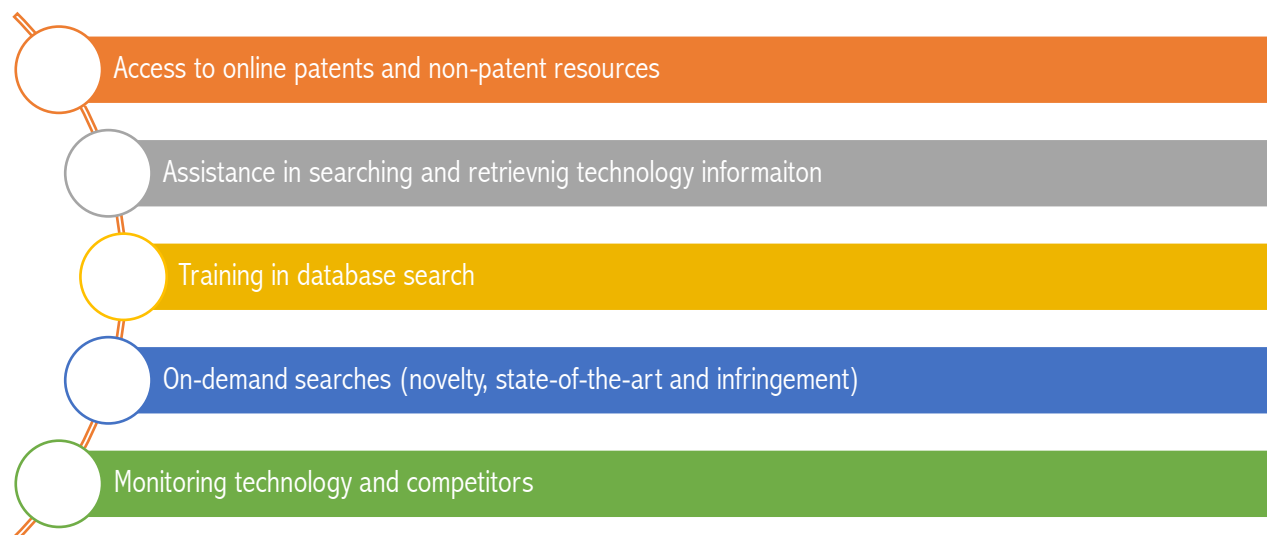
# Eminent Research Awards

LUMS has always been a step ahead when it comes to research and innovation. In order to accomplish the mission of the institute, it actively pursues every single opportunity to create an impact on various research domains.

Following are the top funded projects by **International Donors** during the last two years.

## Assistant Education Officers (AEOs) Training Pilot Project

- Donor: Mott MacDonald
- Award Amount: PKR 55,401,465

## Epigraphic and Petroglyphic Complexes of the Upper Indus: Digital Preservation And Promotion Of Written And Visual Cultures

- Donor: SSHRC (add full name)
- Award Amount: PKR 45,254,182

## Rethinking Cybersecurity in Pakistan - Human Factors's Essential Role

- Donor: European Commission
- Award Amount: PKR 26,437,662

## Real-time Spatiotemporal Emissions Mapping Under WP5 Asi@Connect

- Donor: Trans-Eurasia Information Network (TEIN)
- Award Amount: PKR 23,839,920

## Impact Evaluation of Super Abbu: A Speech Based MNCH Platform in Pakistan

- Donor: University of California, Davis
- Award Amount: PKR 22,240,872

Following are the top funded projects by **National Donors** during the last two years.

## Creating Technological Foundations of Data-Driven Policy Making for Sustainable Urban Development

- Donor: Higher Education Commission (HEC)
- Award Amount: PKR 210,221,860

## Dynamic and Immersive Virtual Emergency Response Training 'Divert' for Mahfooz Pakistan

- Donor: Ignite
- Award Amount: PKR 27,071,747

## Dynamic Financial Data Analytics for Policy and Governance

- Donor: SNG Pakistan
- Award Amount: PKR 20,780,958

## Syed Babar Ali Research Award

- Donor: Babar Ali Foundation
- Award Amount: PKR 20,000,000

## Big Data Based Platform to Promote EV Penetration in Pakistan

- Donor: National Centre in Big Data and Cloud Computing (NCBC)
- Award Amount: PKR 19,214,545

# Research at LUMS during the Pandemic

The outbreak of COVID-19 has created a global health crisis that has had a deep impact on the way we perceive our world and our everyday lives. Considering the challenges faced by the research community all over the world, LUMS has somehow managed to contribute to the community through research projects focused on the pandemic. LUMS has received major grants to study a myriad of aspects of the virus and its impact. Some of them are listed in the figure below.

## Mapping the Immune Response to SARS-Cov2 Using a Multidisciplinary Approach

- Donor: HEC
- Award Amount:  PKR 12,633,414

## A Vital Monitoring Device for Monitoring COVID-19 Patients Remotely

- Donor: Islamic Development Bank
- Award Amount: PKR 7,831,425

## Legal and Regulatory Strategies for the Coordination and Commercial Oversight of Pakistan's Response to COVID-19

- Donor: Hanns Seidel Foundation
- Award Amount: PKR 1,645,000

## Intervention Monitoring and Support Services for Pilots of a COVID-19-Focused Mask

- Donor: Innovations for Poverty Action
- Award Amount: PKR 3,741,441

# LUMS Funding Sources

As mentioned above, besides externally funded projects, LUMS also provides extensive funding opportunities to pursue research. These opportunities also aid faculty members to prepare for and seek larger international grants. The following is the list of all these internally sponsored grants offered by LUMS to its research community.

### 1. Faculty Initiative Fund (FIF)

LUMS understands the significance of research and development and offers funding opportunities to its research community through internal funding sources. FIF is an internal funding mechanism that awards competitive grants of between PKR 500,000 to PKR 1,000,000 to LUMS faculty. These grants are intended to help faculty members develop innovative projects that might enhance the University and lead to larger endeavours, new research initiatives, external funding opportunities or unusually creative works. All full-time and research faculty members at LUMS are eligible to apply for the grant.

### 2. Faculty Travel Grant (FTG)

This Grant provided by LUMS assists in the research activities of the University's full-time regular faculty at various stages of their academic careers. The purpose of FTG is to encourage research-related international travels and collaborations by faculty members.

### 3. Start-Up Grant

Start-up grants are the first grants given to full-time regular faculty newly recruited on tenure track or as tenured faculty, and are awarded by the Deans of the respective schools.

### 4. Students as Co-Researchers (ScR)

This programme is a collaborative effort between OR and the LUMS Learning Institute (LI) to support students as co-researchers. The ScR aims to promote a culture of scholarly activities amongst undergraduate students, who have completed their junior year, are starting their senior year and are interested in pursuing their own research projects, in collaboration with a LUMS faculty member and mentors from the industry/partner organisations. The funding for these projects can also be used for summer research projects or SPROJs.

# Research Accomplishments

## Book on the Communist Movement in Colonial India

Dr. Ali Raza, Associate Professor at MGSHSS, has recently published a book titled *Revolutionary Pasts: Communist Internationalism in Colonial India* (Cambridge University Press, March 2020). In this book, he demonstrates how Communist Internationalism was a crucial project in the struggle for national liberation and presents a new approach to the global history of communism and decolonisation.

## Prestigious Award from the HEC

Dr. Muhammad Shakeel Sadiq Jajja, Assistant Professor of Operations and Supply Chain at SDSB, recently won the Higher Education Commission (HEC) Best Research Paper Award 2017 as part of their National Awards for Outstanding Researchers Programme for his paper, 'Linkages between firm innovation strategy, suppliers, product innovation, and business performance: Insights from resource dependence theory'. The research was published in *International Journal of Operations & Production Management* in 2017, an A Rated journal in global rankings. The award recognises the achievements of Pakistani faculty and researchers.

## Public Health Research Grant 2020

This year, the studies of Dr. Safee Ullah Chaudhary, and Dr. Syed Shahzad ul Hussan, Associate Professors, Department of Biology, have been awarded the Public Health Research Grant 2020 by the Shahid Hussain Foundation (SHF).

SHF works to support education and health access in Lahore and launched the Public Health Research Grant three years ago to support innovative research in Pakistan. The Grant is an effort to undertake a research project within Pakistan that is not only headed by a team comprising of local experts, but is also funded locally. This helps in fostering a culture of meaningful research and learning within the Pakistani community and provides an understanding of the complexities within the country's healthcare sector, eventually leading to a viable health policy solution.

# Project to Optimise Internet Exchange Point Performance

The LUMS team working on the project includes Dr. Zartash Afzal Uzmi, Dr. Ihsan Ayyub Qazi, Chair, Computer Science department, a research assistant, and two undergraduate students. In collaboration with the Pakistan Telecom Authority (PTA), Higher Education Commission (HEC) of Pakistan, the team had previously set up an IXP in Islamabad where all the local service providers connected their optical fibres with each other through the IXP. The team worked to enable SDN at the Internet Exchange Points in a lab setting for further deployment at the IXP in Islamabad.

A USD 30,000 grant was awarded by the Information Society Innovation Fund (ISIF) Asia which is a grants and awards programme that empowers communities in the Asia Pacific region and places particular emphasis on the positive role the Internet has in social and economic development in the region.

# Research Statistics

## Submissions and Approvals

This section encompasses the latest submissions and approvals of the grants that OR has managed for the last two years i.e., July 2018 - June 2020. Starting off with the facts and figures, the following illustration depicts all grants that got submitted by OR and approved by the Sponsors.

**FUNDS REQUESTED/APPROVED (PKR MILLION)**

Funds Requested · Funds Approved

- 2018-19: Funds Requested 6.3, Funds Approved 4.5
- 2019-20: Funds Requested 8.0, Funds Approved 5.0

**PROPOSAL SUBMISSIONS/APPROVAL**

Proposal Submitted · Proposal Approved

- 2018-19: Proposal Submitted 313, Proposal Approved 277
- 2019-20: Proposal Submitted 378, Proposal Approved 280
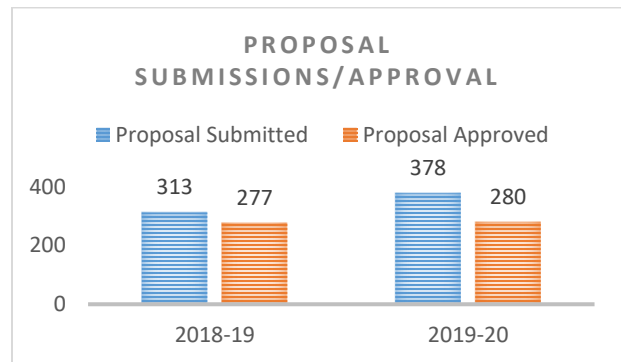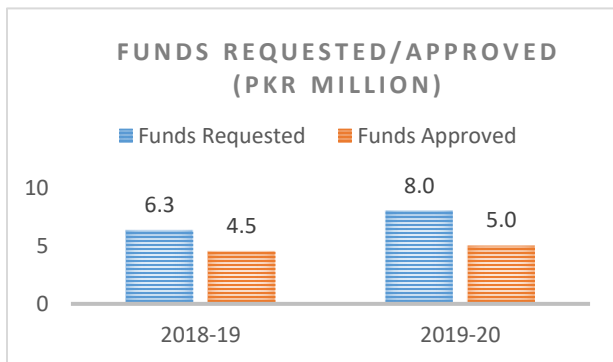
## Scopus Publications

The range of research activities and publications by the LUMS faculty is broad and profound. The graph below is a reflection of the increase in the total unique publications authored by LUMS faculty in the last three calendar years (2018 to 2020). The research publications experienced a growth of 22%, demonstrating a healthy trend during the time period, which is a reflection of the extensive research endeavours by the faculty over the years.

**PUBLICATIONS**

- CY18: 331
- CY19: 360
- CY20: 404
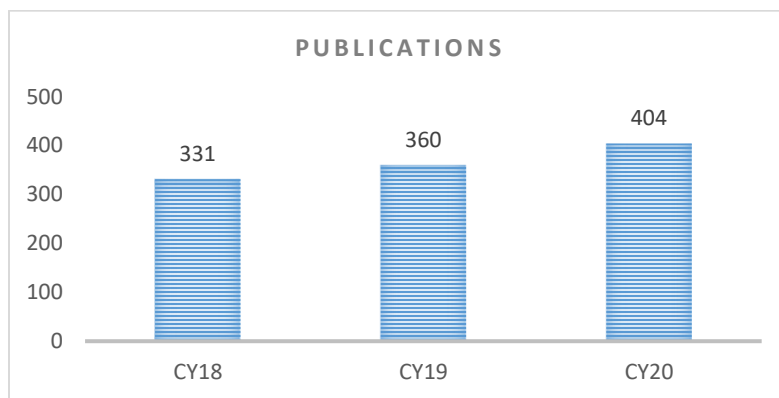
Note: This data is extracted from Scopus.

# Sponsors

The following sponsors extended their support towards research at LUMS. With their generous contributions, the University carried out research endeavours that have created an impact in society and contributed to enhancing the knowledge-based economy of Pakistan.

| | |
|---|---|
| Abacus Consulting | Environmental Protection Agency (EPA) |
| ACCA Pakistan | European Union |
| Adam Smith International (ASI) | Facebook |
| Afiniti Software Solutions | Fatima Fertilizer Company Ltd. |
| Allama Iqbal Medical College (AIMC) | Fatima Group |
| American Bar Association (ABA) | Ferozsons Laboratories Pvt. Ltd. |
| American University | Food and Agriculture Organization of United Nations |
| APNIC Foundation | Foundation Open Society Institute |
| Babar Ali Foundation | German Pakistani Research Cooperation Program - DAAD |
| British Asian Trust | Global Challenges Research Fund |
| British Council | Global Development Network (GDN) |
| Bulleh Shah Packaging | Global Development Services International (GDSI) |
| CDC Group | Goldsmiths, University of London |
| Centre for Economic Research in Pakistan (CERP) | Google |
| Centre for Global Development | Government of Khyber Pakhtunkhwa |
| Central Asia Regional Economic Cooperation Institute | Habib University, Karachi |
| Central Park Medical College | Hanns Seidel Foundation (HSF) |
| Central Power Purchasing Agency (CPPA) | Harokopio University of Athens |
| Centre for Dialogue and Reconciliation (CDR) | Health and Nutrition Innovation Fund (HANIF) |
| Centre for Economic Policy Research (CEPR) | Higher Education Commission (HEC) |
| Centre International de Mathématiques Pures et Appliquées (CIMPA) | HEC-USAID |

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| Centre of Excellence for CPEC | Hivos International |
| Chanan Development Association (CDA) | Huawei |
| Citi Foundation | Human Frontier Science Program |
| Cleaner Production Institute (CPI) | IBA, Karachi |
| Cloud BPO Pvt. Ltd. | IGI Insurance Ltd. |
| Coca-Cola | Ignite - National Technology Fund |
| COMSTECH-TWAS | Indus Consortium |
| DAI Pakistan | Indus Motor Company |
| Department of Tourism, Sports, Culture, Archaeology & Youth Affairs | Industrial Technical Educational Institute (ITEI) |
| Descendants of Late Begum Saida Waheed | Innovations for Poverty Action (IPA) |
| Descon Engineering | Institute of Development Studies (IDS) |
| Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) | International Development Research Centre (IDRC) |
| Duke University | International Food Policy Research Institute (IFPRI) |
| EBE Group | International Foundation for Science (IFS) |
| Economic and Social Research Council (ESRC) | International Growth Centre (IGC) |
| Engineering and Physical Sciences Research Council (EPSRC) | International Institute for Applied Systems Analysis (IIASA) |
| Engro Powergen Thar Ltd. | International Institute for Management Development (IMD) |
| National University of Science and Technology (NUST) | International Labour Organization (ILO) |
| National University of Technology | International Trade Centre (ITC) |
| Nestle | International Water Management Institute (IWMI) |
| Oxfam | Islamic Development Bank |
| Oxford Policy Management | Jaffer Brothers Pvt. Ltd. |
| Packages Ltd. | Japan International Cooperation Agency (JICA) |
| Pakistan Air Force (PAF) | JPAL The Abdul Latif Jameel Poverty Action Lab |
| Pakistan Centre for Philanthropy (PCP) | Kaarvan Crafts Foundation |
| Pakistan Institute of Development Economics (PIDE) | Kalam Research and Media |
| Pakistan Microfinance Network (PMN) | Karandaaz |

Pakistan Science Foundation (PSF)

PakShine

PeaceTech Lab

PepsiCo

Punjab Information Technology Board (PITB)

Punjab Economic Research Institute (PERI)

Punjab Skills Development Fund (PSDF)

Qadri Group

SAARC Energy Centre

Sage Publications, India

Samad Group of Industries

Samsung

Schlumberger Seasdfaco Inc.

Shahid Hussain Foundation

Shirkat Gah

Sight Savers International (SSI)

SOAS University of London

Social Sciences and Humanities Research Council of Canada (SSHRC)

Society for Advancement of Higher Education (SAHE)

Sony

South Asian Network for Development and Environmental Economics (SANDEE)

Sozo Group of Companies

State Bank of Pakistan

Sub-National Governance (SNG) Pakistan

Syeda Henna Babar Ali

KASHF Foundation

Lahore Electric Supply Company (LESCO)

London School of Economics & Political Science

Malala Fund

Marie Stopes Society

Marvell Technology Group Ltd.

Massachusetts Institute of Technology (MIT)

McGill University

Microtech Industries Pvt. Ltd.

Ministry of Commerce, Government of Pakistan (MOC)

Ministry of Federal Education and Professional Training

Ministry of Overseas Pakistanis and Human Resource Development

Ministry of Religious Affairs and Inter-Faith Harmony

Mitsubishi

Mobilink

Mott MacDonald

National Centre for Physics (NCP)

National Centre in Big Data and Cloud Computing (NCBC)

National Centre of Artificial Intelligence (NCAI)

National Centre for Cyber Security (NCCS)

National Centre for Robotics and Automation (NCRA)

National Development Complex (NDC)

National Engineering and Scientific Commission (NESCOM)

National Natural Science Foundation of China (NSFC)

United Nations Educational, Scientific and Cultural Organization (UNESCO)

Tetra Pak

The Asia Foundation

The David and Lucile Packard Foundation

The Global Fund to End Slavery

The Royal Society

Trans-Eurasia Information Network (TEIN)

Tufts University

UET Peshawar

United Nations Women

United Nations International Children's Emergency Fund

U.S. Agency for International Development

Waseda University

Wellcome Sanger Institute

The World Bank

Wrangler Instruments

United Nations High Commissioner for Refugees (UNHCR)

United Nations Office on Drugs and Crime

United States Institute of Peace (USIP)

University College London

University of Birmingham

University of Bristol

University of California, Berkeley

University of California, Davis

University of Chicago

University of Kaiserslautern

University of Leeds

University of Massachusetts Amherst

University of Michigan

University of Oxford

University of Pennsylvania

# Research: Areas of Focus


Natural Sciences


Environment


Energy


Water


Health


Behavioral Studies


Computer Vision


Technology


Law and Policy


Artificial Intelligence


Economic Development


Education


Business & Innovation


Social Sciences


Telecommunications


Development Management


Agriculture


GIS


Political Science


Arts & Heritage


Operations Management


Trade
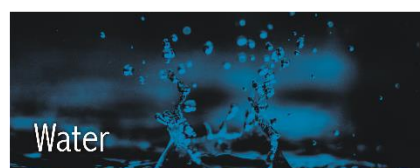
# Suleman Dawood School of Business (SDSB)
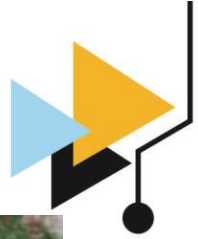
Dr. Fahad Mehmood
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**Profile:** Dr. Mehmood is an Assistant Professor at SDSB. He received his PhD and MS degrees in Industrial Engineering and Management from Politecnico di Torino, Italy in 2015 and 2011 respectively. He is a PhD scholarship winner of a joint collaboration between the Politecnico di Torino and Telecom, Italia, and was an Industrial PhD researcher for three years for Telecom, Italia (2012 to 2014). He received his Bachelor's degree in Mechanical Engineering from NUST in 2009. Dr. Mehmood's research interests include Logistics and Supply Chains, Energy Management and Operations Research.

**Title:** Determining, optimizing and forecasting energy demand and its drivers in Pakistan
**PI:** Dr. Fahad Mehmood
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 880,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Behavioural Studies, Business & Innovation, Energy

**Description:** The project was focused on collecting residential demand data, both for electricity and other fuels used in urban and rural households. The results of the project were important in diagnosing not just the difference between rural and urban demand, but were also helpful in quantifying the differences in price elasticity of electricity demand. Finally, this demand data will be used in a large-scale optimization framework to investigate possible reductions in energy consumption and grid congestion.

Dr. Faiza Ali
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**Profile:** Dr. Ali is an Assistant Professor at SDSB. She received her PhD in Management from Macquarie University, Australia in 2013. Her PhD research inquiries into the prospects for equal employment opportunities for women in Pakistani organisations. She did her MBA from Quaid-e-Azam University, Islamabad in 2001 and MSc in Economics from University of the Punjab, Lahore in 1999. Prior to joining LUMS, she was associated with Liverpool John Moores University, UK as Senior Lecturer in Business Management. Dr. Ali is a Fellow of Higher Education Academy (UK) and Academic Member of Chartered Institute of Personnel Development (CIPD), UK.



**Title:** Transforming Academic Knowledge to Develop Entrepreneurial Universities in Pakistan/ TAKE-UP
**PI:** Dr. Faiza Ali
**Sponsor:** University of Saarland
**Funding Amount:** PKR 21,770,351
**Project Initiated in:** 2020
**Duration:** 36 months
**Category:** Business & Innovation, Development Management

**Description:** This project is a by-product of an initiative by Higher Education Commission (HEC) to transform academic institutions into entrepreneurial universities. It was based on how the TAKE-UP approach can significantly improve the entrepreneurial cultures of the partner universities in Pakistan and transform them into role models for Pakistani universities. Further, TAKE-UP focused on the capacity building of (associated) staff members of BICs, as these play a crucial role in the motivation, development, and sustainability of business ideas at the HEIs and equip universities with the necessary tools to facilitate the work of these incubation centres. Activities during the project used a holistic approach to create a broad understanding of being an entrepreneurial university, so that the capacity building effort had a sustainable effect on the institutions themselves.

Dr. Jamshed Hasan Khan
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**Profile:** Dr. Khan teaches in the area of Total Quality Management, Operations Strategy, and Statistics. He has also designed and delivered numerous executive education programmes for senior executives of local and MNC companies, as well as Small and Medium Enterprises. Dr. Khan has also consulted on ISO 9000 implementation. He specialised in a hands-on approach in implementing TQM and has presented several quality and productivity enhancement programmes in a variety of industries in Pakistan. He has presented many research papers at various international conferences. Some of his research publications include, "Inter-firm Linkages in Pakistan's Automotive Industry", "Total Quality Management and Effective Productivity", and: "Analysis of Cost of Poor Quality in Pakistani Industry". Dr. Khan's research interests include application of productivity and quality management techniques, and developing customer focused culture in a Pakistani business environment. Prior to joining LUMS, Dr. Khan taught Operations Research and Management Sciences courses at University of Texas at Arlington. He is also a certified systems professional from USA.



**Title:** Review of Current Strategy and Challenges
**PI:** Dr. Jamshed Hasan Khan
**Sponsor:** Meezan Bank
**Project Initiated in:** 2018
**Duration:** 9 months
**Category:** Business & Innovation

**Description:** This assignment fulfilled the following objectives: (1) Review of current Meezan Bank Strategy to understand how they are implementing the strategy and cascading goals; (2) To meet with key senior managers and get their feedback on strategy implementation and how well it has translated into strategic objectives for each of the business units; (3) To recommend process for improving strategy implementation within different business units.

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**Profile:** Dr. Syed obtained his PhD in Business from Macquarie University, Australia in 2008 and completed a Postgraduate Certificate in Higher Education at the University of Kent, UK. He also attended Institute for Management and Leadership in Education (MLE) at the Harvard University Graduate School of Education. His PhD research inquired into the relational perspective of cultural diversity management in Australian organisations. Prior to that, he received a Masters of International Business degree from the Western Sydney University, Australia.

Dr. Syed is an Academic Fellow of the Chartered Institute of Personnel and Development (CIPD), UK, and Programme Chair of European Academy of Management's (EURAM) Gender, Race and Diversity in Organisations (GRDO) Special Interest Group. He is a director of the Global Centre for Equality and Human Rights (GCEHR) and coordinator of the South Asian Academy of Management (SAAM). Dr. Syed was conferred the Sitara-e-Imtiaz on August 14, 2011 by the President of Pakistan for his contributions and public service in the field of equality and diversity management.

**Title:** Women leaders and the gender wage gap – an investigation into the banking industry in Pakistan
**PI:** Dr. Jawad Syed
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 936,360
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Education, Development Management

**Description:** In this study, a gender-wage gap at the top-level managerial positions in Pakistan's banking industry was determined. The banking industry was chosen for this study because there are women leaders in this industry and unlike the public sector, or certain other private sector industries, the remuneration packages are not fixed and are negotiated. This study not only presented a representative picture of the country's banking industry and the prevalent wage-gap situation, but the qualitative part of the study also helped policy makers and other stakeholders.

**Title:** Sukkur IBA strategic plan and iSER
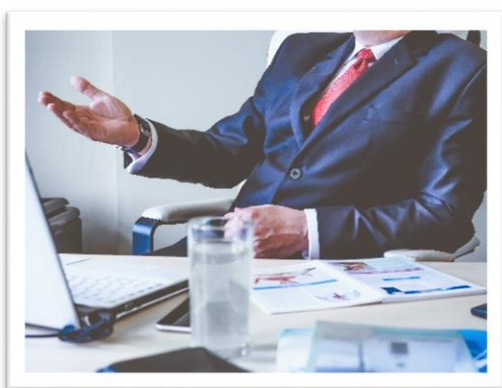**PI:** Dr. Jawad Syed
**Sponsor:** IBA, Sukkur
**Project Initiated in:** 2019
**Duration:** 8 months
**Category:** Education

**Description:** This project was focused on providing strategic advice and consultancy to Sukkur IBA University. The focus was on reviewing and realignment of strategic plan with the university's mission, vision and key strengths, and supporting the Department of Business Administration in its journey towards international accreditation by AACSB.



**Title:** Developing Business Leaders and Managers for CPEC
**PI:** Dr. Jawad Syed
**Co-PI:** Dr. Omair Haroon
**Sponsor:** CEO Clubs Worldwide Pakistan Chapter
**Project Initiated in:** 2019
**Duration:** 1 month
**Category:** Business & Innovation

**Description:** The objective of this project included planning and leading a one-day workshop with China-Pakistan Economic Corridor (CPEC) specific lectures, panels and activities. The outcome of these activities was a few policy changes that will advise the CEOs, Directors and HoDs about business management aspects of CPEC in the near future.



**Title:** Strategic Plan of the Samad Group of Industries
**PI:** Dr. Jawad Syed
**Co-PI:** Dr. Anjum Fayyaz
**Sponsor:** Samad Group of Industries
**Project Initiated in:** 2020
**Duration:** 3 months
**Category:** Business & Innovation

**Description:** The objective of this project was to guide, facilitate and help the client in developing a strategic plan for the entire group and its constituent units and departments at the macro- or strategic-level. Also, to facilitate the drafting of the first strategic plan (2020-24) of the Samad Group of Industries. The aim was to institutionalise strategic thinking and systematic management in this family-run business.

**Title:** Improving labour standards in Pakistan's textile industry
**PI:** Dr. Jawad Syed
**Co-PI:** Dr. Anjum Fayyaz
**Sponsor:** Abacus Consulting
**Funding Amount:** PKR 3,492,500
**Project Initiated in:** 2020
**Duration:** 5 months
**Category:** Business & Innovation

**Description:** The purpose of this assignment was to create a standardised set of modules on six relevant topics for future trainer consultants delivering change management workshops. These modules were to be used as a standard training guide in order to replicate training workshops with ease and create a better understanding of practical usage of Dialogue for Compliance. These modules were also to be used as a reference for change management workshops in order for GIZ to standardise the procedure while pursuing Dialogue for Compliance as a brand. The modules were delivered on the following topics:

a) Productivity (Lean manufacturing and Five S (5S))
b) Occupational health and safety
c) Total productive maintenance (TPM)
d) Quality (Quality management and cost of quality)
e) Human Resource (Human Resource Management and how to reduce absenteeism and turnover)
f) Supply chain management

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**Profile:** Dr. Khawaja Zain ul Abdin is an Assistant Professor at the SDSB. He holds a PhD in Media and Communication Studies (2013) and an MA from the FSU School of Communication (2009), attaining Fulbright scholarships for both degrees. He also completed his MBA in Marketing from the Lahore School of Economics in 2007. Dr. Khawaja's research interests include the effects of social media marketing in the development sector in Pakistan.



**Title:** Testing Front-loading and Short Narrative Digital Advertising for Micro-targeting and Delivery of Family Planning and Sexual Health Advertising
**PI:** Dr. Khawaja Zain Ul Abdin
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 990,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Business & Innovation, Development Management

**Description:** Several conservative countries, including Pakistan, remain critically underserved in family planning and sexual health information despite an unwanted population boom. Severe medical, social and economic consequences exist for cases of unwanted pregnancies, sexually transmitted diseases, and unsafe family planning procedures. Despite these challenges, efforts at improving sexual health information, particularly those based in mass media, have found widespread resistance and are often stopped from being airing. The application of these advertising practices to family planning and sexual health, without adequate correction, results in failure and public backlash. This study builds on an earlier effort that looked to address aforementioned problems by creating new best practices for four components of social marketing advertisements for offensive materials - the mode, the material, the medium, and the environment. The current study used an experiment designed to test solutions based on the findings of the earlier effort, investigating the efficacy of using front-loaded short narrative advertisements (mode), with socially endorsed based fear appeals (materials), through digital marketing channels to deliver population welfare information in private settings bypassing social censure.
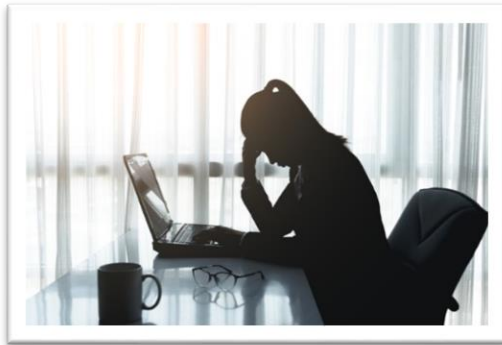
Dr. Mohsin Bashir
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+924235608412

**Profile:** Dr. Mohsin Bashir is an Associate Professor at the Suleman Dawood School of Business (SDSB), LUMS. He has authored research articles, book chapters and industry reports on Leadership and Effectiveness of Organisational Networks, Performance Management including Monitoring and Evaluation, Public Private Partnerships, Organisational Power and Politics, and Non-profit Leadership and Management.

He is a member of the American Case Research Association (NACRA) and the American Society for Public Administration (ASPA) and sits on various boards and committees in the public and development sector institutions.

**Title:** How Do Public Employees Respond to their Job Demands Over Time? Assessing the Moderating Role of Public Service Motivation
**PI:** Dr. Mohsin Bashir
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 590,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Development Management, Economic Development, Education

**Description:** This project aimed to study Employee Engagement in Public Sector i.e. the level of commitment of public employees toward their jobs. More specifically, some important questions pertaining to Employee Engagement are addressed in light of the Public Service Motivation (PSM) theory, which is essentially the intrinsic drive to serve fellow citizens as opposed to simply fulfilling the duties of a job. It also aims to test the effectiveness of PSM in a developing and non-democratic culture. Practical implications of this study are, increased employee motivation through improvements in the organisational culture, possibly in the form of performance based incentives.

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**Profile:** After completing mechanical engineering from UET, Lahore in 1999, Dr. M. Abdur Rahman Malik worked in the private sector of Pakistan for around nine years. Dr. Rahman has worked on various projects related to capital investments, quality management systems and employees' training and development. During these years, he got operations and management related trainings from various organisations in Pakistan, Sri Lanka, Germany, France, Finland and the Netherlands.

Dr. Malik's teaching interest and passion to contribute towards developing a better society brought him towards academia in 2007. He has worked as research associate at LUMS and at Concordia University, Montreal, Canada. Dr. Malik completed his PhD in Business Management from LUMS in 2013. He is teaching Human Resource Management, Organisational Behaviour and Principles of Management at SDSB to the undergraduate, MBA, EMBA and PhD classes. Dr. Malik also worked as Co-Faculty Lead in the LUMS-USAID programme for capacity building in the public sector of Pakistan. He has designed and delivered executive programmes for several organisations including Coca-Cola Pakistan, Engro Foods, MOL Pakistan, Packages Limited, Pepsi-Co Pakistan, Punjab Resource Management Program (PRMP), and UNDP Pakistan. Dr. Malik has presented and published his research in several national and international conferences and journals.

**Title:** Trust and Credibility Study
**PI:** Dr. Muhammad Abdur Rahman Malik
**Co-PI:** Dr. Muhammad Azfar Nisar
**Sponsor:** International Water Management Institute (IWMI)
**Project Initiated in:** 2018
**Duration:** 1 month
**Category:** Behavioural Studies

**Description:** Pakistan is an arid country where water is a limited resource, and thus the irrigation sector is facing problems of water scarcity. With a scarce resource facing increasing demand, water management has turned into a strategic challenge for the government. Furthermore, agriculture plays a significant role in country, both economically and in terms of food production, resolving water scarcity issues through better water management and utilisation are both urgent and important. This study addresses this issue by devising few techniques which can help secure this renewable resource in a sustainable way for future generations. This study was aimed at identifying factors which could help in developing better relationships among four provinces of Pakistan which, in turn, will help advance the overall irrigation water management in the country.

**Title:** Assessment of Performance Management Systems
**PI:** Dr. Muhammad Abdur Rahman Malik
**Co-PI:** Dr. Atif Rahim Khan
**Sponsor:** Sapphire Textile
**Project Initiated in:** 2019
**Duration:** 1 month
**Category:** Behavioural Studies

**Description:** A single day assessment was conducted to evaluate the performance management as well as reward and pay policies and practices at Sapphire Finishing Mills Ltd. The purpose of this assessment was to determine the nature, scale and scope of any future interventions recommended. It included one-on-one interviews with senior managers, a focus group discussion with staff and document reviews. It helped in identification of needs and concerns of staff.

Dr. Muhammad Junaid Ashraf
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**Profile:** Dr. Junaid Ashraf holds a PhD in accounting from University of Essex. He is a fellow member of Association Chartered Certified Accountants (UK) and an associate member of the Institute of Chartered Accountants of Pakistan. He teaches managerial accounting and control to the MBA and Executive MBA students. He is also involved in teaching accounting and control courses to business executives at Executive Development Centre of the University. His research interests are in financial reporting, corporate governance and management control practices of state-owned enterprises. His research has been accepted for publication in *International Journal of Accounting*, *Critical Perspectives on Accounting* and *Financial Accountability and Management*. Before joining LUMS, he served as manager audit in one of the top four accounting firms in the country. Dr. Ashraf is also a visiting fellow in Essex Business School, University of Essex.

**Title:** Governmental Accounting and Auditing Practices in Pakistan
**PI:** Dr. Muhammad Junaid Ashraf
**Co-PI:** Dr. Ayesha Bhatti
**Sponsor:** ACCA Pakistan
**Funding Amount:** PKR 3,864,000
**Project Initiated in:** 2019
**Duration:** 5 months
**Category:** Business & Innovation

**Description:** In line with international trends, there have been several changes in governmental accounting and auditing practices in Pakistan since the early 2000s. Most of these changes or "reforms" have been triggered and sponsored by international agencies. These include World Bank sponsored Project to Improve Financial Reporting and Auditing' (PIFRA), Department for International Development (DFID) sponsored Medium Term Budgeting Framework as well as several other changes in the Auditor and Accountant General of Pakistan' offices. As a result, in many cases, there has been a partial implementation of these reforms. Although, there might be some genuine reasons for 'modifications' of these Western reforms to make them in line with the local needs. Either way, an in-depth understanding of local accounting and auditing practices and their comparison with Western 'ideals' is important for understanding the historical pathways the reforms took and the way forward. This project was thus aimed at understanding the local governmental accounting and auditing practices; their comparison with Western standards; and to explain the 'gap' through an in-depth analysis of political, social and technical reasons. The research was of theoretical and policy significance.

**Title:** Zero Based Budgeting Implementation in a Commercial Bank
**PI:** Dr. Muhammad Junaid Ashraf
**Co-PI:** Dr. Ayesha Bhatti
**Sponsor:** PACRA Analytics (Pvt.) Limited
**Project Initiated in:** 2019
**Duration:** 9 months
**Category:** Business & Innovation

**Description:** The project was implementing Zero Budgeting in Mid-Sized Commercial Banks. The project entails giving senior management overview of the concept, evaluating all expenses and activity that drive them, and eliminate/reconfigure activity to bring the cost down to the required level.

Mr. Muhammad Luqman Awan
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**Profile:** Mr. Muhammad Luqman Awan has rich experience in business management with global organisations. Mr. Luqman started his professional carrier in 2001 and has served in different roles with increased level of responsibilities. His last assignment was as Head of Sales & MARKETING for 3M Pakistan (Wholly owned subsidiary of 3M USA). In August 2013 he started his entrepreneurial journey by establishing sales & marketing consulting business with a single dream to create a world-leading organisation in the area of management consulting by the name of Markex.

Mr. Luqman is proponent of strong industry and academia collaboration; in this pursuit he considers himself privileged to be a faculty member at SDSB at LUMS and teach and train undergraduate, and graduate students, as well as executive participants since 2012 in areas of Sales & Marketing. He is actively involved in business research at LUMS. Mr. Luqman has also been an active member of LUMS alumni community and served on its board. He did his undergrad in Mechanical Engineering (2001), earned his MBA (2007) from LUMS, and is currently enrolled as a Ph.D. Scholar at University of Stirling Scotland.

**Title:** Develop Processes of Export Marketing (EM) Function at Wrangler Instruments.
**PI:** Mr. Muhammad Luqman
**Sponsor:** Wrangler Instruments
**Project Initiated in:** 2018
**Duration:** 12 Months
**Category:** Technology

**Description:** The goal of this project was to define business objectives of export market functioning, and to develop appropriate sales process required to achieve desire business objectives of EM. Furthermore, it was also focused on developing most suitable sales skills required in individuals of export market functioning. The project also determined the key performance indicators, compensation plans and organisational structure for EM.

Dr. Muhammad Shakeel Sadiq Jajja
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**Profile:** Dr. Shakeel Sadiq Jajja did his PhD research in the area of supply chain and innovation management. He has presented several research papers at globally esteemed research platforms. During his PhD, he won the Best Student Paper Award at the 43rd Annual Meeting of the Decision Sciences Institute (DSI) 2012 in San Francisco USA, Emerging Economy Doctoral Student Award at the 23rd Annual Conference of Production and Operations Management Society (POMS) in 2012 in Chicago USA, and Best Graduate Student Paper Award at the 40th Annual Meeting of Western Decision Sciences Institute in 2011 in Portland, USA. He received a Doctoral Fellowship from the Association of Management Development Institutions in South Asia (AMDISA).



**Title:** Improving Customer Participation in Service Delivery: The Context of Healthcare Industry of Pakistan
**PI:** Dr. Muhammad Shakeel Sadiq Jajja
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 990,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Operations Management

**Description:** This research made a significant contribution to both theory and practice. There is lack of research on the interface of operations, healthcare and service management domains in the management scholarship. In essence, healthcare service operations management is an emerging and promising discipline to cater to the modern day needs and management issues of the healthcare industry. This research is one of the initial efforts in this direction. The main objective of the research was to develop and empirically test a service design-based framework for effective customer participation in healthcare service delivery from the operations management perspective. For managers, the research generates insights as to how they could turn customer participation in service delivery to their benefit and the benefit for the very customer. The research suggests an appropriate mix of service design level choices that could be leveraged by the managers for enhancing effective customer participation.

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**Profile:** Dr. Muhammad Shehryar Shahid is an Assistant Professor of Entrepreneurship at SDSB and is also a leading member of the Entrepreneurship Working Group at the University. Dr. Shahid received his PhD from University of Sheffield in 2011, his MBA from LUMS in 2006 and his Bachelor's degree from Ghulam Ishaq Khan Institute of Engineering and Technology in 2003. Prior to his appointment at LUMS, he served as the Head of Management and Organization Division and the Director of Centre for Entrepreneurship and SMEs (CESME) at the University of Central Punjab from 2011 to 2013. He has taught courses like Entrepreneurship, Principles of Management, Business Model Development, Lean Launchpad and SME Management at both undergraduate and postgraduate levels. He is also an Editorial Board Member of Journal of Small Business & Entrepreneurship (JSBE) and an Editorial Advisory Board Member of The Lahore Journal of Business (LJB). His research interests lie in the areas of informal entrepreneurship, small business growth and entrepreneurial intentions.

**Title:** An Exploratory Analysis of the Role of Prior Experience, Start-up Motives and Growth Intentions on the use of Financial Bootstrapping Techniques (instead of formal institutional funding) amongst Women Entrepreneurs in Punjab, Pakistan.
**PI:** Dr. Muhammad Shehryar Shahid
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 605,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Business & Innovation, Economic Development, Social Sciences

**Description:** This study investigated the reasons behind the perceived unawareness of women entrepreneurs towards bootstrapping methods, and the limitations and challenges faced by these women entrepreneurs in utilising these techniques in order to finance their business ventures. More specifically, through a semi-structured survey of 300 women entrepreneurs in the city of Lahore, Pakistan, this study used Pecking Order Theory to investigate the role of factors such as demographic characteristics, prior family business exposure, motivation, and growth intention, on financial bootstrapping among women-led micro-enterprises and small businesses in Punjab, Pakistan. The findings of this study not only provided a basis for an empirical understanding of the difficulties faced by women entrepreneurs in Pakistan, especially when it comes to raising financial capital for their business ventures, but it will also assist financial institutions and policy makers in developing a more practical and supportive credit policy for micro-enterprises and small businesses in the long run.

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**Profile:** Dr. Omair Haroon is an Assistant Professor at SDSB. Dr. Haroon obtained his PhD in Accounting from the Hong Kong Polytechnic University, Hong Kong in 2015, where his research inquired into financial reporting choices and their impact on capital markets' perception of the firm with particular focus on earnings management. Dr. Haroon completed his Chartered Accountancy in 2005 from the Institute of Chartered Accountants of Pakistan and Chartered Certified Accountancy from Association of Chartered Certified Accountants, UK in 2002. Prior to joining LUMS, he was an Assistant Professor with the Caritas Institute of Higher Education, Hong Kong. He was associated with LUMS as Research Associate and Teaching Fellow between 2003 and 2008 prior to his departure for his PhD. Dr. Haroon has conducted several trainings for different courses and programmes at LUMS. His research interests include Capital Market Research in Accounting, Financial Reporting and Corporate Governance.



**Title:** Whistleblowing in Pakistan
**PI:** Dr. Omair Haroon
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 425,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Behavioural Studies, Business & Innovation

**Description:** This project used cultural dimensions (i.e., Hofstede's and Schwartz's values frameworks) to analyse differences in whistleblowing behaviour in several countries. Data for this study was collected from Turkey, Kenya and Uganda. The objective was to study the impact of cultural differences on whistleblowing practices in these countries. These countries were chosen for this task because they vary significantly across several dimensions of the widely accepted and studied frameworks this study intended to use. In addition to academic contribution, key learnings from this study can be used in developing whistleblowing protection policies in public and private sector organisations.

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**Profile:** Dr. Saad Azmat is an Associate Professor of Finance and Director Office of Research at LUMS. Previously he was the Associate Dean Research at SDSB and the founding Chair of the Centre for Islamic Finance at LUMS. His research is published in well-regarded academic journals including *Journal of Economic Behaviour & Organization*, *Journal of Business Ethics*, *Journal of Financial Research*, *Journal of International Financial Markets*, *Institutional and Money*, *International Review of Economics and Finance* and *Pacific Basin Finance Journal*. He has been a visiting researcher at a number of institutions around the world including Harvard University, University of Chicago, Monash University and INCEIF. He has been a consultant to government organisations, Islamic banks and corporate firms.

**Title:** Centre for Islamic Finance
**PI:** Dr. Saad Azmat
**Sponsor:** Multiple Sponsors
**Funding Amount:** PKR 1,926,018
**Project Initiated in:** 2019
**Duration:** 60 months
**Category:** Economic Development

**Description:** CIF-LUMS and Bank Islami collaborated on research related activities. CIF-LUMS requested Bank Islami to help its researchers in collection of survey data and other research related data. Bank Islami offered its assistance in line with its internal policies.

Dr. Syed Zahoor Hassan
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**Profile:** Dr. Syed Zahoor Hassan has over two decades of extensive experience in the higher education sector. At LUMS, Dr. Hassan has served in many capacities besides his teaching and research, including Associate Dean, Dean, Pro-Vice Chancellor and Vice Chancellor (VC) from 2002-8. After completing his second term as VC of LUMS in June 2008, Dr. Hassan has returned to his role as a Professor Emeritus at SDSB. He has been elected as Speaker of the Faculty Council. During his six-year tenure as VC, LUMS expanded by a factor of more two in all dimensions (academic programmes, faculty, schools and infrastructure) and formulated its vision to become a broad-based research university. Launch of the National Outreach Programme (NOP), through which bright students from the disadvantaged sections of our society are groomed and developed to join LUMS on full financial support, is a key highlight of Dr. Hassan's term as VC. Now almost 20% of students joining BSc at LUMS are NOP Scholars.

Currently Dr. Hassan is a charter member and Treasurer of The Indus Entrepreneurs (TiE) Lahore chapter, Member Board of Directors Systems Limited, Chair of IEEE Lahore section, on the board of AMDISA as a past president of the organisation, member of the board of governors of Foundation University, HITEC Education City, and a member of HEC quality assurance and social sciences committees. He also serves as a member of peer-review teams for European Quality Improvement System (EQUIS) and South Asian Quality System (SAQS) for accreditation of management schools.



**Title:** Assessment of Industry Readiness for Manufacturing of Battery Electric Vehicles
**PI:** Dr. Syed Zahoor Hassan
**Co-PI:** Dr. Muhammad Shakeel Sadiq Jajja
**Sponsor:** SAARC Energy Centre
**Funding Amount:** PKR 3,525,500
**Project Initiated in:** 2019
**Duration:** 9 months
**Category:** Technology, Business & Innovation

**Description:** The project was a collaborative research between Pakistan and India to determine the level of readiness in both countries for manufacturing of Battery Electric Vehicles. This project was a promising research since it has the means to contribute significantly to Economic, Environmental and Power sector of both the countries.

**Title:** Review of Strategy and Faculty Capacity at Dow University IBHM
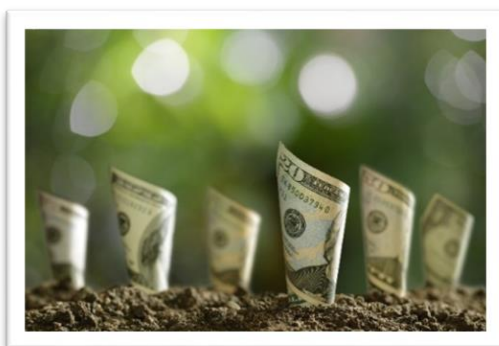**PI:** Dr. Syed Zahoor Hassan
**Co-PI:** Dr. Jawad Syed
**Sponsor:** Dow Institute for Business and Health Management
**Project Initiated in:** 2020
**Duration:** 3 months
**Category:** Business & Innovation

**Description:** The project was a preliminary review of IBHM's strategic plan, faculty capacity and suggestions for future interventions such as strategic refinement, faculty development, students' learning experience, and external engagement. This also incorporates review of strategic documents, faculty profile, meetings with top leaders and policy makers of Dow University and the Institute, meetings with faculty members, administrative staff and students.



**Title:** Agri-business sector diagnostics
**PI:** Dr. Syed Zahoor Hassan
**Sponsor:** Adam Smith International (ASI)
**Project Initiated in:** 2020
**Duration:** 1 month
**Category:** Agriculture

**Description:** The aim of the project was to support the SEED programme in mapping the current and potential landscape of the Agri-Business sector in KP; identifying and analysing key sector players (both public and private) to enhance sector outreach and engagement; provide a gap analysis (covering policy, regulatory, institutional framework, investment and infrastructure, planning and institutional gaps) and identify opportunities for provincial level investments and interventions in the sector.



**Title:** Case Study writing for Fintech Disrupt Challenge for Karandaaz Pakistan
**PI:** Dr. Syed Zahoor Hassan
**Sponsor:** Karandaaz
**Project Initiated in:** 2019
**Duration:** 4 months
**Category:** Business & Innovation

**Description:** The primary objective of this exercise was to generate learnings and insights focused on initiatives serving financially underserved and unserved population segments, business and entrepreneurs in Pakistan.

Dr. Zehra Waheed
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**Profile:** Dr. Zehra Waheed is the coordinator of the BSc Management Science at the SDSB. Prior to SDSB, Dr. Waheed has worked at Heriot-Watt University in Scotland, in the Corporate and Institutional Banking and Textile sector in Pakistan, and in Retail Banking in the UK. Dr. Waheed's teaching experience spans undergraduate and postgraduate teaching in the areas of Construction Project Management, Facilities and Asset Management, Value and Risk Management and Construction Financial Management at Heriot-Watt University, Scotland. She has taught executive, undergraduate and postgraduate students at SDSB. Her primary teaching areas at SDSB and the Rausing Executive Development Centre (REDC) are Project Management and Public Procurement.

**Title:** Predictive Framework for the Success of Industry-academia Technology Commercialization Ventures in Less Advanced Countries: Implications for Funding Bodies' Assessment Practice and Policy.

**PI:** Dr. Zehra Waheed

**Co-PI:** Dr. Basit Yameen

**Sponsor:** Faculty Initiative Fund (LUMS)

**Funding Amount:** PKR 650,000

**Project Initiated in:** 2019

**Duration:** 12 months

**Category:** Business & Innovation

**Description:** The purpose of the research was to undertake exploratory and explanatory inductive research whereby projects funded through two cycles of the Higher Education Commission's Technology Development Fund scheme are evaluated against a proposed framework predicting success of technology commercialisation projects between local industry and academia. The research was expected to not only take over funding bodies' practice of assessing possible collaborative partnership proposals but also the contextually embedded critical success factors that lead to success of such entrepreneurial ventures successful in our context. The research had implications for practice and policy adopted by funding bodies and also paves the way for clarifying partner expectations, market acceptance of products produced and identifying the nature of R&D team composition that makes them entrepreneurial as well as technically sound.

**Title:** Opportunities and Challenges for Agri-food Trade between Kyrgyzstan and Pakistan
**PI:** Dr. Zehra Waheed
**Co-PI:** Dr. Roman Mogilevskii, University of Central Asia, Kyrgyzstan
**Sponsor:** Central Asia Regional Economic Cooperation Institute
**Funding Amount:** PKR 1,482,900
**Project Initiated in:** 2019
**Duration:** 7 months
**Category:** Agriculture, Economic Development

**Description:** The research goal was to analyse potentials and benefits and barriers for Agri-food trade between Kyrgyzstan and Pakistan. According to official statistics, trade between these countries is represented very poorly despite its great potential especially in agricultural sector. This research investigation employed mixed methods to understand the current status-quo qualitatively, while establishing a certain level of causality between various factors affecting Agri-trade between Pakistan and Kyrgyzstan quantitatively. It included analysis of legislation, trade regime (barriers) and practices such as recognition of certificates, tax regimes, exemptions, custom clearance etc., desktop research of existing literature, quantitative analysis of available bilateral trade data and in-depth interviews with stakeholders.



**Title:** Changing Wind Energy Industry Dynamics in the Gharo-Jhimpir Region: Can the Current Tariff-determined Risk-return Equilibrium Adequately Assist the Industry in Transitioning into the Next Phase of Possible Market Expansion?
**PI:** Dr. Zehra Waheed
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 795,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Energy

**Description:** In this project it was assumed that the tariff regime is a major determinant of the industry players' risk-return determined business model on one hand, while changing technology and availability of EPC (turnkey contractors setting up the power plants) and O&M (operation and maintenance) service providers is a key determinant on the other. The research determined the examining and mapping both in detail so that upcoming renewable energy policy can adequately reflect (and support) the very stage of market development now seen in the Gharo-Jhimpir region, the largest (and currently viable) wind power generation corridor in the country.

# SYED BABAR ALI SCHOOL OF SCIENCE AND ENGINEERING (SBASSE)

# DEPARTMENT OF ELECTRICAL ENGINEERING (EE)

Dr. Abubakr Muhammad
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**Profile:** Dr. Abubakr Muhammad is an Associate Professor and Chair of Electrical Engineering, the founding director of the Centre for Water Informatics & Technology (WIT), and the lead for NCRA National Agricultural Robotics Lab at LUMS. He received his Ph.D. in Electrical Engineering in 2005 from Georgia Institute of Technology, USA winning an institute-wide best Ph.D. Dissertation Award. He received master's degrees in Mathematics and Electrical Engineering from Georgia Tech and was a postdoctoral researcher at the University of Pennsylvania and McGill University. Since 2008, his research group at LUMS is doing applied research in robotics, automation and AI with applications to water, agriculture, and environmental issues. He serves on various advisory panels to government agencies and industry in Pakistan on water, climate and agricultural policy, especially on the use of emerging digital technologies for these sectors.

**Title:** Collaboration between ABS, KeepTruckin and LUMS for providing support to LUMS Centre for Water Informatics and Technology (WIT)
**PI:** Dr. Abubakr Muhammad
**Sponsor:** KeepTruckin
**Funding Amount:** PKR 600,000
**Project Initiated in:** 2018
**Duration:** 9 months
**Category:** Water

**Description:** WIT LUMS collaborated with KeepTruckin (through its local subsidiary ABS Labs) to develop an automated driver performance measurement system for KeepTruckin. WIT worked on the Motion Planning approach to measure drivers' performance and efficiency.

**Title:** Addressing Connectivity Challenges in Data-Driven Agriculture
**PI:** Dr. Abubakr Muhammad
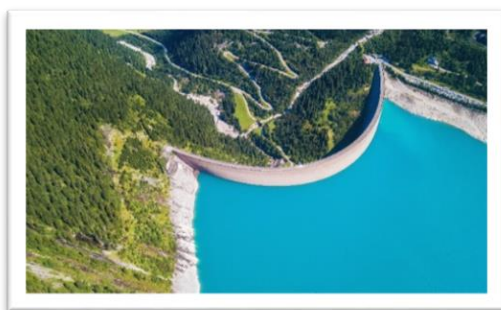**Co-PI:** Dr. Momin Ayub Uppal
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 990,500
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Agriculture, Technology

**Description:** Coping with internal food security challenges as well as achieving international price competitiveness requires that Pakistan's agricultural sector embraces the data-driven agricultural revolution. This revolution entails monitoring and analysing the farm's health using connected sensors (for monitoring soil moisture, temperature, soil nutrient level, pests, plant health etc.), autonomous mobile platforms, and advanced data analysis algorithms. Despite the promising results that are associated with data-driven agricultural methods, their adoption so far has not been widespread, even in the developed world. This is primarily due to the challenges associated with efficiently connecting nodes across the farm for the purpose of data collection, in addition to other major challenges of providing energy to new forms of farm mechanisation and the inability to process high volume data. This study was aimed to address these connectivity challenges in data-driven agriculture by exploring techniques like (1) scatter radios for monitoring of soil moisture content, and communicating the sensed parameter to an RF reader, and (2) TV White Spaces for high-throughput transmission of video feeds from across the farm. In a nutshell this study had a major impact on the conventional farming monitoring techniques thereby assuring the use of a land; at its fullest.



**Title:** A Hydro-informatics Test-bed for Smart Irrigation and Flood Prediction Applications in the Namal Valley
**PI:** Dr. Abubakr Muhammad
**Co-PI:** Dr. Talha Manzoor
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Natural Sciences, Technology, Agriculture

**Description:** The study was targeted at developing a moderate-scale experimental setup in the Namal Valley located in Mianwali district. Namal Canal System irrigates 18 km in length, irrigates an area of 5,897 acres in the downstream area of Musakhel. The initial phase of the project was installation of appropriate sensing technologies to measure quantities such as water flow, reservoir level, and rainfall and so on. These sensors also provide the data to form hydrological models that predict the reservoir water level under ongoing climatic conditions. The scope of this project was to install the required sensors and gather enough data to develop and test a hydrological model of the Namal Lake. This model will be capable of predicting the future reservoir level, given a certain climatic event (such as rainfall) occurring in the catchment area, or the opening of the gates on the dam spillway.

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**Profile:** Dr. Fiaz Ahmad Chaudhry is an Electrical Engineer with over 34 years of experience in senior management roles, power system planning, secure power system operation, project management and teaching.

Dr. Fiaz's areas of expertise include corporate management, management consulting, energy policy, regulation, compliance and monitoring, restructuring of electric utilities, power system planning, technical and operational studies, functional and technical specifications of electric facilities (including FACTS/HVDC), programme and project management, institutional capacity building and providing smart-grid solutions. He has led different sized teams to develop transmission system expansion, integration, operation and investment plans for countries, regions, utilities, transmission owners (TOs), independent system and market operators (ISOs and IMOs) and independent power producers (IPPs) - worth billions of dollars. Dr. Fiaz is experienced in working with consultants, utility boards, government and International Funding Agencies to develop and implement long-term power infrastructure projects. Throughout his professional career, he has managed or participated in hundreds of small and large-scale transmission integration and technology application projects around the world, including in Canada, USA, Ghana, Guatemala, India, Indonesia, New Caledonia, Saudi Arabia, Tanzania, Tajikistan, Uganda and Pakistan.

**Title:** LUMS Energy Institute
**PI:** Dr. Fiaz Ahmad Chaudhry
**Co-PI:** Dr. Naveed Arshad
**Sponsor:** Multiple Sponsors
**Funding Amount:** PKR 2,569,997
**Project Initiated in:** 2019
**Duration:** 36 months
**Category:** Energy

**Description:** This project aimed to create an Energy Institute at LUMS to serve as a think tank, centre of technical excellence, knowledge network, and capacity building entity for the government to institutionalise a renewable rich future for Pakistan in the most sustainable and cost-effective way possible. This project also addresses the issue related to power sector planning, grid modernisation, reliability, and energy policy and finance.

**Title:** Engro's 1st Assignment for SEL Project - Consultancy Project under LUMS Energy Institute
**PI:** Dr. Fiaz Ahmad Chaudhry
**Sponsor:** Engro Powergen Thar Limited
**Project Initiated in:** 2019
**Duration:** 4 months
**Category:** Energy

**Description:** Production Simulation Model requires continuous updating of operational data for all types of plants, scheduled outages, monthly demand data, Merit Order information, indexations and CODs of upcoming power plants, since all factors affect load factors of power plants. Further, transmission constraints also impact the dispatch-ability of units.

It was assured that the model is continuously updated with the latest information available to the operators from various sources. For obtaining simulation results with reasonable accuracy, reconfirmation CODs of the upcoming power plants were observed. Once the model is updated, it runs production simulations and evaluate plant factors for different plants, including SSL 330 MW project under two tariff scenarios.



**Title:** LUMS Energy Institute
**PI:** Dr. Fiaz Ahmad Chaudhry
**Co-PI:** Dr. Naveed Arshad
**Sponsor:** Descon Engineering
**Funding Amount:** PKR 30,106,800
**Project Initiated in:** 2018
**Duration:** 36 months
**Category:** Energy

**Description:** This study was focused on creating a centre at LUMS that will serve as a think tank, centre of technical excellence, knowledge network, and capacity building entity for the government to institutionalize a renewable rich future for Pakistan in the most sustainable and cost-effective way possible. This basis of this centre was laid on four objectives namely, Power & Energy Planning, Adoption of Renewable Energy Technologies, Grid Modernisation, Energy Markets & Data Analytics, and Capacity Development. This centre would employ a new type of electricity grid where both the generation and loads can be controlled. This new grid commonly known as the Smart Grid is currently an active area of research in the research community. In addition to a power layer, this grid has an over-laid communication layer that transmits data between its key components. In fact, the data from the smart grid is expected to be so enormous that in future the smart grid is set to be the largest data network after the Internet. The smart grid will manage the renewable energy matching with the demand through innovate demand-side management (DSM) techniques.

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**Profile:** Dr. Hassan Abbas Khan received the Bachelors of Electronic Engineering from GIKI, Pakistan in 2005. From 2005 to 2010, he was with School of Electrical Engineering, University of Manchester, UK where he first received his MSc (with distinction) and then PhD in Electrical and Electronic Engineering. His current work is on the research and development of novel grid architectures for low-cost rural electrification using solar energy. He is also working on efficient solar PV deployment and maximising performance ratio for grid-tied systems in urban settings. His research work has been published in top tier journals such as *Journal of Renewable and Sustainable Energy* (AIP), *IEEE Quantum Electronics*, *IEEE Electron Device Letters*, *Journal of Applied Physics*, *IET Optoelectronics*, *European Physical Journal*, and *Renewable & Sustainable Energy Reviews*.



**Title:** Towards Efficient Back-up Systems for Residential Consumers in Weak Grids
**PI:** Dr. Hassan Abbas Khan
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Energy

**Description:** Uninterrupted power supply (UPS) have now become an integral part of all the residential electrical infrastructure for many developing countries, as well as for data-centres, because they provide backup in case of outages and in some cases can provides protection against unwanted surges, fluctuations and harmonics. However, from a utility grid perspective, these UPS systems are causing more harm than good due to many inherent inefficiencies which are further burdening the already weak grid of Pakistan. According to a preliminary study conducted at Dept. of EE LUMS, for every 4 kWh (units of electricity) only 1 kWh is recovered. Having said that, this research evaluated the design of a DC UPS system to minimise conversion stages by keeping the medium of power in DC throughout. However, the distribution of DC at low voltages is subjected to losses, therefore, evaluation of multi-level DC were done, and a solution based on typical urban house was developed for optimum power delivery. The work was therefore important in future viability, adoptability, design and implementation of a DC UPS system that will replace the current existing AC UPS systems which have many inherent inefficiencies associated with it.

**Title:** Next Generation DC/AC Hybrid Building Level Distribution Architectures for Intermittent Grids
**PI:** Dr. Hassan Abbas Khan
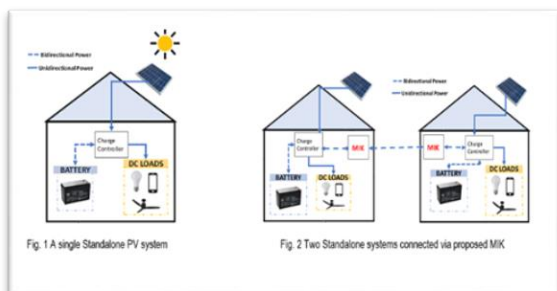**Co-PI:** Dr. Nauman Ahmad Zaffar
**Sponsor:** HEC
**Funding Amount:** PKR 2,508,978
**Project Initiated in:** 2019
**Duration:** 36 months
**Category:** Energy

**Description:** This research was focused on establishing more efficient power architectures in these urban buildings and houses to reduce redundant power conversions. Moreover, with increased emphasis on in-house solar generation, net-metering and increasing percentage of DC loads in modern settings, there is a need to alter the building level power architecture to allow grid-feeding and also cater for DC loads. In order to achieve the rationale stated, the study further investigated to create an efficient hybrid building level power architecture which can reduce local power losses in the buildings by up to 50%. This will allow efficient utilisation of power and will in turn a) reduce consumer's electricity bill and b) reduce the increasing burden on national grid due to urbanisation. The surplus grid power (as a result of direct savings) can then be provided to industry as well as rural electrification which would contribute to the country's GDP.



Fig. 1 A single Standalone PV system    Fig. 2 Two Standalone systems connected via proposed MIK

**Title:** Micro-grid Interface Kit for Standalone Solar PV and UPS Backup Systems
**PI:** Dr. Hassan Abbas Khan
**Co-PI:** Dr. Nauman Ahmad Zaffar
**Sponsor:** HEC
**Funding Amount:** PKR 12,473,000
**Project Initiated in:** 2019
**Duration:** 24 months

**Category:** Energy

**Description:** The study was focused on design and development of a plug-and-play micro-grid interface kit, which will be capable of integrating multiple standalone photovoltaic (PV) systems or multiple UPS backup systems to formulate a microgrid. This prototype comprised of a) bidirectional converter, b) its control regime and c) an energy accounting mechanism. To further enhance the user friendliness and consumer involvement in a free energy trade market, graphical user interface (GUI) based web and mobile applications was developed and integrated with the prototype so that individual users may have a log of their energy transactions and set their transaction preferences for enhanced profitability. MIK has the potential to enhance the utility of standalone systems and its target market / end users range from rural consumers to urban consumers having backup systems installed in their household electricity network.

**Title:** Evaluation of Battery Discharge Profile for In-Service Mobile Phones
**PI:** Dr. Hassan Abbas Khan
**Sponsor:** University of Maryland
**Funding Amount:** PKR 788,430
**Project Initiated in:** 2019
**Duration:** 24 months
**Category:** Energy

**Description:** The performance of Lithium-based batteries in mobile phones is highly dependent on its usage profile among other factors such as aging, operating temperature, defects etc. Therefore, in order to estimate the life of batteries it is important to carefully observe the battery discharge profile under active phone operation. As various apps/processes draw power from these batteries in a varied manner, it can have a significant impact on the life and performance of phones. The main task in this research was to evaluate discharge profile of android based mobile phones to estimate aging process. The implementation of this task was achieved through application programme interface (API) given in the software and a relevant APK (Android Package) was designed to decipher the discharge current.



**Title:** Indigenous, Sustainable, Peer-to-peer Based Solar Electrification for 62 million Off-grid People in Pakistan
**PI:** Dr. Hassan Abbas Khan
**Co-PI:** Dr. Nauman Ahmad Zaffar
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 788,430
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Energy

**Description:** Access to electricity is a key in improving the socio-economic standing of communities. Unfortunately, according to the World Bank, 70.8% population of Pakistan i.e., over 62 million people have no access to electricity. Keeping that figure in mind, the need of the hour is to electrify these off-grid communities through renewables based innovative solution so that they are able to improve their socioeconomic standing a help the GDP of the country. This project deployed a DC micro-grid which was indigenously designed and developed at SBASSE. This research further can enable potential electricity markets in rural community (a novel concept within off-grid electrification).

**Title:** Power Management for Smart Grids
**PI:** Dr. Hassan Abbas Khan
**Sponsor:** Ignite - National Technology Fund
**Funding Amount:** PKR 77,000
**Project Initiated in:** 2019
**Duration:** 6 months
**Category:** Energy

**Description:** This research was focused on designing a prototype of Power management Unit that can be smartly utilised for consumption and distribution of electricity from DC micro-Grid especially in rural areas of Pakistan and a communication system which is able to perform bidirectional flow of information in real time between web server and nodes. Information retrieved by sensors is processed by micro controller namely DSPIC and then channelled to ESP8266 via serial communication which is connected to web portal via Wi-Fi. Based on the information received from the node administrator can take decisions which were relayed back to ESP8266 which transmits the data to PIC16 and then microcontroller takes action based on the administrator's decisions. All the processed data is stored in a memory card at site and online in a cloud storage.

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**Profile:** Dr. Hassan Jaleel is an Assistant Professor at LUMS. He received his M.S. and Ph.D. degrees in Electrical and Computer Engineering (ECE) with specialisation in Systems and Control from the Georgia Institute of Technology, Atlanta, GA, USA. Before joining LUMS, he was a Postdoctoral Research Fellow at the King Abdullah University of Science & Technology (KAUST). His research interests are in the areas of real-time distributed optimisation, game theory, and stochastic geometry. He is interested in designing learning mechanisms with global performance guarantees for self-interested agents in large-scale complex networks. Typical application domains of his research include swarm robotics, sensor networks, and irrigation networks. Dr. Jaleel was a Fulbright scholar from 2009–2013 and is a member of IEEE.
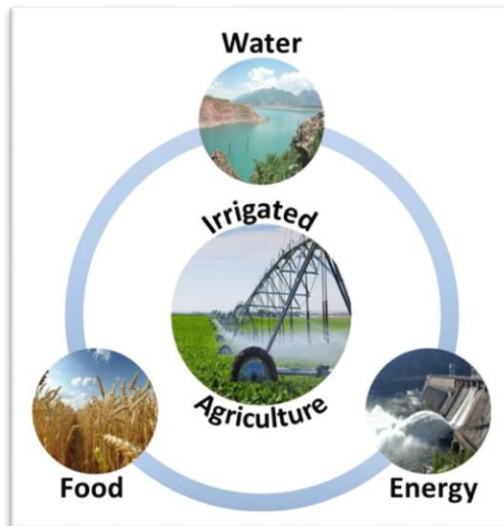


**Title:** Water-Energy-Food Nexus: An Integrated Approach for Active Demand Management of Surface Water in Pakistan.
**PI:** Dr. Hassan Abbas Khan
**Co-PI:** Abubakr Muhammad
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 980,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Agriculture, Energy, Water

**Description:** The goal of this project was to develop policies that will increase the agricultural productivity at the system level while minimising the total cost. The approach that was used to achieve the above-mentioned objective is Food and Agriculture Organization's idea of advocating "Water-Energy-Food (WEF) Nexus". This method takes three sectors under consideration and helps in designing a novel mechanism for the distribution of available surface water at the farm level. Instead of having a fixed schedule, it was an active demand-based mechanism in which farmers will communicate their crop water requirements to the concerned authorities and will receive surface water when their crop needs it the most. This research initiated a paradigm shift in Pakistan and led our agricultural irrigation towards a modern technology driven system.

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**Profile:** Dr. Hassan Mohy-ud-Din is the Director of Clinical and Translational Imaging Lab and an Assistant Professor at LUMS. He completed his PhD and MSE in Electrical and Computer Engineering and MA in Applied Mathematics and Statistics from Johns Hopkins University (2009-2015). From 2015-2017 he was a postdoctoral associate in the Department of Radiology and Biomedical Imaging at the Yale School of Medicine. From 2017-2018 he was a Clinical Research Scientist at Shaukat Khanum Memorial Cancer Hospital and Research Centre.

His research lies at the intersection of Applied Mathematics and Medical Imaging. Dr. Hassan recently launched the Clinical and Translational Imaging Lab at LUMS under the banner of National Centre for Big Data and Cloud Computing. This lab is first of its kind in Pakistan focusing on novel computation algorithms and techniques in multi-modality (medical) imaging. The over-arching goal of this lab is to develop a symbiotic relationship between engineering, mathematics, and clinical sciences in Pakistan where these realms, to this day, are largely disconnected. This pioneering effort is being funded by a start-up grant awarded by Syed Babar Ali School of Science and Engineering, LUMS and a research grant awarded by the Higher Education Commission and Planning Commission of Pakistan.

**Title:** Volumetric Analysis of Hepatic Lesions with Triphasic CT Imaging
**PI:** Dr. Hassan Mohy Ud Din
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 880,580
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health

**Description:** The study was focused on, novel segmentation methods, based on deep learning techniques, for volumetric analysis of hepatic lesions with triphasic CT. Unlike volumetric analysis based on single-phase CT, triphasic CT will pool complementary information from multiple phase-images for robust and accurate tumour volume quantification. This approach was thoroughly validated on a large cohort of subjects ($> 200$) with Hepatocellular Carcinoma (HCC). Validation will include comparisons with state-of-the-art (semi) automatic approaches and gold-standard manual segmentations from expert radiologists and/or nuclear medicine fellows from Shaukat Khanum Memorial Cancer Hospital and Research Centre (SKMCH&RC). This study helped in early diagnosis of HCC is crucial as several potentially curative treatments exist for small hepatic lesions ($1 - 2$ cm).

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**Profile**: Dr. Ijaz Haider Naqvi received his B.Sc. Electrical Engineering from University of Engineering and Technology Lahore (2003), Masters in Radio Communications degree from SUPELEC Paris (2006) and Ph.D. degree in Electronics and Telecommunications from IETR-INSA Rennes, France (2009). He has been a recipient of prestigious ministerial scholarship of French Ministry of Research to pursue his PhD and HEC overseas scholarship for his Masters. He has got several years of research experience in the wireless communications and wireless sensor networks. His current research focuses on ultra-wideband communications, system level aspects in wireless sensor networks and RF optimisation and network management issues in wireless mobile networks. He has published several refereed papers in international journals and peer reviewed international conferences.



**Title:** Development of Space-Time Block Coded Wireless Link (Modulator/Soft-Demodulator)
**PI:** Dr. Ijaz Haider Naqvi
**Sponsor:** National Engineering and Scientific Commission (NESCOM)
**Funding Amount:** PKR 300,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Telecommunications

**Description:** This project intended to design and develop a MIMO system which will be equipped with 2 transmit and two receive antennas. The idea was to exploit the space time diversity to obtain better quality of service and lower bit error rates. Ordinary space time block codes require channel states information to properly decode the received signals. However, differential STBC alleviate this problem, thereby reducing the receiver's complexity. This project was a substantial step in the way of removal of one of the many challenges that wireless communications face now a days.



**Title:** Ageing and Degradation Analysis of Lithium Ion Batteries
**PI:** Dr. Ijaz Haider Naqvi
**Co-PI:** Dr. Nauman Ahmad Zaffar
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Energy, Natural Sciences, Technology

**Description:** As the name suggests, this project focused on conducting a fundamental research on ageing and degradation analysis of lithium ion batteries. The overarching objective of the project was to accelerate the pace of

battery innovation. This helped the industry to reduce the development cycle of the new technology. This was accomplished by developing novel algorithms using data driven and machine learning techniques to predict end of life of the battery early on in the life without requiring run to failure testing. A large number of applications, like electric vehicles, make use of lithium ion batteries. For EVs the batteries need to have longer longevity and lower cost. Ideally, these batteries should have quicker charging cycle and should have larger stored energy.

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**Profile:** Dr. Momin Uppal received the B.S. degree in Electronic Engineering with highest distinction from GIK Institute of Engineering Sciences and Technology, Pakistan, in 2002. He received the M.S. and Ph.D. degrees in electrical engineering from Texas A&M University, College Station, in 2006 and 2010, respectively. He spent the summers of 2009 at NEC Labs of America, Inc., Princeton, New Jersey as a research assistant, and the summers of 2012 at Texas A&M University Qatar as a visiting researcher. He has been associated with the LUMS School of Science and Engineering since October 2010.



**Title:** GrISt: Green Internet-of-Things (IoT) for Climate Smart-Agriculture
**PI:** Dr. Momin Ayub Uppal
**Co-PI:** Dr. Abubakr Muhammad
**Sponsor:** University of Leeds
**Funding Amount:** PKR 4,633,195
**Project Initiated in:** 2018
**Duration:** 8 months

**Category:** Agriculture, Environment

**Description:** With the increasing trend of population growth and adversity of climate change countries like Pakistan are facing or on the verge of food insecurity. If the trend continues its exponential growth soon the situation will worsen and these countries might face issues like famine. In order to deal with this problem at hand, this project adopted the idea of Climate Smart Agriculture (CSA). CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible. In a nutshell, this project had the potential to accelerate the use of smart farming techniques thereby, improve productivity and food resilience for the farmers.



**Title:** Wi-Leak: A System for Non-Invasive Detection of Concealed Water Leaks Using Wi-Fi
**PI:** Dr. Momin Ayub Uppal
**Co-PI:** Dr. Muhammad Tahir
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology, Water

**Description:** Water leaks are arguably the most common defects in buildings. Early detection and isolation of a concealed water leak is extremely important since it is a major cause of corrosion in concrete. Conventional non-invasive solutions for detecting these hidden leaks require specialised hardware (e.g. ultrasonic sensors or infrared/thermal/radar imaging) and are costly. The objective of this project was to develop a novel and cheap alternative that harnesses a building's existing Wi-Fi infrastructure for detecting hidden water leaks.



**Title:** Design of a Channel Emulator for a Jet Aircraft - Phase 2
**PI:** Dr. Momin Ayub Uppal
**Sponsor:** National Engineering and Scientific Commission (NESCOM)
**Funding Amount:** PKR 250,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology

**Description:** The study was focused on Baseband designers which are meant to design physical layers which need to be thoroughly tested before going to the deployment stages. This is an iterative process where designed algorithms need to be tailored to specific environmental condition or more specifically a channel. The channel is critical as the physical layer designer must incorporate methods to mitigate its artifacts accordingly. This project was a continuation of the project approved in RAC-IV. This phase of the project focused on the implementation aspects of the channel emulator on hardware platforms.



**Title:** ATC Voice relay using SDRs for UAV applications (Full duplex)
**PI:** Dr. Momin Ayub Uppal
**Sponsor:** National Engineering and Scientific Commission (NESCOM)
**Funding Amount:** PKR 250,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Natural Sciences

**Description:** Unmanned aerial vehicles (UAVs) flying in remote regions need to have a localised awareness. The UAV can be inquired by a remote air traffic control (ATC) for a reason. In this case, it is required that the UAV be equipped with a full-duplex voice relay system so that the ATC personnel can directly communicate with the UAV operator. The objective of this project was to develop a small form factor voice enabled communication link using an SDR platform in order to facilitate this communication.
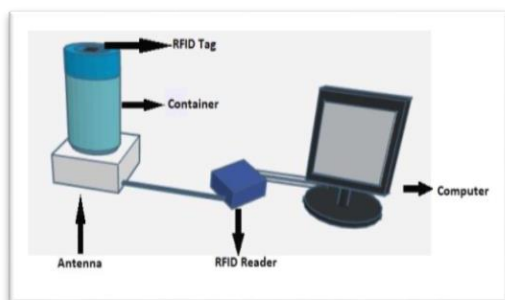
**Title:** Towards Inexpensive and Portable Food Quality Testing using Wireless Stickers
**PI:** Dr. Momin Ayub Uppal
**Co-PI:** Dr. Muhammad Tahir
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology

**Description:** Wholesome unadulterated nutrition is essential to our health and well-being. Unfortunately, food adulteration in Pakistan has become a major crisis. With the increased public awareness, there is a great need for developing food quality testing methods that are not only portable and cheap, but also available for every-day usage by the public at large. Addressing the problem of lack of such techniques, among other steps, the availability of cheap, portable, and publicly accessible food quality testing solutions. In an effort to develop a cheap and portable testing solution, this study intended to develop a novel method for measuring food quality using cheap and battery-free wireless stickers. These stickers, alternatively known as radiofrequency identification (RFID) tags (like the ones placed in our LUMS smart-cards) cost only a few cents. When brought in the vicinity of an RFID reader, the sticker is energised by radio signals emanating from the reader. In a conventional setting, the sticker reflects the radio signal so as to communicate a unique identification sequence. As opposed to this conventional usage, it intended to capitalise on the fact that the analogue features of these reflections vary with the properties of the material placed in the tag's vicinity. Thus, these features would be different if the sticker is placed on a container of pure milk than they would be if the milk was tainted.
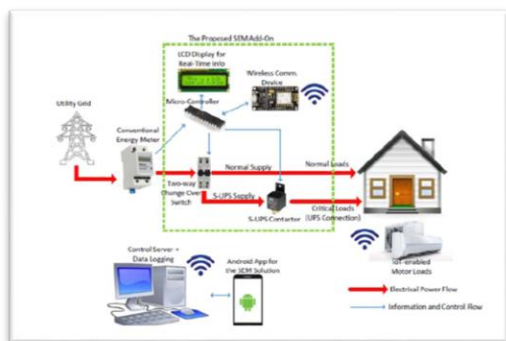
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**Profile:** Dr. Muhammad Adeel Pasha received the BSc degree in Electrical Engineering from the University of Engineering and Technology, Lahore, Pakistan, in 2004, his MS degree in Electrical and Computer Engineering from the University of Nice Sophia-Antipolis, Nice, France, in 2007, and a PhD degree in Electrical and Computer Engineering from the University of Rennes, France, in 2010.

Since 2011, he has been working as an Assistant Professor with the Department of Electrical Engineering, LUMS. He has several years of research and development experience and has published numerous refereed articles in major international journals and peer-reviewed conferences. His research interests include low-power microarchitecture, energy-efficient hardware design, hardware acceleration of machine learning and deep neural networks, and futuristic computing platforms for green computing and communications.



**Title:** Smart Energy Metering Solution with Monitoring and Control Capabilities for Efficient Demand Side Management
**PI:** Dr. Muhammad Adeel Ahmed Pasha
**Co-PI:** Dr. Nauman Ahmad Zaffar
**Sponsor:** German Pakistani Research Cooperation Program - DAAD
**Funding Amount:** PKR 13,421,990
**Project Initiated in:** 2020
**Duration:** 36 months
**Category:** Energy

**Description:** It is a known fact that developing countries like Pakistan, are facing the full brunt of energy crisis. Energy shortfall severely contributes to the economic problems both directly and indirectly. The lack of electricity access and shortages have crippled Pakistan's economy and placed the health, education and future wellbeing of its residents at risk. This project was a mean to address this issue by designing alternate DSM strategies for energy optimisation in electricity distribution network of Pakistan through the integration of smart energy solutions using Information Technology (IT) and Communication Networks (CN) that would help improve the efficiency of the Energy Network (EN). The major objective was to increase the efficiency and the stability during re-activation of the network after load shedding. The study further investigates an IoT-enabled add-on to the existing meters for scalable and modular addition of functionality without disturbing the existing metering infrastructure for billing. The SEM uses these communication capabilities with the central server, the existing meter and peripheral devices to provide value-added services like S-UPS and dynamic control of IoT-enabled motor loads.

**Title:** FFConv: Resource-Efficient FPGA-based Design and Acceleration of Convolutional Neural Networks (CNNs) for Embedded Vision Applications
**PI:** Dr. Muhammad Adeel Ahmed Pasha
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 995,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Computer Vision, Energy, Technology

**Description:** With the advent of Artificial Intelligence (AI) and automation, Neural Networks are being explored as state-of-the-art algorithms for various tasks that require cognitive abilities that machines do not possess. Few of the most well-known problems in computer vision and AI are those of image classification, object detection, semantic and instance segmentation in images. While humans learn the ability to recognise objects and semantics from experience and with practice, machines interpret images merely as a collection of numbers or pixel values that are meaningless to them. Convolutional Neural Networks (ConvNets) are state-of the- art algorithms used to accomplish various computer vision tasks that require perception. ConvNets attempt to simulate human cognitive abilities of identifying objects by processing information in neurons like visual signals in living beings as they travel through synapses.

The main objective of this project was to design and implement an efficient and ubiquitous FPGA-based ConvNet accelerator that can be applied to any of the modern embedded machine vision applications. Furthermore, performance gained from utilising the designed accelerator would be demonstrated by applying our accelerator to object classification in images. Input data and model quantization schemes were also determined to find a right balance among the accuracy, resource utilization and performance of the designed accelerator.



**Title:** Coty – Humanoid Interactive Therapy Aide Robot
**PI:** Dr. Muhammad Adeel Ahmed Pasha
**Sponsor:** Ignite - National Technology Fund
**Funding Amount:** PKR 9,997
**Project Initiated in:** 2019
**Duration:** 6 months
**Category:** Artificial Intelligence, Technology

**Description:** Coty- Humanoid Interactive Therapy Aide Robot, is a social robot aimed to deal with the patients suffering from Autism Spectrum Disorder (ASD). This robot is highly interactive to help the subjects overcome the persistent challenges in social interaction, speech and non-verbal communication and obsessive behaviours. This robot is designed to recognize the mental state of the subjects by their facial expressions and then assisting them with therapeutic lessons. It can also be used by the therapists to assist in the therapy sessions of their patients. It's a portable therapist on the go.

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**Profile:** Dr. Muhammad Awais Bin Altaf in an Assistant Professor in the Department of Electrical Engineering, SBASSE. Dr. Altaf obtained his PhD in Interdisciplinary Engineering and MSc in Microsystems Engineering from Masdar Institute of Science and Technology, Abu Dhabi in 2016 and 2012, respectively. He developed an energy efficient machine-learning based feature extraction and classification processor for epileptic seizure detection sensor with transcranial stimulation. His research is focused on low power bio-medical sensors and processors with special focus on mixed signal circuits. He was an Exchange PhD student during fall 2015 in Massachusetts Institute of Technology (MIT), USA. From November 2012 to June 2013, he was a Digital Design Engineer Intern at Design Solutions, Global Foundries in Dresden, Germany where he was working on the implementation of digital test chips of 20 and 14nm technology. Dr. Altaf is a recipient of IEEE SSCS pre-doctoral achievement award (2016).

His research interests include Next Generation of Biomedical Electronic Devices, Low Energy Design SoC and Energy Efficient Digital/Analog Circuits.



**Title:** A Patient-Specific Fully Integrated Transparent Electroencephalogram (EEG) Sensor for Seizure Prediction
**PI:** Dr. Muhammad Awais Bin Altaf
**Co-PI:** Dr. Nadeem Ahmad Khan
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 14,764,057
**Project Initiated in:** 2019
**Duration:** 35 months
**Category:** Health

**Description:** Breast Cancer is the most commonly diagnosed cancer in women, accounting for 30% of all cancers in women. In Pakistan ~8% of women above the age of 40 years have been diagnosed with breast cancer and is one of the countries having least amount of awareness among its residents for early stage detection and cure of this kind of deadly disease. Currently, many screening (imaging) techniques exists for the early detection of breast cancer that includes mammography, ultrasound, Magnetic Resonance Imaging (MRI), thermography but suffers from lack, of accuracy and reliability, high cost and physical risk, and most importantly stigma and unavailability of proper health infrastructure in the rural areas of developing countries like Pakistan. In order to overcome above mentioned barriers, this project aimed to design and develop safe hand-held non-invasive, non-contact home screening device which can be effective in early breast-cancer detection The detection mechanism will be based on infrared sensor reflection mounted on the hand-held device along with machine-learning based processor to achieve high detection rate and low false positive.

**Title:** A Portable Non-invasive Neuro Feedback Device to for the Early Detection of Autistic Children and their Cognitive/Emotional Development
**PI:** Dr. Muhammad Awais Bin Altaf
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health

**Description:** Autism Spectrum Disorder (ASD) is a neurodevelopment disorder that affects children's verbal and nonverbal communication, cognition and social interaction; typically reveals in the children from age of 18 months to 4 years. A significant amount of research shows that the early identification of Autistic children (ahead of physical symptoms) along with focused teaching and learning centres with specialized equipment increases the chance of bringing the autistic children into the country's mainstream. This project aimed to develop a portable non-invasive, early screening and neuro-feedback device which can be effective in early identification of autistic children and can assist to enhance the cognitive and learning activities. The detection mechanism is based on electroencephalogram (EEG) recordings from the front lobe using a medical grade bio potential acquisition sensor along with machine/deep-learning processor to achieve identification of autistic cases.



**Title:** A Fully Integrated Wearable/Portable EEG System on Chip for Accurate Monitoring of Depth of Anaesthesia
**PI:** Dr. Muhammad Awais Bin Altaf
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Health, Technology

**Description:** One of the current challenges in medicine is monitoring the patients' depth of general anaesthesia (DoA). This project aimed to develop a wearable, "non-invasive, patient-specific" device for accurate monitoring of DoA in collaboration with local and international Anaesthesiologists that can be used during the surgery as well in the post-operative stage to ensure patient proper recovery without burdening the medical staff. This is the world's first "patient-specific" DoA estimator System-on-Chip (SoC) combined, all in a small form-factor sensor. The proposed device was composed of an EEG acquisition system, followed by EEG signal filtering and then signal processing for extraction of useful information. The overall system was realized on a single silicon chip (IC) to allow small form factor and minimum battery requirements for long time operation. It will be attached to the patient's forehead and analyses EEG for in-surgery (can be several hours) or post-surgery couple of days), applies pre-processing techniques, extract the discriminating features and based on those features; an adaptive decision model detects the DoA.

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**Profile:** Dr. Imran Cheema obtained his PhD in Electrical Engineering with emphasis on Photonics Systems from McGill University, Montreal, Canada in 2013. During the PhD research, he developed novel theoretical and experimental techniques for bio-optical sensing applications. He received his BS and MS in Electrical Engineering from UET Lahore and University of Colorado, Boulder USA, respectively. He also worked as an Optical Engineer in Oerlikon Optics Inc., USA after his MS. During his industrial experience he worked on laser based RGB head up display units, infrared lasers, and laser based miniature projectors for cell phones.
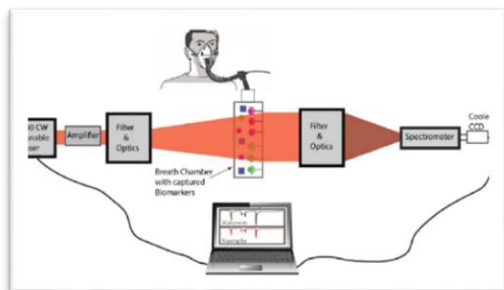


**Title:** Towards Developing Portable Optical Sensor for Rapid and Non-Invasive Diagnosis of Pneumonia
**PI:** Dr. Muhammad Imran Cheema
**Co-PI:** Dr. Shaper Mirza
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months

**Category:** Health, Technology

**Description:** According to the WHO report, pneumonia is leading cause for deaths of children under the age of five years annually (1.4 million). In Pakistan, pneumonia is responsible for deaths of 92,000 children every year. The reason for such a high death toll is due to the time consuming and inaccurate diagnosis of the disease. Currently, state of the art tests for detecting pneumonia include X-ray, blood test, sputum culture, and pleural membrane culture. However, these methods are not specific and can give false positive results. Therefore, the need of the hour is that we need a robust, fast, non-invasive and requiring less expertise diagnostic method. Keeping that in mind, this projects aimed to develop a novel optical sensor that uses laser Raman spectroscopy to analyse the breath of a patient for rapid pneumonia diagnosis. A child's breathe will be collected in a disposable cell whose inner walls are chemically treated to capture the pneumonia biomarkers present in the child's breath. A laser beam is then passed through the chamber, and the transmitted/scattered light is then detected as a function of the Raman shifts (frequency). The diagnosis of pneumonia is then performed based on the chemically-specific spectroscopic signatures of the pneumonia biomarkers present in the breath. This process provides a novel pneumonia sensor which is non-invasive, accurate, sensitive, and portable.

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**Profile:** Dr. Muhammad Tahir received the Bachelor of Science in Electrical Engineering in 2007 from University of Engineering and Technology, Lahore and the Master of Science in Electronic Engineering in 2009 from Politecnico di Torino, Italy. In April 2013, he obtained his Ph.D. degree also from Politecnico di Torino, Italy in the field of Electronics and Telecommunication. His research activity is focused on the development of novel algorithms for satellite navigation receiver technology. His research interests include receiver baseband signal processing algorithm design and development, Bayesian signal processing, detection and estimation theory, channel coding in communication networks, machine learning and sequential Monte Carlo methods.

**Title:** Environmental Noise Pollution: It's Mapping and Reduction in an Acoustical Network Framework Based on Wave-Domain Adaptive Techniques
**PI:** Dr. Muhammad Tahir
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 10,649,000
**Project Initiated in:** 2019
**Duration:** 35 months
**Category:** Environment, Health, Technology

**Description:** The project goal was to address the increasing noise pollution, its impact on population exposed to it and its mitigation through Wave- Domain Adaptive Techniques. As the advancements in Information and Communication Technologies (ICT) are increasing, their role to improve the quality of life is also expanding with the proposition and development of solutions for modern healthcare, city infrastructure, better security for citizens, smart and secure city asset management and intelligent transportation etc., therefore, this project is one of the most important project of SBASSE because it proposes to leverage the advances in ICT by developing a system which provides a technological and sustainable solution to the problem of environmental noise pollution which has become one of the major environmental issue.

**Title:** Motorway to Safety: Design and Development of an Intelligent System for Active Traffic Law Enforcement on National Highways and Motorways
**PI:** Dr. Muhammad Tahir
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Computer Vision, Technology

**Description:** This project was aimed at developing a basic prototype of an intelligent system for National Highways and Motorways Police (NH&MP) authority which is to be deployed on national highways and motorways of Pakistan, to minimize the risk of accidents and to keep the rules and regulations in check. The system will be deployed on multiple sections along the motorway to detect any aggressive and careless behaviour of the drivers based on a number of sensors and information processing inside it. Further, it will alert law and enforcement agencies about unsafe driving for effective enforcement of safety rules and regulations on national highways and motorways. This project successful completion will have a huge impact not only on the capacity building of LUMS but also on the society as a whole in terms of safety of users on highways and motorways especially in the context when the network of national highways and motorways is expanding due to incoming activities of China—Pakistan Economic Corridor (CPEC).



**Title:** PPGBeat: Remote and Ambulatory Monitoring of Cardiovascular Diseases Using Wearable Photoplethysmography with Deep Learning
**PI:** Dr. Muhammad Tahir
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health, Technology

**Description:** According to the World Health Organization (WHO), CVDs are the primary cause of death world-wide among non-communicable diseases, and according to the predictions this situation will become worse. In Pakistan, according to WHO statistics, more than one third (34%) of all deaths are caused by CVDs, making it the leading non-communicable disease in the country. Considering these statistics, this project developed a wrist-worn wearable prototype to avail other hidden information in PPG signal about different CVDs using advanced machine learning techniques such as deep learning. This proposed solution relies on PPG signals as recorded by wrist worn sensor non-invasively. The recorded signals will then be used by advanced signal processing and machine learning algorithms to extract relevant information from them in order to perform a classification according to pathology for effective ambulatory cardiac health monitoring.

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**Profile:** Dr. Nadeem Khan received his PhD from the Eindhoven University of Technology. Dr. Khan Joined LUMS in May 2002. Earlier, he worked at Streaming Networks (Pvt) Ltd, Islamabad where he performed several projects related to image processing and video compression in the context of multimedia products. His PhD research work was on minimal training dependent and robust text recognition systems. This research work and rest of his graduate study have been in close association with Philips especially with its facilities of Philips Research Lab (LEP), France, and Centre for Manufacturing Technology, The Netherlands and Philips International Institute, The Netherlands. In between his degrees he had worked both locally and abroad including teaching at University of Engineering and Technology, Lahore and working as a Hardware Design Engineer at Philips Industrial Automation Systems, Eindhoven, and The Netherlands.



**Title:** Analysing and Predicting the Performance and/or Recovery of Human Muscles in Repetitive Tasks Based on Wireless Wearable s-EMG Sensor Development
**PI:** Dr. Nadeem Ahmad Khan
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health, Technology

**Description:** Surface Electromyography sensors (s-EMG) when mounted on hand or feet at muscle locations capture the electrical activity or signals of these muscles. With the advent of wireless wearable or in-sleeve devices and the possibility to synchronize and integrate its data with data from other sensors like motion camera, there is an emerging area of research to analyse localized muscle performance and its fitness (injury, strain and fatigue condition) at the individual level, for monitoring their performance in activities of special interest ranging from sports to limb rehabilitation. and to make useful predictions about the resulting effect of the repeated activity on muscle performance and muscle recovery from injury etc.,. This project is focused specifically on two fields of importance for our society namely cricket and rehabilitation. Performance of fast and spin bowlers were the focus of this study as the role of both hands and feet muscles is important under the assumption that no abrupt mishap takes place and other physiological parameters including joints, stamina etc. are in normal range. Rehabilitation of hand or feet with muscular injury (partial or full) will be the focus as well. The key point of this research was the focus on collection of data in real-life scenario for activities (involving repetition) for more accurate modelling made possible with the advent of wearable sensors. The research is significant as use of these techniques in our society in the focused fields is very limited owing to the cost or limitation of foreign expertise availability.

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**Profile:** Mr. Nauman Ahmad Zaffar received his BS (1990) and MS (1991) in Electrical Engineering from University of Pennsylvania. He then continued his work at the Electro-Optic / Magneto-Optic Labs at the University on development of a high resolution frequency swept microwave diversity imaging system in multiple simultaneous bands from 2GHz-60GHz. He joined University of Engineering and Technology in 1994 where he worked till 2000 as Assistant Professor in the department of Electrical Engineering.

He joined LUMS School of Science and Engineering in 2010 as full-time faculty member in the department of Electrical Engineering. He is part of LUMS Energy Optimization Committee and is working on establishing a research base at SSE in the area of Power Electronics, Smart Grids and Renewable Energy. His current areas of interest include dc/dc converters for Solar PV applications, dc/ac inverters for grid-tie distributed energy sources and VFDs for industrial, off-grid and automotive applications. He has also worked with PEPCo and various Distribution Companies in Pakistan to propose solutions for Power Distribution management and smart solutions for load management.

**Title:** Electric TTrike Replacement of Donkey Carts
**PI:** Dr. Nauman Ahmad Zaffar
**Sponsor:** Xavor Corporation
**Funding Amount:** PKR 600,000
**Project Initiated in:** 2020
**Duration:** 6 months
**Category:** Technology

**Description:** The objective of the study was to build a functional prototype that demonstrates the product vision. This will result in a tangible product to validate the functional, technical and financial parameters and to show officials, investors and policymakers the possibility and potentials of a Smart Tricycle for Pakistan and the Export Market. The intervention also cover areas of strategic importance to Xavor in development of new product ideas in the Electric Vehicle (EV) sphere. It may cover variants of 3-wheelers that can be used as replacement of donkey carts, and any other area that may be of importance to Xavor.
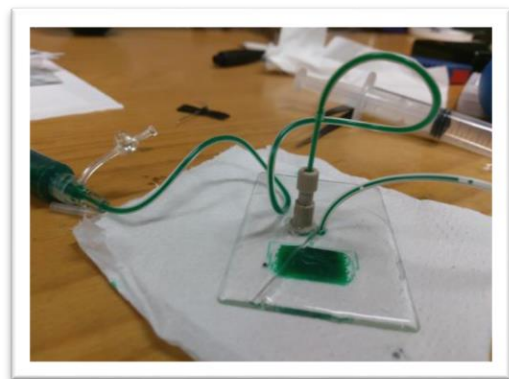
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**Profile:** Dr. Nauman Z. Butt did his PhD in Electrical Engineering from Purdue University in 2008 and B.S. in the same field from University of Engineering and Technology, Lahore in 2002. From 2008 to 2012, he was a member of technical staff in Semiconductor Research and Development Centre (SRDC) in IBM Microelectronics Division, Hopewell Junction, and NY.

Dr. Butt's research interests include investigating physics and technology of microelectronic and optoelectronic devices through theory, compact modelling, simulations and experiments. His PhD thesis was on computational study of scaling and radiation damage in nanoscale memory devices. In IBM, he has been involved in the development of embedded DRAM and dense SRAM devices in 32nm and 14nm SOI technology.

**Title:** Microfluidic Lab on a Chip Cytometer for Point of Care HIV/AIDS Diagnostics
**PI:** Dr. Nauman Zafar Butt
**Co-PI:** Dr. Shaper Mirza
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 11,083,000
**Project Initiated in:** 2018
**Duration:** 24 months
**Category:** Health, Technology

**Description:** This project is aimed to develop a product level demonstration of a biochip for the point of care diagnosis of HIV/AIDS. The current medical equipment used for HIV/AIDS diagnostic is bulky and expensive (cost around 7 -15 million PKR) and requires operating/maintenance cost of about 1 million PKR. Due to this reason this equipment is only available in big hospitals and sophisticated research laboratories in Pakistan, and is neither accessible nor economical for a vast majority of the infected population. Lab on a Chip is an emerging technology that has made it possible to develop portable biochips for the diagnosis of a broad spectrum of diseases. The device could not only enumerate the biomarkers but could also provide useful information about the disease signatures associated with its developmental stages in a human body. The chip will intake a tiny blood sample that will flow through microfluidic channels fabricated using integrated circuit technology. A set of microelectrodes integrated on the microfluidic channels will output electrical pulses sensitive to the count and shape of the target cells as the blood sample is pushed to flow through the inlet of the channel. By coating biological antibodies that are specific for a given biomarker, the biomarkers in the blood sample will be captured in a chamber inside the chip while rest of the sample will flow through another set of microelectrodes. A differential impedance signal between the inlet and outlet of the capture chamber provides information that correlates to the number, size, morphology, and, the membrane properties of the target cells.

**Title:** Biosensor Point of Care Operations
**PI:** Dr. Nauman Zafar Butt
**Sponsor:** Ignite - National Technology Fund
**Funding Amount:** PKR 70,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Education, Health

**Description:** In this study, the design and characterization of Coulter-based microfluidic cytometer was investigated through electrical circuit simulations considering an equivalent electrical model for the biological cell. Effects related to microelectrode dimensions, microfluidic detection volume, suspension medium, size/morphology of the target cells, and the impedance of the external readout circuit, on the output response of the sensor were explored.

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**Profile:** Dr. Naveed Ul Hassan received his B.E. degree in Avionics Engineering from the College of Aeronautical Engineering (CAE), Risalpur, Pakistan, in 2002 and his M.S. and Ph.D. degrees in electrical engineering, with specialization in digital and wireless communications, from the Ecole Superieure d'Electricite (Supelec), Gif-sur-Yvette, France, in 2006 and 2010, respectively. In 2011, he joined as an Assistant Professor at the Department of Electrical Engineering, Lahore University of Management Sciences (LUMS), Lahore, Pakistan. Since 2012, he has also been a visiting Assistant Professor at Singapore University of Technology and Design (SUTD), Singapore during the months of June-August. He has several years of research experience and has authored/co-authored numerous research papers published in refereed international journals and conference proceedings. His major research interests include cross layer design and resource optimization in wireless networks, demand response management and integration of renewable energy sources in in smart grids, indoor localization and heterogeneous networks. He is a senior member of the IEEE.



**Title:** Towards the development of block chain-enabled prosumer-oriented electricity markets in Pakistan
**PI:** Dr. Naveed Ul Hassan
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 11,083,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Energy, Technology

**Description:** This project focuses on the research and development on block chain-enabled prosumer-oriented electricity markets. This includes the identification of appropriate block chain-based setup and associated tradeoffs according to the specific requirements (latency, through put, privacy, etc.) of various market models such as, peer-to-peer and community based.

The project also proposed to develop a real-time energy trading algorithms using game theory, double auction approach, and machine learning techniques. A lab-scale demonstration of block chain based energy trading platform was also developed. In this demonstration, block chain technology would be used to manage prosumer, record their energy production and consumption, match their buying and selling requirements, and track their financial settlements. This project enabled the early introduction and adoption of block chain technology for a really useful energy-sector application in Pakistan. The project also helped in improving the understanding of smart grid research community on the integration of block chain in smart grid applications.

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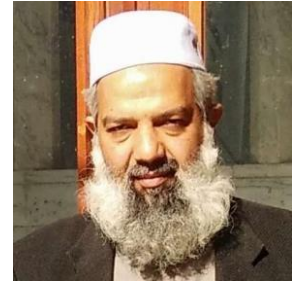
**Profile:** Dr. Tariq Jadoon completed his PhD degree in Electrical and Electronics Engineering from the University of Strathclyde, Glasgow, Scotland in 1998 for research in Traffic Characterization and Performance Evaluation of High Speed Networks. Prior, he received his BSc (Hons) degree in Electrical Engineering from the NWFP UET, Peshawar in 1991 and MSc (Communications, Control & DSP) in 1993 from Strathclyde. Before joining LUMS, he worked at the NWFP University of Engineering & Technology (UET), Peshawar where he co-founded the Centre for Computer Information Systems Engineering and taught at the EE department. He has been on the LUMS faculty since 2001, and has served in various capacities including Associate Dean Undergraduate Programmes (2007), Registrar (2008-11), and Department Chair EE (2016-19) and is currently serving as Vice-Provost. On Sabbatical from LUMS in 2011-12 he worked in the Software Industry for Techlogix, Singapore PTE implementing an ERP solution for Singapore Institute of Management (SIM) in conjunction with IBM Global Services. His research interests lie in the area of network modelling and simulation, tele traffic, VoIP and IoTs and is a member of the System and Networking Research Lab (SysNet) at LUMS.

**Title:** Internet of Things (IoT) Based Conversion Kit for Motor Loads
**PI:** Dr. Tariq Mahmood Jadoon
**Co-PI:** Prof. Nauman Ahmad Zaffar
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 13,958,000
**Project Initiated in:** 2018
**Duration:** 24 months
**Category:** Technology

**Description:** The project, as the name suggests is basically focused on the development of a conversion kit solution that not only retrofits legacy air conditioner with an adjustable-power operation (like dc inverter type air conditioners) to allow up to 60% power saving but also eliminates power surge drawn by motor loads at the onset and during load transitions. Pakistan being a developing country is plagued with a weak and intermittent grid. One-half of the population solves this issue by arranging alternate to grid solutions like UPS, captive generation, or renewable energy systems. Effective uptake of renewable energy systems is constrained by its high upfront cost, battery life, below-par utilization of available energy, and excessive sizing to run critical and convenient motor loads. The conversion kit aims to address all these issues. This allows user to operate their ACs even using constrained sources e.g., UPS. The solution is an Internet of Things (IoT) enabled over Wi-Fi allows dynamic control and monitoring of operational parameters and complies with the growing trend of enhanced user interaction with the devices. It also offers centralized control over a network of appliances being operated. It records consumption data, which can be used for data analytics, future planning, and growth. The work entails the prototype's production readiness and the development of testing procedures and techniques to ensure the product's durability and reliability.

Dr. Wala Salem Mustafa Saadeh
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**Profile:** Dr. Wala Saadeh is an Assistant Professor at the Department of Electrical Engineering, SBASSE. Dr. Saadeh obtained her PhD in Interdisciplinary Engineering and MSc in Microsystems Engineering from Masdar Institute of Science and Technology, Abu Dhabi in 2016 and 2012, respectively. Her current research focus is on ultralow energy Body Area Network (BAN) transceiver for wearable healthcare. She developed a low-energy BAN transceiver for binaural hearing aid for long-term continuous monitoring. During her Master studies, she developed a high efficiency LED driver circuit for Heart Rate Monitoring based on Pulse Oximetry. Prior to joining LUMS, she was associated with Masdar Institute of Science and Technology, Abu Dhabi as Research Assistant.

Her research interests include Wearable Biomedical Devices, Low Power DC-DC Converters and Energy Efficient Digital/Analog Circuits.

**Title:** Non-invasive Continuous Glucose Monitoring Using a Multisensor IoT Based Glucometer Powered By Energy Harvesting
**PI:** Dr. Wala Salem Mustafa Saadeh
**Sponsor:** Higher Education Commission (HEC)
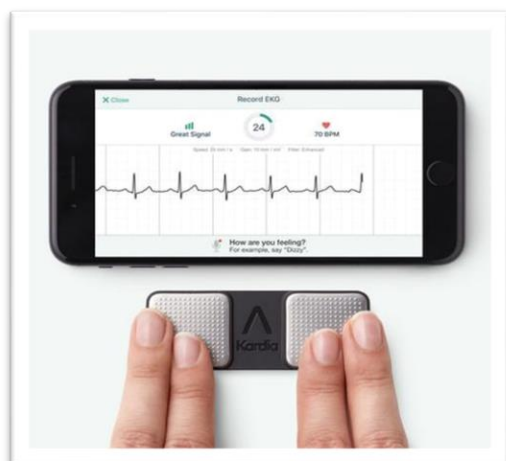**Funding Amount:** PKR 2,094,576
**Project Initiated in:** 2019
**Duration:** 35 months
**Category:** Health, Technology

**Description:** According to a recent national survey, 26% of Pakistan's total population is diabetic. The survey conducted during 2016-2017 states that almost 35 to 40 million children under the age of 20 are victims of diabetes. Those patients are required to continuously monitor the blood sugar level to avoid any complications. The conventional method of "finger-stick" that measures the sugar level by taking blood samples is very painful for frequent usage by patients. This project aimed to develop the first wearable continuous glucometer for diabetic patients powered by a clean energy source on a small chip. It measures the sugar level without the need to draw blood samples from the patient. Therefore, it can be used more frequently with no pain while providing a high level of accuracy. The device is also connected to the doctors through the internet which allows the doctors or caregivers to monitor sugar levels of the patients remotely in real-time.

**Title:** A Fully Integrated Wearable Patient-Specific ECG sensor for Ventricular Arrhythmia Detection System

**PI:** Dr. Wala Salem Mustafa Saadeh

**Sponsor:** Faculty Initiative Fund (LUMS)

**Funding Amount:** PKR 1,000,000

**Project Initiated in:** 2019

**Duration:** 12 months

**Category:** Health, Technology

**Description:** One way to enhance the efficiency of the health care services in Pakistan is to provide low-cost systems that monitor the patients outside the hospital environment while they are performing their daily activities. Thus, reducing the number of required visits for doctor's clinics. This project aimed to develop a wearable, non-invasive device that can be used during daily life routine and provide the user an early alarm for further clinical follow-up. The designed device is composed of an ECG acquisition system, followed by ECG signal filtering and then signal processing for extraction of useful information. The overall system will be realized on a single silicon chip (IC) to allow small form factor and minimum battery requirements for long time operation. It is attached to patient's chest and analyzes ECG for 15-20 days, applies preprocessing techniques, extract the discriminating features and based on those features; an adaptive decision model detects the occurrence of VA. Developing a wearable ECG measurement system with the ability to detect arrhythmia conditions will make it easier for the patients to keep a daily track of their cardiac conditions, and allow physicians to track disease progression.

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**Profile:** Dr. Wasif Tanveer Khan received his BSc degree in Electrical Engineering from the University of Engineering and Technology, Lahore, Pakistan, in 2005, his MS and PhD in Electrical and Computer Engineering from the Georgia Institute of Technology, Atlanta, USA in 2010 and 2014, respectively. From January 2006 to December 2008, he served as a Lecturer with the National University of Computer and Emerging Sciences-FAST, Lahore, Pakistan. He was awarded M.S. Leading to Ph.D. Fulbright scholarship, in 2008. In 2009, he joined Professor John Papapolymerou's research group "Microwave Circuit Technology" at the Georgia Institute of Technology. During his Ph.D., Dr. Wasif authored/co-authored more than 30 research papers in peer-reviewed conferences and journals. Since January 2015, he has been working as an Assistant Professor at the department of Electrical Engineering of the Lahore University of Managements Sciences (LUMS), Pakistan.



**Title:** Vision Based Autonomous VTOL UAV
**PI:** Dr. Wasif Tanveer Khan
**Co-PI:** Dr. Murtaza Taj
**Sponsor:** Ignite - National Technology Fund
**Funding Amount:** PKR 70,000
**Project Initiated in:** 2018
**Duration:** 6 months
**Category:** Artificial Intelligence, Technology

**Description:** This project aimed to develop a fully autonomous Vertical Take-Off and Landing (VTOL) Hybrid Unmanned Aerial Vehicle (UAV) that can be used for multiple civilian applications. UAVs are used for a number of applications such as surveillance, localization, delivery, photography and more importantly remote monitoring of crops and forests. In nutshell, this project not only focused on the development of highly efficient UAV system but opens doors for applications of UAVs in many more areas, especially here in Pakistan.

**Title:** Development of Low Cost Inkjet Printed Solar and RF Energy Harvesting Solution for Powering up IoT Sensors
**PI:** Dr. Wasif Tanveer Khan
**Co-PI:** Dr. Nauman Zafar Butt
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology

**Description:** The development of a smart society consisting of wireless sensor networks (WSNs), home automation systems, smart cities, smart skins and Internet of Things (IoT) utilizes self-sustainable sensing devices, which are capable to operate autonomously. Ambient energy harvesting technologies have significantly drawn attention of the research communities in the recent years as a source to provide uninterrupted wireless power to these sensor nodes.

This research project developed an inkjet-printed RF and Solar energy harvesting solution to wirelessly power up battery-less swarm of wireless sensors, which finds myriad of applications in IoT based applications related to health, agriculture, and environmental sensing etc. Using this technology, many other low-cost applications in the form of smart skin, smart packaging, smart textiles and RFID enabled sensors can be developed for IoT applications, which will greatly improve the cognitive intelligence and knowledge of the environment around us in real time.

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**Profile:** Dr. Zartash Uzmi received his PhD in Electrical Engineering from Stanford University in 2002. His graduate research focused on Multi-user Detection for CDMA systems for which he devised schemes and algorithms for practical implementation of multi-user detectors. He has held positions at Nokia Research centre, Bell Laboratories, and Hewlett Packard Company. He is on LUMS faculty since 2002. At LUMS, his current research is focused on scalable and efficient network design and measurements for wide-area deployments as well as data centre networks.

**Title:** Establishment of a Carrier Neutral Software-Defined Internet eXchange Point (IXP) and Training Programs for Capacity Building in Managing IXPs
**PI:** Dr. Zartash Afzal Uzmi
**Co-PI:** Dr. Ihsan Ayyub Qazi
**Sponsor:** APNIC Foundation
**Funding Amount:** PKR 3,696,600
**Project Initiated in:** 2018
**Duration:** 36 months
**Category:** Education, Technology, Telecommunications

**Description:** Internet exchange points (IXP) are a critical piece of the Internet infrastructure that enable ISP networks to exchange traffic with each other. The Internet has more than 300 IXPs worldwide with more than 80 in US/Canada alone and some IXPs carry as much traffic as the Tier-1 ISPs. IXPs offer a number of benefits including cost savings on International transit costs, better performance and user experience for locally hosted content, and improved security and availability. However, several less developing countries face two key challenges:

(a) They either lack IXP infrastructure or have recently deployed IXPs with limited capabilities (e.g., Pakistan, the 6th most populous country, deployed their first ever IXP in Islamabad just last year), and
(b) They lack expertise and human resource for operating and managing IXPs, which is essential for realizing the true potential of IXPs.

This research aimed to address deployment of software-defined IXP, which uses recent advances in Software-Defined Networking (SDN) that allows operators to enable new applications such as application-specific peering, traffic redirection through middleboxes, and inbound traffic engineering. Pakistan IXP was used as a testbed for deployment, testing, and evaluation. In addition, training programs were carried out to prepare human resource in managing IXPs as well as in using SDN controllers.

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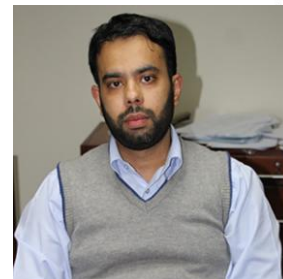
**Profile:** Dr. Zubair Khalid received his BSc (First-class Hons.) degree in Electrical Engineering from the University of Engineering and Technology (UET), Lahore, Pakistan in 2008. He received the PhD degree in Engineering from the Australian National University of Canberra, Australia in Aug. 2013. Previously, He was working as an Assistant Professor in the Electrical Engineering Department, UET Lahore. Prior to that, he worked as a Research Fellow (Post-doc) with Prof. Rodney A. Kennedy in the Research School of Engineering, Australian National University (ANU), Canberra, Australia. He was awarded University Gold Medal and Industry Gold Medals from Siemens and Nespak for overall outstanding performance in Electrical Engineering during the undergraduate studies. He has also been a recipient of an Endeavour International Postgraduate Award for my Ph.D. studies.

**Title:** Industrial Internet of Things (IIOT) test-bed for Intelligent Predictive Maintenance
**PI:** Dr. Zubair Khalid
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Artificial Intelligence, Technology

**Description:** This research was aimed to develop novel algorithms and IIOT test-bed for intelligent predictive maintenance to support and facilitate the industries in designing, developing and analysing the innovative maintenance solutions. The concept is to use large amounts of machine or production data processed via efficient pipelines for statistically modelling recurring patterns and then predicting anomalies in real-time. The developed test-bed, with on-board multiple sensors, motor drive, wireless communication and real-time access to cloud, effectively utilizes the strengths of big-data, on-line machine learning and deep learning techniques, advanced data analytics, and real-time signal processing techniques for the intelligent prediction of the faults in the machines and processes.
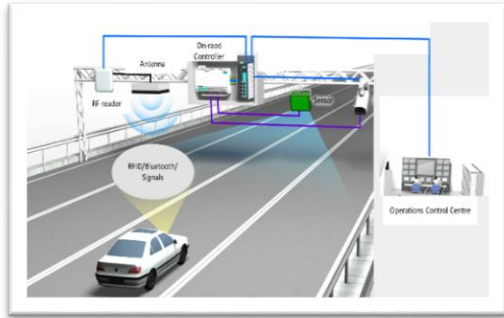
**Title:** Motorway to Safety: Design and Development of an Intelligent System for Active Traffic Management and Efficient Law enforcement on National Highways and Motorways
**PI:** Dr. Zubair Khalid
**Co-PI:** Dr. Muhammad Tahir
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 12,745,000
**Project Initiated in:** 2019
**Duration:** 24 months

**Category:** Technology, Computer Vision

**Description:** This project is aimed to design, develop and deploy an active highway safety system consisting of a set of sensing and decision making road-side modules capable to communicate the sensed and inferred information over a wireless channel, on national motorways and highways to assist law and enforcement agencies so that they can implement and enforce traffic rules and regulations more efficiently and effectively for enhanced highways safety. The overarching goal of this research was to enhance safety of travellers and commuters on national highways/motorways by developing systems for automated speed enforcement (ASE) and detection of mobile phone usage while driving. Scientific, administrative and operational challenges in the development of these systems will be addressed by utilising the technology advancements in smart and ubiquitous sensing, computer vision and the industrial internet of things paradigm along with the expertise in information theory, reinforcement learning, machine-to-machine communication, signal processing, and predictive modelling to develop cutting-edge automation solutions for the industrial sector. These developments are sustainable as end-user is on-board and the plans are in place for the commercialization.



**Title:** Review, Study, Analysis, Visualization and Optimization of End-to-End Quality Parameters and Logistics Fill Rate in Tetra Pak Supply Chain Process
**PI:** Dr. Zubair Khalid
**Sponsor:** Tetra Pak
**Funding Amount:** PKR 1,460,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Computer Vision, Technology

**Description:** The project involves the study, mapping and analysis of end-to-end quality parameters in the Tetra Pak production process; and system development for the fill rate computation, analysis, visualization and optimization in Tetra Pak supply chain management process. In this project, the aim was to develop an intelligent software system for end-to-end quality parameter mapping using artificial intelligence and advanced data mining methods. In addition to the end-to-end quality mapping, the proposed system also enables visualization of process flow and suggest quality control improvements.

**Title:** Development of System for the Profiling of the Polymer Trim in Tetra Pak Lamination Process using Computer Vision
**PI:** Dr. Zubair Khalid
**Sponsor:** Tetra Pak
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Business & Innovation, Computer Vision, Technology

**Description:** In Tetra Pak lamination process, extrusion coating on the board is applied at different stations of the process line. Polymer missing on the edges or folding is a failure developing from the instability in the process. This instability causes reduction in the neck in during ramp-up, increase in the neck in during ramp-down and instability of the edge during stable (constant) speed. To avoid these failure modes, the deckles are kept at positions such that the extra (wider than the web-width) polymer is applied on the board. This project seeks to design a system for the measurement of the width of the extra polymer (trim on edges) in the extrusion coating (lamination) processes and develop fully configurable software for robust estimation of the trim width; and deploy the system in the Tetra Pak Arabia factory. This development limits this waste material produced during production, the extra trim polymer will be kept to a minimum while still limiting the polymer missing rate.



**Title:** Development of System for the Detection of Spots in Bulleh Shah Packaging Board Production Process using Machine Vision
**PI:** Dr. Zubair Khalid
**Sponsor:** Bulleh Shah Packaging
**Funding Amount:** PKR 2,435,000
**Project Initiated in:** 2020
**Duration:** 11 months
**Category:** Business & Innovation, Technology, Computer Vision

**Description:** This project aimed to develop a system that exploits machine vision algorithms to capture/identify the spots from video stream of the web running at high rates in real time. To ensure the simplicity in design, commercial of the shelf components was used. In addition, to address computational overhead state-of-the-art machine vision algorithm were employed. The developed system is robust enough to capture the spots at speeds up to 200 meters per minute.

# DEPARTMENT OF BIOLOGY

Dr. Amir Faisal
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**Profile:** Dr. Amir Faisal received his PhD in Cell Biology from Friedrich Miescher Institute for Biomedical Research/University of Basel, Switzerland in 2004. During his PhD he identified novel roles for Shc protein, an important adaptor downstream of tyrosine kinases, in insulin signalling and cytoskeletal reorganization. He received his first postdoctoral training (2004-2008) in Protein Phosphorylation Laboratory at London Research Institute where he discovered that another adaptor protein, MyD88, couples Protein Kinase C epsilon to Toll like receptors during innate immunity. From 2008 to 2014, he worked at Cancer Therapeutics Unit of Institute of Cancer Research in Sutton first as postdoctoral fellow and later as senior scientist. He played an important role in progression of several drug discovery projects, one of which resulted in discovery of a pre-clinical development candidate that will undergo phase I clinical trials in 2016. After joining LUMS in August 2014, he has been establishing a cancer therapeutics lab at SBASSE.
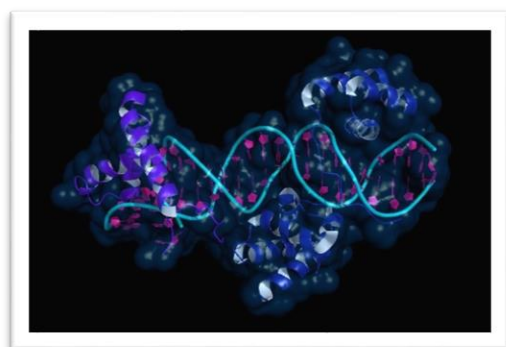
**Title:** High-throughput Compound Library Screening and Validation of Potential Targets for Regulators of Polycomb/Trithorax Group Members
**PI:** Dr. Amir Faisal
**Co-PI:** Dr. Muhammad Tariq
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Health

**Description:** Regulation of gene expression is one of the key fundamental processes that regulate development and disease in multicellular organisms, including humans. Changes in expression and activity of certain proteins (made from genes), for example, can result in developmental disorders and cancers. Understanding how expression of proteins is regulated, therefore, not only enhances our knowledge about how our bodies work but is also critical in tackling devastating diseases such as cancer.

This project deals with identification of novel regulators of Polycomb and Trithorax proteins through screening of large number of drugs (1127) through a process called "high-throughput library screening". Drugs with known targets were used in a cell-based reporter assay to identify the ones that can increase or decrease the gene expression downstream of PcG/TrxG. The identified targets were further explored and characterized to elucidate the mechanism operating in their interaction with PcG/TrxG. The findings of this study enhance the understanding of this fundamental biological process central to the development of the multicellular organisms.
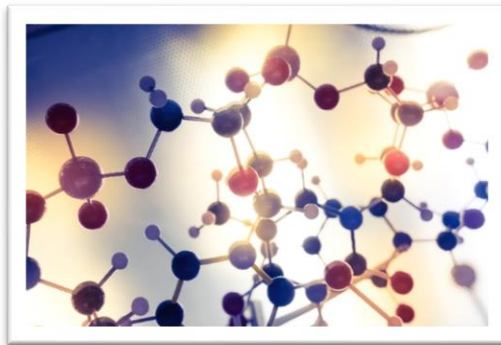
Dr. Aziz Mithani
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**Profile:** Dr. Aziz Mithani started as a computer scientist and received his Masters in Computer Sciences from FAST-NU, Karachi before attending University of Cambridge, UK where he did an MPhil in Computational Biology. In summer 2006, he went to Harvard Medical School for a research internship in Paulsson Lab at Department of Systems Biology. Dr. Mithani received his DPhil in Statistics (Computational Biology) from University of Oxford, UK in November 2009 under the supervision of Prof Jotun Hein and Dr. Gail Preston. His dissertation focused on modelling the evolution and analysis of the properties of metabolic networks. Subsequently, Dr. Mithani joined Harberd Lab at the Department of Plant Sciences, University of Oxford, UK as a postdoctoral research associate where he worked for two years on the evolution of bread wheat.

His research interests include the application of computational and mathematical methods in the area of modern biology. Specifically, he is interested in the development of computational tools and techniques for the analysis of next-generation sequencing data and biological networks, and to investigate how different organisms function and evolve over time.

**Title:** Detection of Differential Gene Expression and Alternative Splicing in Trophoblast Giant Cells Compared to Trophoblast Stem Cells
**PI:** Dr. Aziz Mithani
**Co-PI:** Dr. Amir Faisal
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health

**Description:** This project, aims to employ high-throughput sequencing and associated computational analyses to identify genes that are differentially expressed and differentially spliced using TS/TG cells as a model system. The identification of altered gene expression will enhance the understanding of trophoblast stem cell differentiation into trophoblast giant cells. Overall findings helped in understanding placental development in mammals at molecular level and provide insights into how polyploidy cells avoid apoptosis in diseases such as cancer and Alzheimer.
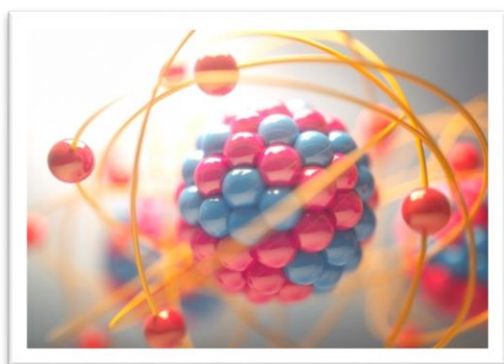
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**Profile:** Dr. Afzal Muhammad studied Biotechnology at NIBGE Faisalabad and QAU Islamabad. He joined FMI Basel, Switzerland for training and later obtained the title of PhD in Biology and Medicine from ISREC/EPFL and University of Lausanne. He worked first as post-doctoral fellow and then was promoted to senior scientist position at ETH Zurich. Afterwards worked as a scientific assistant (Wiss. Assistant) at Inselspital Bern, Switzerland. Currently serving as an Associate Professor in the Department of Biology at LUMS.



**Title:** Restoration of Growth Inhibitory TGF- β Signalling Using Small RNAs: A Therapeutic Strategy for Cancer
**PI:** Dr. Muhammad Afzal
**Co-PI:** Dr. Amir Faisal
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health

**Description:** Cancer is the second leading cause of deaths worldwide; the number estimated by World Health Organization was 8.8 million in 2015. This means nearly 1 in 6 deaths due to cancer, which is projected to increase further by 45%. To reduce global cancer burden which is rising at an alarming rate; there is dire need for new drugs to treat this devastating disease. There are many cancers types but the common to all types is the tumorigenesis process where normal cell transforms into malignant tumour cell then invasion and metastasis leading to death. Perturbations of the transforming growth factor beta (TGF-β) signalling are documented in all tumorigenesis processes.

In previous studies it has been shown RNA based drugs, which could break TGF-β resistance by activating growth inhibitory arm of TGF-β signalling. Thus, a rescue of the TGF-β growth inhibitory response is achievable pharmacologically using oligonucleotides against TGF-β1 mRNA. However, RNA based drugs have a delivery problem, but novel discoveries are paving the way for RNA drugs delivery using naturally occurring extracellular vesicles, the exosomes. This research is an attempt to screen more cancer types for the TGF-β resistance and treat them with RNA drugs using exosomes to break their resistance to growth inhibition.

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**Profile:** Dr. Muhammad Tariq received his PhD in Molecular Cell Biology from Friedrich Miescher Institute for Biomedical Research in Switzerland. During his PhD, he worked in Jerzy Paszkowski's lab specializing in epigenetics of gene silencing in Arabidopsis. In 2003, he joined Renato Paro's lab as a postdoctoral fellow at Zentrum fur Molekulare Biologie Heidelberg (ZMBH). He was awarded prestigious EMBO long term fellowship for his postdoctoral studies elucidating a link between molecular chaperones, in particular Hsp90 (Heat shock protein 90), and epigenetics in Drosophila. He joined Syed Babar Ali School of Science and Engineering as an Associate Professor in 2009 and started developing Biology Program.

His research interests include molecular link between epigenetic cell memory and cell signaling during development and the epigenetic basis of diseases. He has developed first epigenetic research lab in Pakistan which uses Drosophila to teach basic concepts of genetics, epigenetics and development. He has taught several courses at LUMS which include Genetics, Developmental Biology, Molecular Biology, Gene regulation and Epigenetics, Fundamentals of Molecular Techniques and Methods lab in Molecular Biology.

**Title:** An Interdisciplinary Approach to Rationalize Water-intensive Rice Crop by Integrating Water Informatics Technologies and Economics
**PI:** Dr. Muhammad Tariq
**Co-PI:** Dr. Abubakr Muhammad
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Water

**Description:** Rice, an important food and cash crop, is the third largest crop of Pakistan after wheat and cotton and one of the main export commodity of the country. Its export potential is being lost due to old techniques used. There is an increased realization in the farmlands that continuously standing water contributing to stress and high humidity coincides with high incidence of bacterial and fungal diseases in the rice fields. These disease infestations like bacterial leaf blight, rice blast and stem borers have massively damaged rice crops in Pakistan over the last few years. This project addresses the above mentioned issues, by introducing a System of Rice Intensification (SRI) and Direct Seeded Rice (DSR) techniques, which are based on biological, technological and economic aspects of rice farming. It is well documented that SRI method requires nearly 50% less water to grow rice per acre with at least 1.5 time more yield, it is also suggested to be less infested with insects and diseases. Similarly, DSR also requires relatively less water and reported yield to be higher than conventional standing water method. Further, in order to keep the economic aspect of the study Policy Analysis Matrix methodology was employed which provides information to farmers and policy makers in assessing the physical and economic gains in using biological process, adopting new technology in cultivation of rice.

**Title:** Investigation of Hyperglycemia Specific Circulating Non-coding RNAs in Type 2-diabetes
**PI:** Dr. Muhammad Tariq
**Co-PI:** Dr. Safee Ullah Chaudhary
**Sponsor:** Shahid Hussain Foundation
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health

**Description:** Environmental contributions to the development of T2DM potentially include exposures such as suboptimal in utero environment, low birth weight, obesity, inactivity and advancing age. Among environmental factors, lifestyle and dietary changes are linked to fuelling a worldwide epidemic of this disease, which also leads to development of comorbid conditions such as cardiovascular disease and other complexities in T2DM. This research suggests that specific lifestyle and dietary habits of Pakistani population lead to changes in gene expression, which involve epigenetic factors like specific non-coding RNAs in diabetes. These non-coding RNAs will regulate specific genes, which lead to development of disease and comorbid conditions such as cardiovascular conditions. Discovery of circulating non-coding RNAs will not only provide an excellent tool to understand development of diabetes in such a high number in Pakistan but will also lead to the development of a robust method for early diagnosis of cardiovascular disease in those with diabetes.

**Title:** A Gene Activator or a Gene Silencer: Analysis of Anti-Silencing Effect of Hatx on Polycomb Group Genes and Link to Cancer
**PI:** Dr. Muhammad Tariq
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health

**Description:** Each cell type (eye, liver, kidney, heart etc.) in our body has characteristic gene expression patterns which is maintained throughout life of an individual; referred to as cell memory. Two groups of genes, namely Polycomb group (maintain silent (**OFF**) state of cell type specific genes) and Trithorax group (maintain anti-silent (**ON**) state of cell type specific genes) are known as gatekeepers of cell memory. However, recent studies have indicated that besides these two groups a sub group of Trithorax genes have been discovered HATX, this belongs to histone acetyl transferase (HAT) family of genes which are known to facilitate gene expression (switching ON genes) by opening and losing the highly condensed gene structures. This study proposes to understand molecular function of this HAT in relation to TrxG gene and its effect on PcGs which also act as tumour suppressor genes. Successful completion of this project led to the discovery of precise role of HATX as either an activator or a silencer and how it may be linked to cancer development due to its impact on tumour suppressor genes like PcG.

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**Profile:** Dr. Safee Ullah Chaudhary received his BS in Computer Systems Engineering from the Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, Topi, Pakistan in 2002. He spent the next four years at Ultimus Inc (HQ NC) serving in the software development group. He was the team leader for design and development of Ultimus XML Formula Engine. He then proceeded to South Korea for graduate studies and obtained an M.S. and Ph.D. in 2008 and 2013, respectively. His doctoral research at the Department of Bio. & Brain Engineering, Korea Advanced Institute of Science and Technology (KAIST), was focused on computational modelling of multiscale cancer systems biology. He took an agents-based (multi-agent) approach to model tumorigenesis and uncovered the role of cell death in Warburg Effect. This work also led to the development of Electronic Cancer System (ELECANS), which is a next-generation modelling platform for applications in cancer systems biology. In 2014, he joined the Department of Biology at LUMS where he established the Biomedical Informatics Research Laboratory (BIRL) which is now involved in the development of cutting edge techniques and software for applications in computational proteomics, systems biology and mobile health.



**Title:** Smartphone-based Self-diagnosis for Tuberculosis using GIN Clinical Guidelines
**PI:** Dr. Safee Ullah Chaudhary
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 984,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health

**Description:** Public healthcare system in Pakistan is burdened by a plethora of infectious diseases such as Tuberculosis (TB), Hepatitis-C Virus, Influenza and Malaria. The limited governmental support in terms of policy and budget are extracting a hitherto unaccounted cost from public in the form of high mortality rates along with a poor quality of life for patients suffering from these diseases. In order to cope up with such scenarios, this research is a first step towards a better and healthy nation. In this project, the target was to develop a highly sensitive, easy to use and freely accessible smartphone-based TB self-diagnosis platform. Standard clinical guidelines were adapted from the Guidelines International Network (GIN) to ensure highest quality of diagnosis. The proposed application will be integrated into "Diagnia" (Diagnia.com), an Android-based public platform that is currently dispensing self-diagnosis for antenatal, HCV, Diabetes, Influenza and Cardiovascular diseases. This platform will aid in the national drive to eliminate tuberculosis from Pakistan and protect our future generations from the menace of this disease.
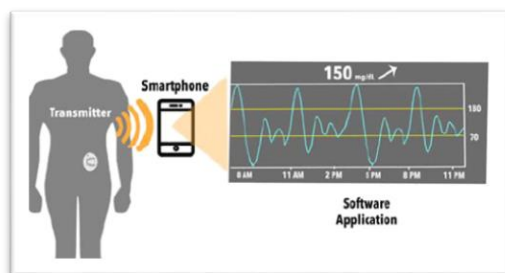
**Title:** Design and Development of a Wearable Continuous Glucose Monitoring System for Diabetes Patients
**PI:** Dr. Safee Ullah Chaudhary
**Co-PI:** Dr. Shaper Mirza
**Sponsor:** Higher Education Commission (HEC)
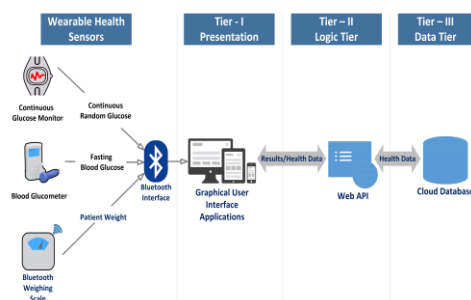**Funding Amount:** PKR 13,946,000
**Project Initiated in:** 2019
**Duration:** 24 months

**Category:** Health

**Description:** As per the research suggests, Pakistan alone had 7,474,000 cases of diabetes, which is 6.9% of the total adult population. Unmonitored diabetes can give rise to micro- and macro vascular diseases, for example, 37% kidney failure, 40% cardiovascular diseases, 14% heart attacks and 10% strokes. This project is focused on the development of an in-house Continuous Glucose Monitoring (CGM) system to provide for constant monitoring of glucose levels for diabetic individuals, around the clock.

The designed CGM device displays current levels of blood glucose in near real-time and alerts the diabetic before a high-risk situation arises due to extreme variations in their blood glucose. This device also allows the diabetic to keep a complete log of blood glucose data which can be used to better identify the causes and timings of glycaemic excursions. The CGM helps diabetics in managing blood glucose in acceptable rang, thereby preventing organ damages, saving lives and also billions of rupees in health care cost.

**Title:** Smartphone-Based Sensor-Integrated Assistive-Diagnosis for Diabetes Using Gin Clinical Guidelines
**PI:** Dr. Safee Ullah Chaudhary
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 13,946,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health, Technology

**Description:** The research focuses on the development of a clinically validated, easy to use and freely accessible smartphone-based diabetes diagnosis framework that is integrated with a continuous glucose monitor. Standard clinical guidelines from the Guidelines International Network (GIN) Consortium, National Institute for Health and Care Excellence (NICE), and World Health Organization (WHO) in unison with latest research literature was incorporated to ensure the highest quality of diagnosis. The decision support engine containing the aforementioned guidelines were employed Bayesian networks and integrate into an android application. This application along with the novel sensor creates a disruption in the national Diabetes control landscape by its ubiquitous availability and diagnostic precision in both rural and urban healthcare provision centres. Taken together, successful implementation and deployment of this project will assist in the national drive to eliminate diabetes from Pakistan and protect our future generations from it.

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**Profile:** Dr. Shaper Mirza holds a BSc (Hon) degree from University of Karachi and a doctorate from The University of Alabama at Birmingham (UAB). Her PhD studies involved understanding mechanisms of nasal colonisation by a Gram-positive pathogen Streptococcus pneumonia. More specifically the work was focused on understanding the interaction of a human mucosal protein lactoferrin with pneumococcal surface proteins and its downstream effects on colonisation by Streptococcus pneumonia. Dr. Mirza received several awards and honours during her PhD which included a student travel grant award for Gordon Conference on Structure and Functions of Lactoferrin, held in Hawaii 2005; Gail Castle award for best poster presentation as PhD student and Gail Castel Award for best post-doctoral presentation.

Dr. Mirza is an Associate Professor in the Department of Biology at Syed Babar Ali School of Science and Engineering. Dr. Mirza's specialised areas of teaching at LUMS include immunology and bacterial pathogenesis. Dr. Mirza is a recognised researcher in the areas of molecular pathogenesis. She has authored several papers in high impact factor journals and serves as an editor for two journals.

**Title:** Investigation of Hyperglycemia Mediated Inflammation on the Risk of Cardiovascular Disease in Type 2-Diabetes
**PI:** Dr. Shaper Mirza
**Co-PI:** Dr. Safee Ullah Chaudhary
**Sponsor:** Shahid Hussain Foundation
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health

**Description:** This study determined the effect of hyperglycemia-mediated inflammation on progression of atherosclerotic cardiovascular disease in type 2-diabetes. The exact mechanism leading to inflammation in diabetes remained obscure, until recently when it was demonstrated that hyperglycemia, a characteristic of poorly controlled type 2-diaebtes, mediates epigenetic reprograming (methylation and acetylation) in genes implicated in inflammation such as RELA. The RELA gene encodes for p65 subunit of NF-kB, a master switch that regulates the expression of pro-inflammatory cytokines. It was further demonstrated that methylation of RELA was sensitive to glycaemic control, where transient spike in glucose levels induced persistent epigenetic changes in RELA gene. Therefore, this study is focused on research i) To measure epigenetic changes over time in RELA gene and its impact on expression of NF-kB in response to hyperglycemia, ii) measure the effect of hyperglycemia on inflammatory response in type 2-diabetes iii) evaluate the potential of pro-inflammatory cytokines and non-cytokine markers (C-reactive protein, and lipid profile) in determining the risk of CVD in those with diabetes.

**Title:** Evaluating Immune Efficacy of Pneumococcal Vaccine in Children in Pakistan
**PI:** Dr. Shaper Mirza
**Co-PI:** Dr. Safee Ullah Chaudhary
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health

**Description:** Pneumonia (an infection of lungs) caused by a bacterium called Streptococcus pneumonia, kills over 200,000 children annually in Pakistan. Pneumococcal infections can be prevented by vaccination and currently three formulations of pneumococcal vaccines are available. The observed high rates of pneumonia in children by vaccine serotypes, especially 5-years post licensure, necessitate further investigation into factors responsible for low efficacy of the vaccine. To understand the reduced efficacy of pneumococcal vaccines in children, this study suggests to investigate the immune response of children to pneumococcal vaccine, and to characterise serotypes most commonly associated with infections in children. Additionally, effectiveness of the vaccine will also be measured by estimating the burden of pneumonia in un-vaccinated individuals in the province of Punjab. These studies were instrumental in furnishing information on factors associated with low efficacy and effectiveness of pneumococcal vaccine in Pakistan. Information gained was used for designing interventions to enhance the efficacy of pneumococcal vaccine for children in Pakistan.
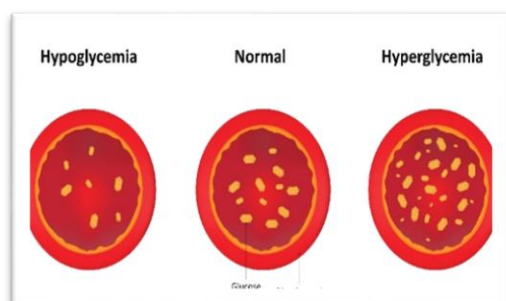
**Title:** Investigation of Effect of Diabetes Associated Hyperglycemia on Bactericidal Activity of Neutrophil
**PI:** Dr. Shaper Mirza
**Co-PI:** Dr. Amir Faisal
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 1,661,991
**Project Initiated in:** 2020
**Duration:** 24 months
**Category:** Health

**Description:** The association of type 2-diaebtes with lower respiratory tract infections (LRTI) caused by the bacteria Streptococcus pneumonia, some of which are fatal, is well recognised. An important factor that contributes to increase susceptibility of those with diabetes to pneumococcal infections is impairments in cells of immune system such as neutrophils, which are required for optimal killing of invading pathogens. While the exact mechanism of impairment in neutrophil function remains poorly understood, there are mounting evidence suggesting an association between abnormally high levels of glucose (hyperglycemia) and functional impairments in neutrophils. This study evaluates the possible role of hyperglycemia and its associated oxidative stress, on impairment of neutrophil functions. This project helped in developing a complete understanding of neutrophil responses in diabetes, which aids in predicting outcome of vaccination and help in designing strategies to enhance the function of neutrophils in diabetes.

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**Profile:** Dr. Shahzad ul Hussan joined the Department of Biology at SBASSE in December 2013 as an Associate Professor. He did his Ph. D. in Bioorganic Chemistry from the University of Luebeck, Germany in 2005. In 2005, he obtained the Postdoctoral Fellowship Award from the National Institutes of Health (NIH), USA and joined the Laboratory of Bioorganic Chemistry at NIDDK, NIH. During the postdoctoral training his research was focused on NMR structural studies of anti-HIV lectins and understanding the sub-molecular level basis of HIV entry inhibition by those lectins. In 2010, Dr. Hussan Joined the Vaccine Research Centre of NIAID at NIH as a research fellow where the focus of his research was to study the atomic level details of HIV-surface-displayed-glycan recognition by HIV-1 neutralizing antibodies. His research during last 10 years has resulted in several publications in high-ranking journals namely, *Nature, Science, Nature Structural and Molecular Biology, Journal of the American Chemical Society, Journal of Biological Chemistry, Chembiochem* and *Journal of Virology*. His research interests, in general, include understanding the structural properties of ligands in their macromolecular-bound state, the solution structure of proteins and biophysical characterisation of recognition phenomenon involving glycans. He has implemented his expertise in understanding the atomic level details of recognition involving viruses.

**Title:** Understanding the Spontaneous Clearance of Hepatitis C Virus from Certain Infected Individuals, with Vaccine Design Perspective
**PI:** Dr. Syed Shahzad Ul Hussan
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health

**Description:** This project focused on identifying the specific target sites of the antibodies present in the serum of infected individuals that can clear the virus by their effective immune response without any treatment. In this research, the blood sera of such individuals were collected. The research further had peptide antigens designed, consisting of different conserved regions of HCV envelope to screen the serum samples through ELISA for the presence of antibodies specific for these antigens. In the following period, antibodies were isolated using B-cell sorting techniques and solve the structure of their target site in the antibody bound conformation that provided lead to design immunogenic molecules as potential vaccine candidates. This study is highly significant to obtain essential information for structure-based vaccine design against a globally as well as locally prevalent infection.

**Title:** Understanding the Molecular Mechanism of Disease Related Endothelial Activity of Oxidized Phospholipids
**PI:** Dr. Syed Shahzad Ul Hussan
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Health

**Description:** This project aimed to understand the binding of a specific class of oxidation products of phospholipids called PEIPC to HRas protein, which is one of the cellular proteins involved in signalling. This is known that PEIPC binds to HRas protein at the cells present in the interior of blood vessels and activates signalling pathway that results in the development of atherosclerosis. However, which particular isomer of PEIPC binds to HRas and activates disease related signalling pathway is still unknown. In this project, the aim was to develop an understanding of molecular recognition through NMR spectroscopy, further identifies specific isomer of PEIPC, from the mixture of different isomers that binds to HRas and activate disease related signalling. Moreover, it determines if PEIPC isomer activates signalling by just binding to HRas non-covalently or by modifying the HRas protein through developing permanent covalent bond with the protein.

# DEPARTMENT OF CHEMISTRY & CHEMICAL ENGINEERING

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**Profile:** Dr. Rauf has a Ph.D. in Chemical Engineering from the Sungkyunkwan University, Seoul, South Korea (2018) with a concentration in the design and synthesis of novel hetero-structured photo catalysts for environmental applications. He also has a Bachelor's in Chemical Engineering from the University of Punjab (2012). Prior to joining LUMS, he has been academically engaged as Lecturer at the University of Engineering and Technology (UET) Lahore in the Department of Chemical, Polymer and Composite Material Engineering while his industrial experience includes working as a Technical Management Resource at NIMIR Industrial Chemicals Ltd (2012). His research interests include Photo Catalysis, Water Splitting and Energy Storage Devices.
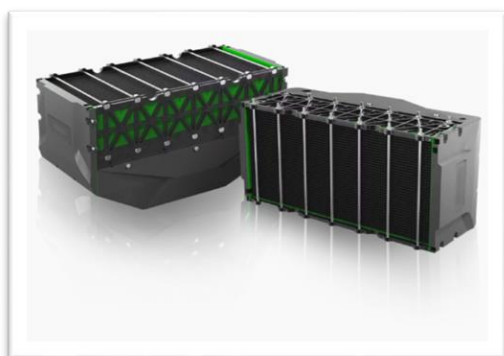


**Title:** Synthesis of Copper Phosphide-based Z-scheme Composite for Photochemical Water Splitting
**PI:** Dr. Ali Rauf
**Co-PI:** Dr. Basit Yameen
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 466,931
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Energy

**Description:** This research was primarily focused in decreasing the dependency on non-renewable energy resources such as fossil fuels, and develop a rather feasible and economical method that would not only help in meeting the energy requirements of the nation but will also contribute towards a sustainable future. Hydrogen gas had been opted for this project.

Hydrogen gas is a clean and sustainable fuel. Production of hydrogen gas via solar water splitting is feasible, economical and straight forward method. Visible light is 45% of solar spectrum, in this project such photo catalytic systems were designed which were visible light sensitive can not only increase the efficiency of photo catalytic system, but it also ensures maximum utilisation of solar light. Designed photo catalytic composites can be checked and their performances can be compared against standard photo catalyst.

**Title:** In-House Utilisation of Excess Lime / Development of Commercial Use of Lime being produced at Fatima Fertiliser Company Limited
**PI:** Dr. Ali Rauf
**Co-PI:** Dr. Muhammad Zaheer
**Sponsor:** Fatima Fertilizer Company Limited
**Funding Amount:** PKR 1,300,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology

**Description:** As the name suggests, this project is aimed at finding the appropriate ways to utilise the excessive lime that is being produced by Fatima Fertilizer Company. As per the research, this excessive calcium carbonate can be utilised in the Calcium ammonium nitrate (CAN) plant, however due to various impurities like AN and P2O5 and the particle size of CC hinders the utilisation in CAN plant. Impurities cause a caking problem during the level build up. Furthermore, the very fine particle size of CC produced increases the particle size variation in final CAN product. Targeted regular CAN product is 2-4 mm in size. This research helped in formulating such ways where these impurities can be removed, and this excessive CC can be utilised in the in-house CAN plant or can be used elsewhere like in buildings or sand lime bricks.
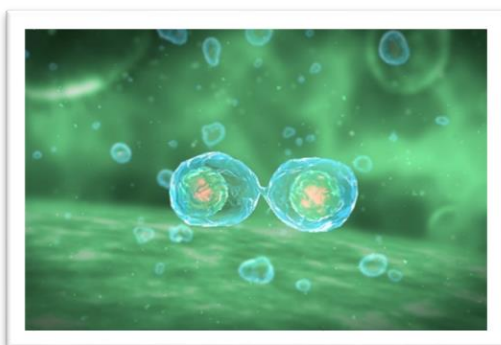
Dr. Basit Yameen
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**Profile:** Dr. Basit Yameen received his M.Sc. degree (2000) in Chemistry, with distinction, from Government College University, Lahore. He received his M.Phil. degree (2003) in Organic Chemistry from Quaid-e-Azam University, Islamabad, and Ph.D. degree (2008) in Chemistry from University of Mainz, Germany. Dr. Yameen carried out his Ph.D. research work under the supervision of Prof. Dr. Wolfgang Knoll at Max Planck Institute for Polymer Research, Mainz, Germany.

Dr. Basit Yameen is a renowned expert in polymers with more than 18 years of experience in developing functional polymers, smart materials, and interfaces. His current research activities are related to the development of smart materials for biomedical applications (nanomedicine and structural biology), (bio)sensing applications (biomarkers and environmental contaminants), alternative energy technologies (solar cells, fuel cells, batteries), environmental remediation, and antiviral and antibacterial surfaces. Dr. Yameen has won several national and international research grants. He has authored more than 65 research articles, review articles, and book chapters published at the peer reviewed venues of high international standing.

**Title:** UV Printable Functional Interfaces: Fabrication of Sensor and Antimicrobial Surfaces
**PI:** Dr. Basit Yameen
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Environment, Technology

**Description:** The practice of overlooking environmental impact, and impact on the health for that matter, of human activities in quest of achieving economic robustness is alarmingly prevalent in the developing countries. Pathogenic microorganisms (e.g., bacteria, viruses, parasites, fungi), and chemical contaminants (e.g., toxic metals, toxic gases) are among the chief environmental contaminants that have direct impact on health.

Considering the health implications that these pathogens might cause this study is focused on designing a UV printing technology for the development of two types of functional interfaces: 1) Sensors for the detection of toxic contaminants 2) Antimicrobial surfaces to combat against pathogenic microorganisms and multidrug resistance. This activity will lead to the development of easy to fabricate and low-cost sensors to monitor toxic chemical contaminants. In addition to this outcome, the study also resulted in the development of scalable strategies for printing antimicrobial surfaces on a variety of different substrates that will help in controlling the spread of infectious diseases and overcoming the multidrug resistance.
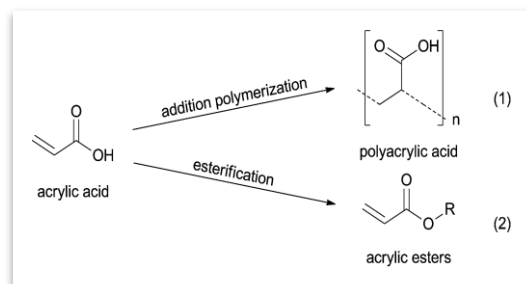
Dr. Falak Sher
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**Profile:** Dr. Falak Sher is currently working as an Associate Professor at the Department of Chemistry, SBASSE, LUMS. Before joining LUMS in October 2008, he was a faculty member at the Pakistan Institute of Engineering and Applied Sciences (PIEAS), Nilore, Islamabad. Dr. Sher completed his PhD degree in Chemistry from the University of Cambridge, UK, in 2005. Prior to this, he received his MS Nuclear Engineering degree from the PIEAS (2nd position) in 1999 and M.Sc. Chemistry degree from the Institute of Chemistry, University of the Punjab in 1996. Dr. Sher also gained the Postdoctoral Research Experience on two different occasions from the University of Edinburgh (2005) and the University of Cambridge (2007-2008). His research has been published in reputed international journals like *Nature, Journal of the American Chemical Society (JACS), Angewandte Chemie International Edition, Chemistry of Materials, Inorganic Chemistry, Physical Review B* etc. Dr. Sher's research group focuses on synthesis and characterisation of functional transition metal oxides with interesting properties and applications.



**Title:** Characterisation and Development of Chemicals and Materials of Commercial Value
**PI:** Dr. Falak Sher
**Co-PI:** Dr. Habib-ur-Rehman
**Sponsor:** Cmyk Research & Development
**Funding Amount:** PKR 600,000
**Project Initiated in:** 2020
**Duration:** 12 months

**Category:** Natural Sciences, Technology

**Description:** The study is focused on acrylate-based polymers which can be synthesized through several routes. One of those routes of synthesis is through esterification of an acrylic acid with an alcohol. The study is aimed in developing polymers using esterification process. It is believed that the monomers required for acrylate-based polymer synthesis can be produced through the esterification process. Therefore, in this study the focus was to conduct research in the development of relevant monomers which can then be polymerized into the required molecular weights for desired properties.

**Title:** Investigation of Hexagonal Perovskite Derivatives as Oxide Ion Conductors for Solid Oxide Fuel Cells
**PI:** Dr. Falak Sher
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 980,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology, Natural Sciences

**Description:** Use of more sustainable and energy efficient fuels is becoming very popular with every passing day. Research and in field experimentation favour the solid oxide fuel cells that can efficiently convert chemical fuel i.e., H2 and O2 gases into electricity without producing any harmful gases and are rendered as an efficient alternative to fossil fuels. However, with the available materials these fuel cells can only operate at higher temperatures of around 900-1000 ℃. This issue can be resolved or at least minimised if we can find alternative electrolyte materials which can exhibit high oxide ion conductivity at intermediate temperature range of 400-600 ℃. This study is aimed at resolving this issue by using hexagonal perovskite oxide compositions as electrolyte materials, it further investigates their structural, thermal and electronic properties and try to understand and find structure-property correlations for these materials.

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**Profile:** Dr. Irshad Hussain is among the founding members of SBASSE, LUMS, and has led the Chemistry department during its formative years, which has now been upgraded to the Department of Chemistry & Chemical Engineering. He completed MSc in Chemistry from Quaid-i-Azam University, Islamabad, and Ph.D. (Chemistry, Nanomaterials) from the University of Liverpool, UK. Prior to joining LUMS, Dr. Hussain spearheaded research and development program in Nano biotechnology at National Institute for Biotechnology & Genetic Engineering (NIBGE), Faisalabad, and developed a Nanotech group/facility that is now one among the few leading Nano biotech groups in Pakistan.

Dr. Hussain has served as the Chair of National Nanotech Experts Panel at Pakistan Council for Science and Technology in 2015 and currently is the member of the National Core Group of Chemistry and Chair of the National Core Group of Nanotechnology formed by the PM Task Force on Science and Technology. He has also been awarded two Gold Medals in Chemistry by Pakistan Academy of Sciences (PAS); Prof. Atta-ur-Rahman Gold Medal in 2007 and PAS Gold Medal in 2014.

**Title:** Developing Novel Catalysts for Hydrogen Production — A Step towards Sustainable Hydrogen Economy
**PI:** Dr. Irshad Hussain
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Energy

**Description:** This study focuses on the controlled synthesis of the geologically abundant metal (Ni, Cu, Fe, Co) nano clusters (NCs) and their graphene based composite materials for photo-electrochemical water splitting. Metal NCs having a size $\leq 2$ nm comprises of distinctive physicochemical size dependent properties. They are atomically mono dispersed species with high surface to volume ratio and can potentially harness the sunlight due to the discrete electronic levels and are being envisioned to catalyse water splitting, analogue to the appealing natural photo-driven 'H2' production in the plants.

The exponential increase of the world population, the need and consumption of energy are significantly increasing, and it is projected that global energy demand will be doubled by 2050. To fulfil the increasing energy demand, employment of such techniques has become necessary, and ultimately will lead to sustainable development.

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**Profile:** Dr. Muhammad Saeed joined LUMS in 2014 as an Associate Professor. He established the Bioorganic and Medicinal Chemistry (BMC) group in The Department of Chemistry and Chemical Engineering. Originally trained as synthetic organic chemist, he has extensive postdoctoral research experience at the interface of chemistry and biology. He is interested to address the modern challenges in biological sciences and medicinal chemistry by using the tools of organic chemistry. More specifically, he pursues rational antiviral and anticancer drug designing and discovery by using modern day techniques of computational modelling, protein dynamics and simulations, supported by the conventional wet-chemistry of organic synthesis and high-throughput screening of synthetic compounds and natural products.

He has published around 50 research articles in reputed international journals, such as J. Biol. Chem., Int. J. Cancer, Free Rad. Biol. Med. Chem. Res. Toxicol., and Tetrahedron Lett. His is currently investigating proteases of different viruses (COVID-19, dengue, HCV) as drug targets for designing efficient direct-acting antivirals (DAAs).

**Title:** Development of Bioassay for Discovering New Drugs for Treatment of Hepatitis C Virus Infection by Targeting the Virus Protease
**PI:** Dr. Muhammad Saeed
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health

**Description:** Hepatitis C virus (HCV) is rampant in Pakistan, infecting at least 5% population. Despite the availability of several FDA-approved DAAs, such as Sofosbuvir (Sovaldi®), Daclatasvir, Velpatasvir etc., the global success in the clinical treatment of HCV remains only 90%. Treatment failure in 5-10% cases is mostly due to the emergence of drug resistance. This research intends to address this issue by targeting a viral protein, called HCV protease for discovering new drugs that can avoid drug resistance. The specific aims were, 1) the development of a 96-well plate-based screening bioassay by using the recombinant expressed HCV protease; 2) synthesizing and screening of a variety of small organic molecules to discover newer 'hits'; and 3) determining the binding interaction of selected 'hits' with HCV protease by using NMR-based experiments and computational docking. The structure of hits was then refined to avoid interaction with a mutate-able residue of HCV protease.

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**Profile:** Dr. Muhammad Zaheer earned his M.Phil. Degree from Quaid-i-Azam University. In 2009, he was awarded with HEC Overseas Scholarship for PhD studies in Germany. He completed his degree under the supervision of Prof. Dr. Rhett Kempe from the University of Bayreuth. During his PhD, he worked on the development of robust heterogeneous catalysts for sustainable chemistry applications including biomass transformation into fuels and chemicals.

Dr. Zaheer has got published papers in the scientific journals of high impact like Chemical Society Reviews and Chemistry of Materials. He was a post-doctoral fellow at the Department of Inorganic Chemistry, University of Bayreuth before joining LUMS as an Assistant Professor. His research interests include the development of heterogeneous catalysts for the conversion of biomass to obtain fuels/chemicals, renewable energy generation/storage and green chemistry.



**Title:** Visible Light-Mediated Conversion of Biomass into Selected Chemicals
**PI:** Dr. Muhammad Zaheer
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Natural Sciences

**Description:** 95% of all chemicals, for instance pharmaceuticals, plastics, polyester etc., that sustain our daily life are derived from crude oil. Unfortunately, these fossil reservoirs are depleting enormously and would be available to feed chemical industry for a short time period. Therefore, seeking alternate renewable feedstock for the production of chemicals is highly demanded. Plant biomass, in this regard is the only renewable source for the production of both fuels and chemicals. Pakistan is an agricultural country and plentiful sources of biomass in the form of agricultural residues are available. The current project aimed to prepare reusable catalysts to convert biomass into selected chemicals in the presence of light as an energy source.
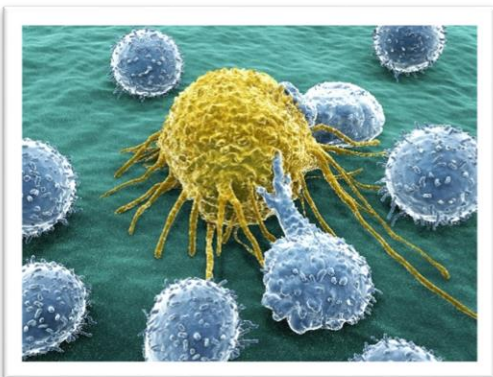
Dr. Rahman Shah Zaib Saleem
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**Profile:** Dr. Rahman Shah Zaib Saleem joined LUMS in 2012 as an Assistant Professor and was promoted to Associate Professor in 2020.  He is an enthusiastic experienced organic chemist with a proven track record in medicinal chemistry and materials. He enjoys teaching and training organic chemistry, spectroscopy, medicinal chemistry and drug discovery courses to undergraduate and postgraduate students. He builds effective collaborations within and outside of the institution.

In medicinal chemistry, he has expertise in the discovery of lead molecules for various cellular targets. His specialties include hit and lead generation, lead optimisation, medicinal chemistry, organic synthesis and methodology, structure-based drug design, data analysis, natural product isolation and structure elucidation. On the materials front, he is also working on the novel metal-free organic dyes for solar cell and organic scaffolds for metal-organic frameworks (MOFs) and modification of the drug molecules to prepare nanoparticles for subsequent evaluation. As an organic chemist, he has also done the isolation, characterisation and total synthesis of natural products.



**Title:** Developing Novel Inhibitors of MDM2:p53 Interaction: Hit-to-lead Optimisation
**PI:** Dr. Rahman Shah Zaib Saleem
**Co-PI:** Dr. Amir Faisal
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health

**Description:** Cancer is one of the major causes of mortality around the globe and current chemotherapies often suffer from the development of drug resistance in cancer cells. This project studies the pathways through which a cancer cell death is achieved and how this process can be halted by the different levels of tumour suppressor hormone (p53) and Mouse double minute 2 protein (MDM2). This resistance to chemotherapeutic drugs occurs when (1) MDM2 is produced in more than normal amount or (2) examine certain mutations in p53 leads to its enhanced binding with MDM2. This study determines how this resistance can be prevented by using small organic molecules that can block the interaction of MDM2 with p53 can reactivate p53 and make cancer cells more susceptible to cell death (apoptosis). The successful completion of this project led to a compound for the inhibition of MDM2:p53 interaction.

**Title:** De-clustering the Supernumerary Centrosomes in Cancer Cells Using Small Organic Molecules: An Approach to Selectively Kill Cancer Cells

**PI:** Dr. Rahman Shah Zaib Saleem

**Co-PI:** Dr. Amir Faisal

**Sponsor:** Faculty Initiative Fund (LUMS)

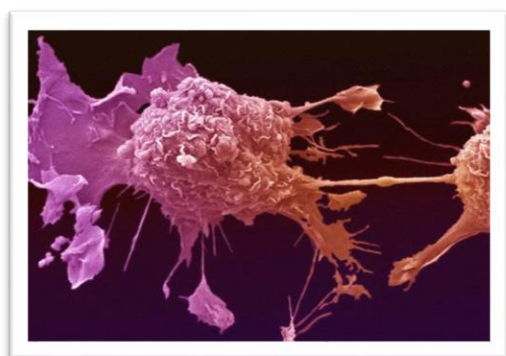**Funding Amount:** PKR 1,000,000

**Project Initiated in:** 2019

**Duration:** 12 months

**Category:** Health

**Description:** Cancer is one of the major causes of death around the globe. This fatal condition can be cured via various procedures, but Chemotherapy proves to be the most systematic approach for cancer treatment. As beneficial as chemotherapy has proven to be it still have severe side effects, because form of treatment not only attacks the cancerous cells, but also kills the normal cells, thereby following non-selective approach. There is, therefore, a need to improve current therapies. This study focuses to do so by the synthesis and evaluation of the small organic molecules that can inhibit formation of two poles during division of these cancer cells. It also includes the preparation of the library of organic molecules based on our literature insights and test those in the cells with normal number of centrosomes and with supernumerary centrosome. During this process, robust in-house assay for the screening of our compounds and quantify the activity of these compounds were also developed.

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**Profile:** Dr. Salman N. Arshad received BS in Metallurgy and Materials Engineering from GIK Institute of Engineering Sciences and Technology, Pakistan, and then moved to South Korea for Masters in Materials Science and Engineering from Korea Advanced Institute of Science and Technology (KAIST). At KAIST he developed novel bottom-up methods to synthesize carbon nanotubes reinforced metal and ceramic nano composite materials with enhanced mechanical and multifunctional properties.

Dr. Arshad's research focuses on the design and synthesis of nanofibers and nanocomposites for applications in energy and environment (see figure). His research work has been published in high quality peer-reviewed journals such as Advanced Materials, Carbon, Polymer, Scripta Materialia, Acta Materialia, Journal of Materials Research, Scientific Reports and RSC Advances. He also earned a US Patent and has more than 1100 citations to date.

**Title:** Value Addition for Local Artificial Jewellery Industry through Electroplating Process Optimisation
**PI:** Dr. Salman Noshear Arshad
**Co-PI:** Dr. Falak Sher
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 12,464,000
**Project Initiated in:** 2019
**Duration:** 24 months
**Category:** Technology

**Description:** The jewellery industry in Pakistan has a great potential to enhance the exports and contribute to the national economy through indigenous skill and technology development in the field. The quality of the finished product relies on the various manufacturing steps including casting, surface preparation, and the final coating through electroplating of copper, nickel, gold, etc. The aim of this project is to enable the local jewellery industry to compete internationally by adding value to their products through electroplating process improvement optimisation. A demo and training lab was established in LUMS for electroplating which benefits the local industry and provide a benchmark process and conditions to adopt in their respective setup. This facility will have a wider impact on other related industries wherever electroplating is employed such as automotive, kitchen utensils, etc.

**Title:** Low Cost, High Efficiency, Transparent, and Thermally Stable Air Filters for PM2.5 Removal
**PI:** Dr. Salman Noshear Arshad
**Co-PI:** Dr. Hafiz Muhammad Afzal
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 960,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Environment, Health

**Description:** Air pollution has become a global environmental issue due to rapid urbanisation, industrial growth, and reliance on the fossil fuels. Particulate matter (PM) is one of the major contributor for the fast deteriorating air quality. This contaminant is categorised on the basis of its size into PM 2.5 and PM 10 respectively. Inhalation of PM2.5 by humans is of great health concern, due to its smaller size, which penetrates into the blood vessels, lungs, alveolus, and bronchi, which lead to severe diseases including cancer, heart failure, stroke, asthma, reduce lung function and increased mortality from the lung cancers. This project aims to develop low-cost PM2.5 filters with high capturing efficiency, high transparency, ease of breathability, and high thermal stability, and this will be performed much better than the commercially available filters in different harsh environments such as hot and humid conditions.

# DEPARTMENT OF COMPUTER SCIENCES

Dr. Agha Ali Raza
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**Profile:** Dr. Agha Ali Raza is an Assistant Professor in the Department of Computer Science at LUMS and the Founding Director of the Centre for Speech and Language Technologies (CSaLT). He is a Fulbright Scholar and received his Ph.D. from the Language Technologies Institute, School of Computer Science at Carnegie Mellon University, Pittsburgh, USA.

His research interests include Speech and Natural Language Processing, Speech-based Human Computer Interfaces, and Information and Communication Technologies for Development (ICT4D). His research has been funded by many prestigious organisations like Google Inc., Facebook Research, UNICEF, GIZ, National Institutes of Health (NIH), the National Academies of Sciences, Engineering, Medicine, Keck Futures Initiative (NAKFI), and the Higher Education Commission of Pakistan. He was also an Associate Chair in the program committee for CHI. He has also served as program committee chair for short papers for ICTD 2017 and a programme committee member for ICTD, and ACM COMPASS (formerly ACM DEV) since 2015.
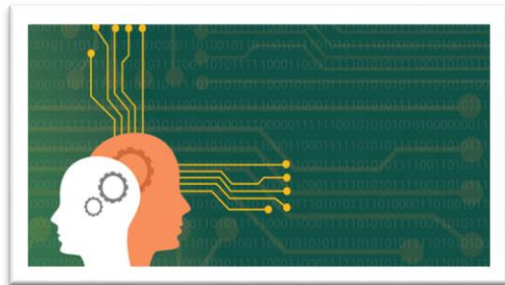
**Title:** Impact Evaluation of Super Abbu: A Speech-based MNCH Platform in Pakistan
**PI:** Dr. Agha Ali Raza
**Sponsor:** University of California, Davis
**Funding Amount:** PKR 22,240,872
**Project Initiated in:** 2020
**Duration:** 19 months
**Category:** Technology

**Description:** Super Abbu is a service that connects expectant fathers to each other and to doctors over a speech-based interface as simple as a phone call. In this project the focus was to determine the effectiveness of Super Abbu that will not only help understand how such speech-based public health information delivery services might overcome MNCH challenges in Punjab but will generalise to public health service delivery across the developing world where many of the same challenges exist. Super Abbu will also generate useful information on frequently asked questions for public health professionals to better understand their population. Additionally, Super Abbu itself, if found to be successful, could easily be scaled up to reach other developing countries to improve public health.

Dr. Asim Karim
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**Profile:** Dr. Asim Karim is an internationally recognised academic in the areas of data mining, machine learning, and applied artificial intelligence. Dr. Karim obtained his doctorate from the Ohio State University and his bachelors from University of Engineering and Technology, Lahore. He has authored over 70 articles at leading venues including two books and 25 journal articles. His publications have over 2,100 citations (h-index = 21), and his work has won recognition at international competitions. In 2015 he was awarded the prestigious PAS-COMSTECH Prize in Computer Science by the Pakistan Academy of Sciences in recognition of his outstanding scholarship in computer science and information technology.

For the past 15 years, he has focused on data mining and machine learning applied to problems in text analytics, social media understanding, Web mining, and social aspects of data analytics. He is founding director of the Knowledge and Data Engineering Lab at LUMS which is the centre of his research activities.

**Title:** Emotion Detection in Bilingual and Informal Short Text
**PI:** Dr. Asim Karim
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 997,500
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology

**Description:** Pakistan has a growing software industry with revenues exceeding billions of dollars. Software across many domains such as web, mobile, embedded systems, and desktop based legacy systems are developed and maintained. A common shortfall of all kinds of software systems are the code similarities or code clones that abound within and across systems. In this research project the issue of codes clones was addressed by development of the Language Independent Clone Management Tool (CMT) Suite for Single and Multiple Systems. This tool aimed to capitalise the untapped potential of software similarities that abound in existing software systems, helping the software industry to increase its efficiency in software development, and to enhance its potential to capture new customers and new market segments globally.
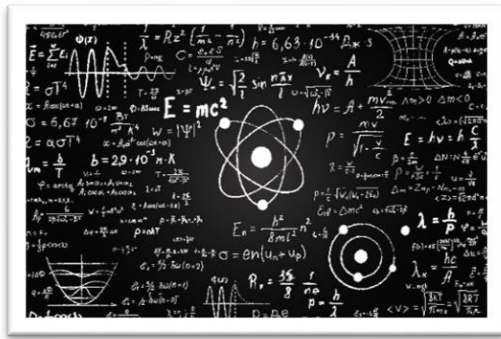
**Title:** INTEGRA: Capacity Building in Higher Education
**PI:** Dr. Asim Karim
**Sponsor:** Harokopio University of Athens
**Funding Amount:** PKR 17,623,809
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology

**Description:** The main objective of this project was to develop an open-source system which supports descriptive narration of the mathematical content within a PDF file. Popular screen readers like JAWS and NVDA are incapable of reading mathematical notation and various other symbols. Hence, in this project an Accessible LaTeX-based Authoring and Presentation (ALAP) was developed which extends an open-source Eclipse plugin "TeXlipse" and is integrated with Microsoft's text to speech API. Using ALAP, blind users can generate and understand LaTeX based documents comprising of even advanced math independently.

Dr. Basit Shafiq
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**Profile:** Dr. Basit Shafiq received his B.S. degree in Electronic Engineering from GIK Institute of Engineering Sciences and Technology, Pakistan, M.S. and Ph.D. degrees in Electrical and Computer Engineering from Purdue University, USA. He is currently an Associate Professor in the Computer Science Department at LUMS. Prior to joining LUMS, he was a Research Assistant Professor at the Centre for Information Management, Integration and Connectivity (CIMIC), Rutgers University, USA. Dr. Shafiq's interests include information systems security and privacy, access-control management in distributed systems, Web services composition and verification, ontologies, and distributed multimedia systems. His research work resulted in several publications in well-renowned journals, including, IEEE Transactions on Knowledge and Data Engineering, ACM Transactions on Information and System Security, IEEE Transactions on Multimedia, IEEE Transactions on Service Computing, IEEE Computer, IEEE Communications Magazine, and Journal on Information and Computer Systems. In addition, he has also presented his work in leading IEEE and ACM conferences and workshops. Dr. Shafiq is a member of the IEEE. His research has been sponsored by Higher Education Commission (HEC) Pakistan, United States National Science Foundation (NSF), and SAP Research Labs.
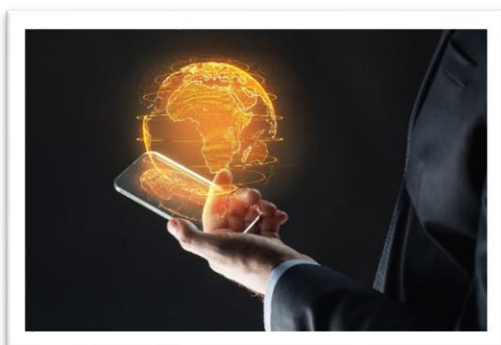
**Title:** Dynamic Composition of Internet-Centered Distributed Applications in the Cloud and Edge Computing Environment
**PI:** Dr. Basit Shafiq
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 960,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology

**Description:** The project aimed at developing a framework for rapid development and deployment of next generation Internet-centered distributed applications, using the resources available in the emerging cloud and edge computing environment. These resources include computational, data, and storage resources available in the cloud data centres and enterprise networks as well as large number of Internet of Things (IoT) devices providing diverse sensory and computation services. This project leads to the development of algorithmic solutions and prototype implementation for Internet-centered distributed application composition and instantiation in the cloud and edge computing environment.
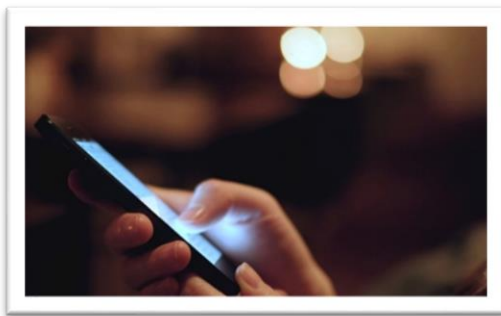
Dr. Ihsan Ayyub Qazi
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**Profile:** Dr. Ihsan Ayyub Qazi is an Associate Professor and the current Chair of the Department of Computer Science at LUMS, Pakistan. He received his Ph.D. in Computer Science from the University of Pittsburgh, PA, USA in 2010 and the BSc. (Hons) degree from LUMS with a double major in Computer Science and Mathematics in 2005. He was a Visiting Research Scientist at the University of California, Berkeley, USA in 2017. Previously, he has held positions at BBN Technologies (Cambridge, USA) and the Centre for Advanced Internet Architectures (Melbourne, Australia). His research interests are in computer networks and distributed systems and span cloud computing and datacentres, mobile/wireless networks, ICT for developing regions, Internet censorship, and online privacy. His work has appeared in premier networking conferences, such as ACM SIGCOMM, and journals including IEEE/ACM Transactions on Networking. His work was selected as a best ACM SIGCOMM CCR paper in 2018. He is a recipient of the Google Faculty Research Award and the Andrew Mellon Fellowship. His research has been sponsored by the United States National Science Foundation (NSF), World Bank, Australian Research Council (ARC), HEC, and Ignite.

**Title:** Improving Web Performance over Low-end Smartphones in the Developing World
**PI:** Dr. Ihsan Ayyub Qazi
**Sponsor:** Google
**Funding Amount:** PKR 1,543,750
**Project Initiated in:** 2018
**Duration:** 40 months
**Category:** Technology

**Description:** Mobile devices have become the primary mode of Internet access in developing countries. Driven by their low cost, such devices are often equipped with small memory sizes and slow CPUs. Despite the prevalence of such devices in these markets, there are few systematic studies of the differences between web performance on low-end and high-end smartphones. In addition, lack of principled techniques to analyse and prevent web page stalls and crashes and improve performance on low-end phones. The goal of this project is to fill this important gap. First, using low-end smartphones is popular in Pakistan, a large-scale measurement study was conducted to identify bottleneck resources in the page load process and analyse how these bottlenecks may change over time based on device characteristics, network connectivity, and page structure. The insights from this study helped in understanding the effectiveness of various infrastructure design choices and page load optimisation techniques for developing regions. Second, anecdotal evidence suggests that small memory sizes in existing low-end smartphones are a significant pain point. Further, determination of when, where, and why memory bloats occur potentially leading to stalls and crashes for different popular web pages. Using these insights, optimisations that would aim to throttle the usage of memory-heavy web page resources were developed.

**Title:** Learning Based Resource Allocation in the Cloud
**PI:** Dr. Ihsan Ayyub Qazi
**Co-PI:** Dr. Zartash Afzal Uzmi
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 980,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology, Telecommunications

**Description:** The project involved design, implementation and evaluation of SWAP, a new scheduling framework that is robust across metrics and changing workloads – a ground existing scheduling policies are unable to cover. To achieve this, SWAP combines multiplexing and serialisation in a principled way, ensuring tail optimal performance across workloads while also improving the lower percentiles. It is assumed that SWAP sets out a new direction in datacentre scheduling, where robustness is elevated as a key metric, which can eventually help with the adoption of such schemes in practice.



**Title:** Reducing Tail Latency in the Cloud using Proactive Job Duplication
**PI:** Dr. Ihsan Ayyub Qazi
**Co-PI:** Dr. Zartash Afzal Uzmi
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 985,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology, Telecommunications

**Description:** This project involved the designing, implementation and evaluation of a duplication aware scheduling framework (DASE) that will be robust to changes in workloads – a ground existing scheduling policies are unable to cover. To achieve this, DASE combines prioritisation and purging in a principled way, ensuring high tail performance across workloads. DASE sets out a new direction in duplication-aware scheduling, where robustness is elevated as a key metric.

Dr. Imdad Ullah Khan
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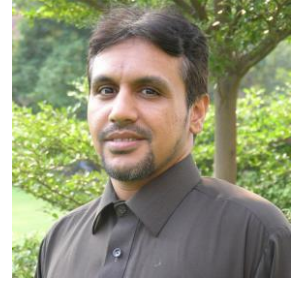
**Profile:** Dr. Imdad Ullah Khan is an Assistant Professor of Computer Science at SBASSE. He received his Ph.D. in Computer Science from Rutgers, The State University of New Jersey. Prior to joining LUMS, Dr. Khan was an Assistant Professor at the Department of Computer Science, in Umm Al-Qura University, KSA.

**Title:** Development of a Cricket Players Performance Metric for Data Driven Selection and Drafting
**PI:** Dr. Imdad Ullah Khan
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Technology

**Description:** The main objective of this project was to develop players' recommendation system that will assist in various decision-making processes at the team selection and franchise drafting level. The first goal was to design a system that will aid selectors in making an informed decision regarding choosing a player, taking into account his past performance in a given scenario. The system predicted player's performance in each of the available options using statistical analysis of players' past record and current circumstances. The long-term goal was to solidify the collaboration with PCB, keeping in mind the quality and availability of data that built the project bottom up starting from Pakistan's international team and building it up to other levels like domestic tournaments and leagues, so it has broader applicability in Pakistan. It will make this subsequent phase of the project a viable candidate for research grants from international donor agencies.

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**Profile:** Dr. Maryam Mustafa received her Ph.D. in Computer Science from the Technical University of Braunschweig in 2015, Master's in Computer Science from Cornell University NY and BSc. (Hons) degree from LUMS with a major in Computer Science. Her research interests are in Human Computer Interaction (HCI), Mixed Realities and Information Communication Technologies for Development (ICT4D). Her work is interdisciplinary in nature and draws from cognitive sciences, human perception, sociology and anthropology to inform the design of ICT interventions. More recently her work has focused on the gendered design of technologies to promote equitable access for women in Pakistan.

Her work has appeared in premier HCI conferences, such as ACM CHI, and journals including Communications of the ACM (CACM). She has also published in premier perceptual graphics journals including *ACM Transactions on Applied Perception* and *IEEE Computer Graphics and Applications.* Her work has been funded by the Gates foundation and the United States National Science Foundation.
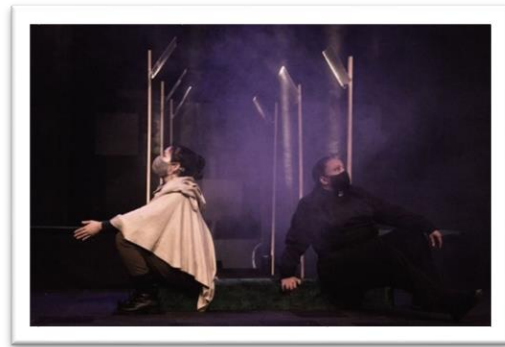
**Title:** Digital Street Theatre for Global Maternal and Child Health Education
**PI:** Dr. Maryam Mustafa
**Co-PI:** Dr. Agha Ali Raza
**Sponsor:** University of Michigan
**Funding Amount:** PKR 16,541,461
**Project Initiated in:** 2019
**Duration:** 24 months
**Category:** Technology, Health

**Description:** The research goal of this study was to conduct cross-cultural, inter-disciplinary research to (a) identify low-income mother's health knowledge, attitudes and behaviours that may lead to a reduction in maternal or infant mortality in those settings (b) design and test technology enabled solutions that can help spread health education to low-income mothers in a format that is easily embraced by such communities.

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**Profile:** Dr. Javed received her Doctorate in Computer Science from UC Berkeley in 2016 with focus of research on Internet Security and Measurement. She then spent a year as a post-doc at the International Computer Science Institute, Berkeley. She holds her bachelor's degree from National University of Sciences and Technology (NUST), Islamabad, Pakistan.

Her research interests include Internet Security & Privacy, Internet Measurement and Data Science for Social Good. Her awards and honours include Distinguished Paper Award at USENIX Security 2017 and the Internet Defence Prize 2017 ($100K award by Facebook). She also serves on the technical program committees of several top Internet security and measurement conferences (IMC, SIGCOMM, and USENIX Security).

She takes a keen interest in social impact and was a Data Science for Social Good (DSSG) Fellow at the University of Chicago in 2016, where she worked with the Government of Mexico to help mitigate poverty through data science. Dr. Javed is also the co-founder of GradApp Lab, Pakistan, a mentoring program that connects aspiring graduate school applicants with mentors abroad.

**Title:** Measuring and Understanding Website Unavailability
**PI:** Dr. Mobin Javed
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology

**Description:** One of the Internet's greatest strengths is its ability to allow access to any of its resources from users anywhere in the world. Various forces, however, have arisen that lead websites and ISPs to block large classes of users, including even whole countries, from websites. This project was to measure and understand such unavailability of websites. While much research exists on censorship, other forms of access restriction, ranging from websites rejecting users from countries perceived as fraud-prone to ISPs enforcing copyright laws, have received much less empirical exploration. This project brought a better understanding to Internet users who currently struggle to understand why pages won't load. Some may erroneously assume the worst, such as discrimination or censorship, when more mundane reasons might exist for website unavailability. The study provides a much-needed perspective on the real nature of the problem.

Dr. Muhammad Fareed Zaffar
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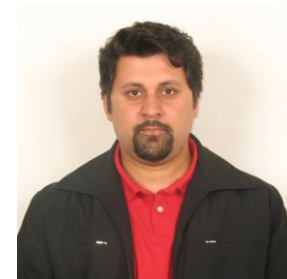
**Profile:** Dr. Muhammad Fareed Zaffar received his Ph.D. in Computer Science from Duke University in 2005 and the BSc. (Hons) degree from LUMS with a major in Computer Science and minor in Mathematics in 1999. His primary research interests are in the areas of security, privacy and internet measurement. His recent work focuses on social networks, online fraud and cybercrime and his previous work looked at enabling public sector reform through technology and the use of information and communication technologies for development. Dr. Fareed is particularly interested in the use of program analysis techniques to make software efficient, compact and secure.

**Title:** UNICEF Pakistan Development of Child Protection Case Management and Referral System
**PI:** Dr. Muhammad Fareed Zaffar
**Co-PI:** Dr. Suleman Shahid
**Sponsor:** Oxford Policy Management
**Funding Amount:** PKR 1,891,400
**Project Initiated in:** 2019
**Duration:** 27 months
**Category:** Technology

**Description:** The establishment and strengthening of a child protection case management and referral system holds the primary focus for UNICEF's technical engagement on child protection with provincial governments. In this context, this project entails the provision of technical assistance by the consulting firm to support the respective governments of Balochistan, GB, Sindh and KP towards the establishment of their respective provincial public child protection case management and referral systems, inclusive of a child protection information management system.

**Title:** Automated Authorship Obfuscation
**PI:** Dr. Muhammad Fareed Zaffar
**Co-PI:** Dr. Ali Hasanain
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology

**Description:** The objective of the project was to develop a fully automated authorship obfuscation tool chain that is based on genetic algorithms. The idea was to systematically make changes to input text such that the semantics of the text are preserved. Care was also taken to ensure that the automated

transformations do not affect the readability of the text. This project scheme did not require any manual effort on part of the user and crucially perhaps, it works without requiring any text previously written by the author for training. This approach is derived for evasion effectiveness and soundness. Evasion effectiveness means obfuscation will be considered successful and therefore safe when the text can no longer attributed to the original author.
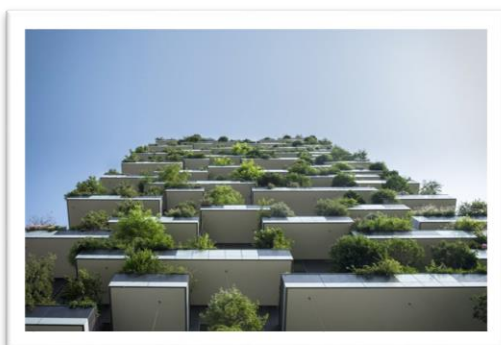
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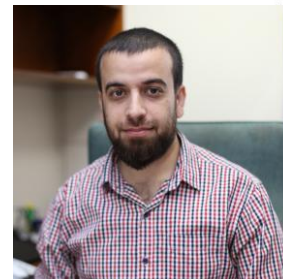
**Profile:** Dr. Hamad Alizai has over 10 years of experience in Germany and Pakistan as a researcher, software engineer, and technical lead both in industrial and academic settings. He has authored book, book chapters and published numerous scientific papers, while abroad and indigenously from Pakistan, several of them in topflight ACM SIG sponsored venues such as ACM SenSys, IPSN, BuldSYS and CoNEXT. He is experienced in leading innovative research projects in pervasive computing technologies such as Internet of things, sensor and delay tolerant networks, ICT4D, and mobile computing. He was employed as a software engineer in several European Union projects and has a wealth of experience in teaching/training cutting edge technologies and courses in theoretical and practical computer sciences at grad, post grad and professional level. He is also a visiting researcher at his alma mater: ComSys, RWTH Aachen, Germany.

**Title:** Greenifying Older Building in Emerging Countries
**PI:** Dr. Muhammad Hamad Alizai
**Co-PI:** Prof. Klaus Wehrle (RWTH Aachen University)
**Sponsor:** German Pakistani Research Cooperation Program - DAAD
**Funding Amount:** PKR 18,435,256
**Project Initiated in:** 2019
**Duration:** 36 months
**Category:** Energy, Technology, Environment

**Description:** Pakistan has a rapidly growing population, with a burgeoning fraction residing or working in urban buildings or industrial complexes. This population growth, along with aging building infrastructure, puts tremendous pressure on the supply of three basic resources: electricity, gas, and water. The study focused on development of Internet of Things (IoT) based approach that seeks to retrofit the current lot of buildings with an Integrated Resource Management (IRM) system. IRM can remove inefficiencies in the resource consumption and improve the safety and living standards of Pakistani citizens. The local conservation of resources directly results in a country wide better supply-demand balance that provides economic respite (no need to buy additional resource to meet demand) and also keeps the citizens satisfied (demand being met at lower cost). The IRM's ability to enforce safe living standards and prevent fatal accidents indirectly provides socioeconomic benefit by maintaining a healthy and able workforce that contributes to the development of Pakistan. We thus target two important aspects of the Vision 2025 of the Government of Pakistan: integrated resource management, and modernising infrastructure. This project required an initial survey to quantify inefficiencies in resource consumption at building level, followed by a prototype development and evaluation of the IRM solution that can curb these inefficiencies through preventive resource management.

**Title:** Scylla: The Internet of Things Can Live without Gateways
**PI:** Dr. Muhammad Hamad Alizai
**Co-PI:** Dr. Zartash Afzal Uzmi
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology, Telecommunications

**Description:** This study focused on the designing of a novel software-only approach, called Scylla1 that can dynamically interleave multiple wireless stacks on an IoT device equipped with only a single radio. The design of Scylla builds upon the bold assumption that dynamic switching between stacks is possible even on resource constrained devices and at timescales required to support multiple stacks simultaneously.

**Title:** No-fills Water Comfort for Developing Regions
**PI:** Dr. Muhammad Hamad Alizai
**Co-PI:** Dr. Tariq Mahmood Jadoon
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Energy, Environment, Technology

**Description:** In developing countries, majority of the households use overhead water tanks to have running water in their taps. These water tanks are exposed to the elements, which usually render the tap water unsuitable for use, given the extreme subtropical weather conditions. Externally weatherproofing these tanks to maintain the groundwater temperature is short-lived, and only results in a marginal ($0.5 - 1$ °C) improvement in tap water temperature. In this project, an ASHRAY was proposed, it is an IoT-inspired, intelligent system to minimize the exposure of water to the elements thereby maintaining its temperature close to that of the groundwater. Further, a machine learning based approach for ASHRAY was also proposed that will learn the water demand patterns of a household and pump water into the overhead tank only when necessary. ASHRAY provides thermal comfort in summers, and savings in water heating costs in winters through reduction in natural gas consumption, by leveraging ground water temperature.

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**Profile:** Dr. Murtaza Taj earned his Ph.D. and M.Sc. degrees in electronic engineering and computer science from the Queen Mary University of London (QMUL), United Kingdom, in 2009 and 2005, respectively. Currently, he is an Assistant Professor at SBASSE, LUMS. He is also an adjunct faculty at the Ontario Tech University, Canada. His research interest lies in the area of Computer Vision, Graphics and Image Processing. In particular, he is interested in detection and tracking of object in 2D and 3D scenes and in automatic generation of 3D models from raw point cloud data. At LUMS, he is a director of Computer Vision and Graphics Lab (a research group within the LUMS Computer Science department), and Director of Technology for People Initiative (TPI), which is a research and development group at LUMS that focuses on solutions that leverage technology to catalyse development in the public sector and improve data accessibility to facilitate good governance.
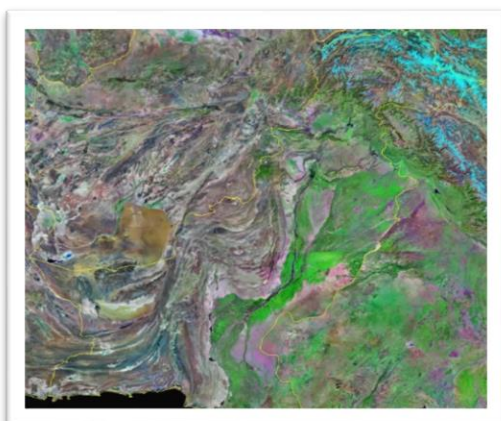
**Title:** Analysing and Forecasting Socio-Economic Development Using Satellite Imagery of Districts of Punjab
**PI:** Dr. Murtaza Taj
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 4,267,776
**Project Initiated in:** 2019
**Duration:** 24 months
**Category:** Energy, Technology

**Description:** This research work focused on the development of specialized techniques of Machine Learning to understand satellite image for the extraction of socio-economic indicators. In this study the approach that is employed draws on McKinsey's concept of "Government for Design" which explicates the importance of merging Big Data Analytics with local insight in order to promote the design and development of locally-relevant interventions. Hence, the availability of cost effective satellite imagery captured at different time frames and availability of huge data gathered by different agencies provide a solution to this age-old problem, opening an avenue for policy makers and researchers. Nonetheless, some work has been done in this country by researchers in the past on using satellite imagery for visualization separately at different intervals which is highly cumbersome, expensive, ineffective and lacking holistic view but there is no such major research on how to solve this problem with temporal analysis portal having smart algorithms to deduct different socio-economic indicators. The portal facilitates policy maker/researcher to make correlation at different time intervals on different social and economic parameters, promoting new means of monitoring and evaluating results.

**Title:** Computer Vision & Machine Learning Consultancy
**PI:** Dr. Murtaza Taj
**Sponsor:** Confiz
**Project Initiated in:** 2018
**Duration:** 2 months
**Category:** Computer Vision, Technology

**Description:** Confiz Solutions is a global technology services and solutions company, catering to small, medium and large enterprises. One of their flagship solutions is shopper value, which provides a retail footfall measurement solution. The solution provides real-time in-store analytics that helps businesses in analysing consumer behaviour and thus enabling them in increasing their sales. This solution was based on utilising information available via an in-store camera network. The project provided technical expertise in the area of computer vision, particularly multi-view geometry and the use of modern machine learning techniques such as object detection and tracking. These services were provided through the Computer Vision and Graphics Lab (CVGL, formerly CV Lab) which is one of the first graduate research labs at the Department of Computer Science and of the first computer vision lab in Pakistan.



**Title:** Bonded Labours of Brick Kilns: Employing Machine Learning on Remote Sensing Data to Perform Comprehensive Survey of Afghanistan-Nepal Brick-Belt
**PI:** Dr. Murtaza Taj
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Computer Vision, Economic Development, GIS

**Description:** The proposed project aimed to help eliminate bonded labour in South Asia by providing an up-to-date count of brick kilns within the Afghanistan-Nepal belt, along with the geographic coordinates of individual kilns, and an estimate of the number of individuals working at each site. This entails the use of satellite imagery, machine learning and computer vision techniques to identify brick kilns in the Afghanistan-Nepal belt. Kilns were identified by automatically classifying each patch of satellite imagery. Once the kilns were identified, higher resolution images of those geographical coordinates were obtained. These were used to count the number of houses in its immediate vicinity by employing instance counting techniques of image segmentation, allowing to automatically estimate the number of bonded labourers within each kiln. The resulting data set was unique in that it provides the spatial location of each kiln, as well as an estimate of bonded labour per kiln, and help governments target their interventions with precision that was previously impossible. The efficiency of the approach was validated using Punjab Brick Kiln Census data and qualitative analysis.

**Title:** 3D Realistic Character Animation Using 3D Laser Scanning and Photogrammetry and Bio-Mechanical Motion Capture
**PI:** Dr. Murtaza Taj
**Sponsor:** Ignite - National Technology Fund
**Funding Amount:** PKR 43,100
**Project Initiated in:** 2019
**Duration:** 6 months
**Category:** Computer Vision

**Description:** This project aimed to generate animations using 3D laser scanners and Bio-Mechanical motion capture. Using point cloud data, 3D laser scanners were used to create a mesh of several kinds of objects. These body meshes were refined to generate a 3D model. A body model can be generated by applying CGI on body mesh and skeleton. Bio-Mechanical motion capture is used to record actions performed by the actor. Such actions can then be used to generate a skeleton performing that action. Once an action has been recorded then this action skeleton can be applied to the CGI body model. This generates an animation of the body performing that action. Multiple actions can be recorded and applied to the CGI body model which can be combined to make clips ranging from small videos to full-fledged animated movies. It can also be used in making cut scenes for games or recording actions such as swinging a sword, throwing a projectile etc.

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**Profile:** Dr. Naveed Arshad is an Associate Professor at the Department of Computer Science. He is also the Director of Energy Informatics Group at LUMS. His research interests include short, medium and long term forecasting of energy demand, renewable energy generation forecasting for wind and solar resources, demand side management in agricultural, residential and industrial sectors, energy efficiency, and renewable energy integration in existing building stock. Dr. Arshad holds MS and PhD in Computer Science from University of Colorado at Boulder.

**Title:** Using Batteries as a Large Virtual Energy Store for the Grid
**PI:** Dr. Naveed Arshad
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 1,940,255
**Project Initiated in:** 2019
**Duration:** 24 months
**Category:** Technology, Energy

**Description:** This study was focused on decreasing the dependency of the country's energy source from fossil fuels to wind and solar power. This was a research effort to study the possibilities of inclusion of UPSs as energy storage for utility-scale electricity systems. To this end, this research effort looks into making existing UPSs more efficient through better charging and discharging models, linking charging and discharging of a myriad number of UPSs with available renewable generation and to develop an initial cost-benefit analysis of such massive small-scale storage for utilities. Additionally, the study looked into the integration of rooftop solar with traditional batteries for power supplement for the grid during evening hours. Finally, newer highly efficient battery technologies such as Tesla Power Wall and glass batteries for usage as rental energy space for the grid were also studied.

**Title:** Traversing the Path towards Next Generation Electric Transportation in Pakistan – Models and Scenarios
**PI:** Dr. Naveed Arshad
**Sponsor:** UET Peshawar
**Funding Amount:** PKR 2,841,600
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Technology, Energy

**Description:** This project studied and analysed the scenarios of Electric Vehicles (EV) adoption in Pakistan. In particular the focus was on how to best utilise the new energy generation sources to introduce the EV paradigm in the country. The plan was to understand the feasibility of EV vehicles in the country by looking into its associated needs like charging stations, managing load in the grid etc. Finally, the plan was to propose for policy recommendations on phased wise sustainable introduction of EV in the country and phasing out fossil fuel vehicles.
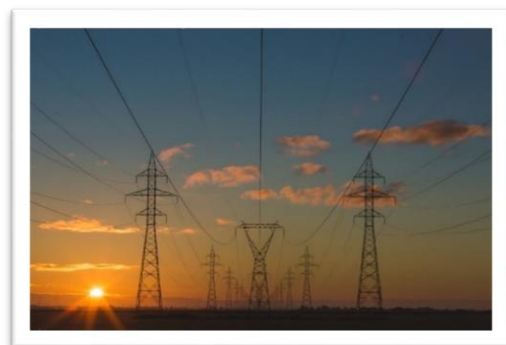


**Title:** Towards a Paradigm Shift in Power System Planning through Spatiotemporal Load Forecasting
**PI:** Dr. Naveed Arshad
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Energy

**Description:** In this project a new approach towards load forecasting, which is based on spatiotemporal scales that vary between National-scale to feeder-scale in space and vary between years to hours in time, was studied. For Pakistan, such fine-grained forecast would minimise the variations in future load forecasting. Moreover, this technique helped in reducing the cost of transmission as well as in increasing renewable energy resources share in the energy generation mix at a relatively low cost.
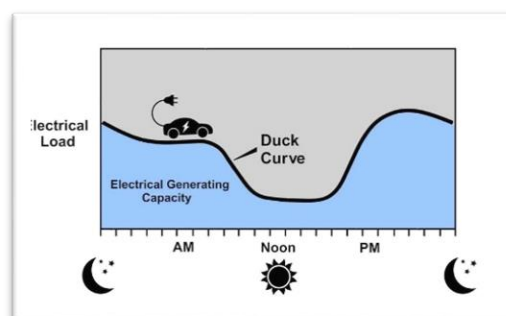


**Title:** Challenges and Opportunities of Duck Curve in Solar PV
**PI:** Dr. Naveed Arshad
**Sponsor:** Hadron Solar
**Funding Amount:** PKR 584,250
**Project Initiated in:** 2018
**Duration:** 6 months
**Category:** Energy

**Description:** This project focused on challenges and opportunities impending energy duck-curve with widespread solar PV installations. Possible solutions with respect to Pakistan's energy market was also evaluated as part of the research.

**Title:** Electricity Market Program 2019
**PI:** Dr. Naveed Arshad
**Co-PI:** Dr. Nauman Ahmad Zaffar
**Sponsor:** Central Power Purchasing Agency (CPPA)
**Funding Amount:** PKR 500,000
**Project Initiated in:** 2019
**Duration:** 5 months
**Category:** Energy

**Description:** In this project, CPPA collaborated with LUMS to facilitate Power Market in transition in Pakistan. The project was focused on dissemination of knowledge, by conducting trainings and capacity building for power market participants of Pakistan.



**Title:** Real-time Spatiotemporal Emissions Mapping under WP5 Asi@Connect
**PI:** Dr. Naveed Arshad
**Co-PI:** Dr. Mohammad Jahangir Ikram
**Sponsor:** Trans-Eurasia Information Network (TEIN)
**Funding Amount:** PKR 23,839,920
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Environment

**Description:** Environmental pollution has plagued almost every major city across Pakistan. Presently, Lahore, the second largest city of Pakistan, is ranked as one of the most polluted cities in the world in terms of air quality index together with Delhi, India. Conservation of environment through curtailment of environmental emissions is the need of the hour. However, before any mitigation and adaptation efforts are commenced to help the environment, it is of paramount significance to measure and analyse the spatiotemporal distribution and concentration of pollutant particles in the urban atmosphere. To this end, this project proposed the development of a real-time spatiotemporal emissions mapping mechanism through deployment of cost-effective and portable environment monitoring stations on service or public transportation vehicles.
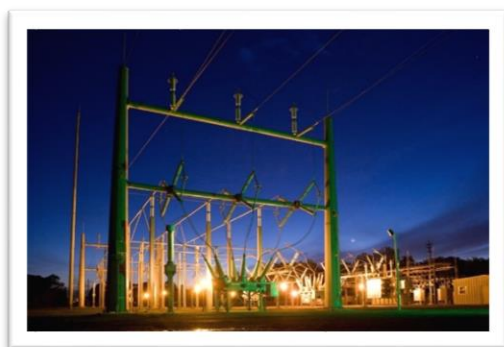
**Title:** Design and Development of a Software Framework to Facilitate Electricity Markets in Pakistan
**PI:** Dr. Naveed Arshad
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Energy

**Description:** To aid the transition of the power market and to facilitate the participants, this study proposed to develop a decision support system for participants of electricity markets that enables them to participate in competitive electricity in a way that favours their individual interests. For instance, the proposed software framework allows retailers to use this tool for forecasting demand, and make decisions regarding the management of financial resources, negotiation of short-term contracts, selection of wholesale electricity providers, and power dispatch levels. In addition to facilitating decisions, the developed framework also enables communication between the market participants and ensure transparency of electricity trade.



**Title:** Transition of Residential Gas Appliances from Natural Gas to Electricity
**PI:** Dr. Naveed Arshad
**Sponsor:** Fatima Fertilizer Company Limited
**Funding Amount:** PKR 1,800,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Energy

**Description:** This project focused on carrying out a study on the opportunity to convert natural gas-based loads in the country to electric energy. To this end, the research was conducted on the technical and economical aspects that have to be considered for this conversion. Furthermore, new business and entrepreneurial models for diversifying this process were studied in this research project.

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**Profile:** Dr. Shafay Shamail completed his BSc Electrical Engineering from University of Engineering and Technology (UET) Lahore, MSc Electronics from University of Wales, UK and PhD in Electrical Engineering from University of Bath UK. Before joining LUMS, Dr. Shamail worked in both the software industry as well as in academia. During his stay at SoftNet Systems, he gained experience in e-commerce technologies, especially those from Microsoft. Dr. Shamail has taught at UET Lahore as well as at Pak-AIMS, and has a vast experience of curriculum design and implementation. He was Chair Department of Computer Science LUMS from 2004 to 2009. He served as Vice Provost LUMS from 2010 to 2012. Since 2012 he is working as Director Office of Sponsored Programmes (OSP) at LUMS. Dr. Shamail is a Senior Member of IEEE and chaired IEEE Lahore Section for the session 2010-2011.

**Title:** CureMD
**PI:** Dr. Shafay Shamail
**Sponsor:** CureMD Research & Development
**Funding Amount:** PKR 600,000
**Project Initiated in:** 2018
**Duration:** 7 months
**Category:** Technology

**Description:** The objective of this task was to study the current software quality assurance infrastructure at CureMD and suggest changes in processes to improve the software quality. This activity involved looking at different software development processes, observing how software process was executed, and suggesting improvements in the process and supporting documents and instruments.

Dr. Suleman Shahid
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**Profile:** Dr. Suleman Shahid is an Assistant Professor at the Department of Computer Science where he directs the 'Computer Human Interaction and Social Experience Lab' (CHISEL). His research interests include assistive technologies (mobile apps and VR/AR systems) to enhance the quality of life of persons with disabilities (e.g. autism, dyslexia, visual impairment) and older adults, educational technologies for children (child-computer interaction), and affective computing. More recently he has become interested in 'information and communication technologies for development' (ICT4D) where he takes a multidisciplinary approach for designing interventions in the areas of education and health. Since 2009, he has been offering consultancy and training services in the areas of design thinking and user experience (UX) design and strategy.
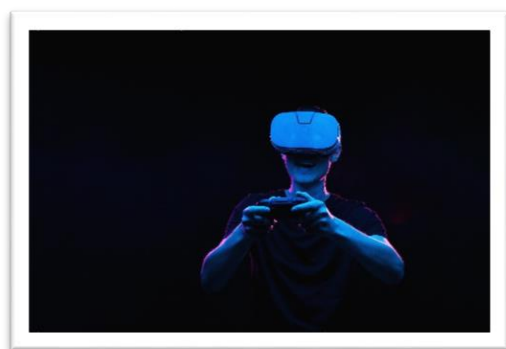


**Title:** Dynamic and Immersive Virtual Emergency Response Training DIVERT for MAHFOOZ PAKISTAN
**PI:** Dr. Suleman Shahid
**Co-PI:** Dr. Muhammad Hamad Alizai
**Sponsor:** Ignite - National Technology Fund
**Funding Amount:** PKR 27,071,747
**Project Initiated in:** 2020
**Duration:** 24 months
**Category:** Technology

**Description:** This project focused on the development of a training software (immersive game-like environment and supporting information system) to provide training through virtual reality (VR) and simulations, by specifically focusing on the Pakistani context and real-life scenarios. This was a web-based system for the common people to help both responders and victims by making them aware of what to expect from each other and what steps to take for self-help in difference scenarios (home, public place, workplace school/university, etc.) and by evaluating their performance through testing exercises. It is expected that at the end of this project, the VR training system and an online training environment will be fully functional as well as a usable software for both emergency response workers and the general public.

**Title:** Tarteeb: Towards Designing Assistive Technologies for Improving the Communication Skills of People with Aphasia in Pakistan
**PI:** Dr. Suleman Shahid
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Behavioural Studies, Technology

**Description:** Aphasia is a neurological language disorder that can occur after a Cerebral Vascular Accident (CVA) or colloquially 'stroke'. In many cases aphasia substantially affects the patient's communicative capabilities, with an attendant effect for the quality of life of the patients and their social environment. The aim of this project was to design technological aids that assist people with Aphasia in Pakistan to improve their verbal communication skills. More specifically, this project aimed to develop two different but related solutions for improving communication skills, primarily in Urdu, and in different social contexts: (1) a mobile application platform for people with Aphasia and their caregivers (2) Virtual reality based application scenarios for people with Aphasia for improving their communication capacity.



**Title:** Design and Evaluation of Interactive Museum Experience
**PI:** Dr. Suleman Shahid
**Sponsor:** United Nations Educational, Scientific and Cultural Organization (UNESCO)
**Funding Amount:** PKR 204,500
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Education, Computer Vision

**Description:** This project focused on building capacities and mobilising resources of the staff and curators at museums in Hund and Chitral to facilitate the learning of school children of the district and general visitors regarding respective cultures and societies where these museums are located. In this project an application software was designed that navigates amongst audio visual resources installed in tablets in Chitral Museum.

**Title:** Developing Digital Aids for Early Diagnosis and Intervention of Children with Learning and Developmental Disabilities
**PI:** Dr. Suleman Shahid
**Sponsor:** Babar Ali Foundation
**Funding Amount:** PKR 3,720,000
**Project Initiated in:** 2018
**Duration:** 48 months
**Category:** Technology, Health

**Description:** There is a rough estimate that around 2 million children in Pakistan are effected by learning disabilities and majority of them are diagnosed at a very late age. This project aimed to understand and address the needs of children with learning (Dyslexia) and developmental (Autism) disabilities in Pakistan thus helping them to perform well academically and socially. For both groups, the emphasis was on helping parents, caregivers, and teachers in early diagnosis and supporting them with digital tools for improving URDU language skills (reading, speaking and eventually writing) of children with disabilities. Another key objective was to run a national prevalence study, starting from Lahore and then broadening it to Punjab, to understand the overall pervasiveness of these disabilities.



**Title:** Customizable IVR Technology for Diabetes Patients in the Global South
**PI:** Dr. Suleman Shahid
**Sponsor:** Swansea University
**Funding Amount:** PKR 568,378
**Project Initiated in:** 2019
**Duration:** 3 months
**Category:** Technology, Health

**Description:** The project introduced the idea of customizable IVR technologies that will benefit Diabetic patients with mechanisms that facilitate making care-plans to improve their lives using IVR technology. Since each Diabetic patient has a different lifestyle, the current design of IVR technology is unable to cater for their differences appropriately. In this project, through various forms of Participatory Design, these patients were allowed to build their own tailored form of IVR technologies that helped them search for solely their required information. This enabled them to manage their disease and ultimately lead more fulfilled lives.

**Title:** Persuasive Prompting as a Coping Mechanism for Depression: Towards Designing Digital Aids to Support People with Depression
**PI:** Dr. Suleman Shahid
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology, Health

**Description:** In recent years, there has been a growing concern regarding an increased occurrence of mental health disorders amongst the population worldwide and its debilitating effects on not only individual suffering but also on the economy. Depression, being the most prevalent mental illness, urges the need to test different methodologies to try and tackle the issue. One such method is the adoption of persuasive behavioural change models in prompts for mHealth applications to assist in 'prompting' the user to adopt healthier behaviours. However, the acceptability of such persuasive prompts along with the selection of behavioural change models most suitable for people suffering through depression is unknown. The main objective of this project was to create an mHealth application which not only allows depression monitoring (first time in Pakistan) but also acts as a rehabilitation tool through behaviour change persuasive prompts (a very new concept worldwide).



**Title:** Supporting Children with Disabilities with Smart Digital Aids to Become Self-reliant Members of the Society
**PI:** Dr. Suleman Shahid
**Sponsor:** Mitsubishi
**Funding Amount:** PKR 5,150,000
**Project Initiated in:** 2019
**Duration:** 18 months
**Category:** Technology, Health

**Description:** This project was focused on the reported rates of childhood intellectual disabilities in Pakistan. Often such children are marginalised by the societies, and are not accepted by main stream schools. In order to address such issues, a holistic approach was taken under consideration, (1) using online (social media and design of a web portal) and offline (community workshops with localised material) platforms to address (social) stigma and raise awareness, and (2) developing open source digital aids to assist parents, teachers and caretakers in the diagnosis and rehabilitation process.
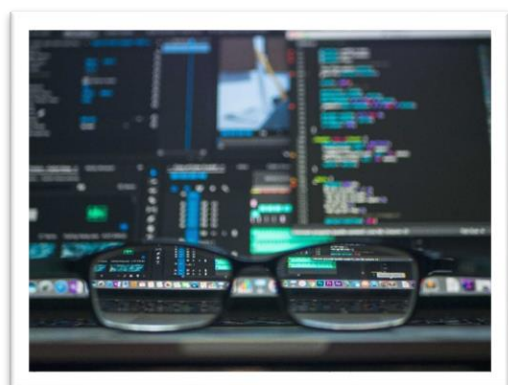
**Title:** Development of APP & Website for Shirkat Gah
**PI:** Dr. Suleman Shahid
**Co-PI:** Dr. Muhammad Fareed Zaffar
**Sponsor:** Shirkat Gah
**Funding Amount:** PKR 6,254,700
**Project Initiated in:** 2019
**Duration:** 24 months
**Category:** Technology

**Description:** The project is developing an application and a website for Human Rights Defenders (HRDs) in collaboration with Shirkat Gah Women's Resource Centre. The application and website serves as a platform to guide HRDs through the process of helping victims (often women) facing human rights issues. The application also provides a referral directory for HRDs to seek support with their cases. The application and website has information about helplines, nearest government services (police stations, hospitals, shelters, etc.), as well as a directory of laws pertaining to human rights matters.

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**Profile:** Dr. Zafar Ayyub Qazi received his PhD in Computer Science from Stony Brook University, New York in 2015 and BSc (Hons) degree from LUMS in 2009. Prior to joining LUMS, Dr. Qazi was a Postdoctoral scholar at UC Berkeley. He has also worked at Hewlett Packard Labs and AT&T Research. His research interests are in computer networks and systems. His current research focuses on the design of future cellular networks, design and management of large-scale cloud and data centre networks, and improving web and video access over the Internet in developing regions. Dr. Qazi has published multiple papers in ACM SIGCOMM, one of the premier conferences in computer networks and systems. He is also a recipient of the Google Faculty Research Award.

**Title:** Improving Web Performance over Low-end Smartphone in the Developing World
**PI:** Dr. Zafar Ayyub Qazi
**Sponsor:** Google
**Funding Amount:** PKR 1,543,750
**Project Initiated in:** 2018
**Duration:** 40 months
**Category:** Technology

**Description:** Mobile Internet access has become increasingly common in developing countries. According to the International Telecommunication Union. Despite the rising popularity of mobile Internet access in such regions, anecdotal evidence suggests that the common use of low-end smartphones and slow network connections often leads to poor user-perceived performance. Even worse, frequent memory bloat incidents (e.g., due to JavaScript allocating large objects) can lead to stalls and even crashes of web pages and other running applications (e.g., mobile browser). In this project, the aim was to (i) understand how low-end smartphones, commonly available in developing regions, impact user-perceived performance, (ii) identify bottleneck resources (e.g., memory, CPU, and network) in the page load process and understand how these bottlenecks may change over time based on device characteristics (e.g., memory sizes), network connectivity, and the web page structure and (iii) develop client-side techniques for optimising web performance by throttling the usage of memory-heavy resources (e.g., JavaScript) and processes.

**Title:** Design and Implementation of a High Performance and Scalable 5G Packet Core
**PI:** Dr. Zafar Ayyub Qazi
**Co-PI:** Dr. Zartash Afzal Uzmi
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 960,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology

**Description:** In this project, a new cellular packet core system for 5G networks that can achieve high and scalable performance was designed and developed. The designed solution once made was rigorously tested with real cellular network traces and evaluated against state-of-the-art industrial designs (e.g., Intel's EPC). As the fourth industrial revolution approaches, designing a solution to such an important problem will increase Pakistan's technology competitiveness across the globe and will help train human resource in cellular networks and specifically, in the design and implementation of cellular packet core.

**Title:** A Low Latency Cellular Control Plane
**PI:** Dr. Zafar Ayyub Qazi
**Co-PI:** Dr. Zartash Afzal Uzmi
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 960,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology

**Description:** This project is intended to design a new edge-based cellular control plane, targeted at the next generation of cellular deployments. The primary goal of this work is to provide low control plane latency while ensuring consistent UE processing in case of failures. The plan is to redesign the key cellular control plane functions: Mobility Management Entity (MME), and aggregator nodes for control traffic. As part of this work, few concepts will be re-visited (i) how user device state can be stored for fast access by control messages, (ii) speeding up the processing of control updates between base stations and MME by designing fast serialization mechanisms for cellular control traffic, and (iii) designing mechanisms for fast failure recovery while ensuring consistency.

# DEPARTMENT OF MATHEMATICS

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**Profile:** Dr. Amer Rasheed received his MPhil degree in Applied Mathematics from Quaid-e-Azam University Islamabad and PhD degree from the National Institute of Applied Sciences (INSA) Rennes France. He worked as a Lecturer in INSA, France for two and half years and taught several courses in its engineering programmes. His specialisation is in Numerical and Theoretical Analysis and Simulations of the Partial Differential Equations arising in different fields of applied sciences using Finite Element Methods.



**Title:** Transient Heat and Stress Analysis of Exhaust and Inlet Valves in a Diesel Engine
**PI:** Dr. Amer Rasheed
**Co-PI:** Dr. Naveed Ahmed
**Sponsor:** Pakistan Science Foundation (PSF)
**Funding Amount:** PKR 499,800
**Project Initiated in:** 2018
**Duration:** 36 months

**Category:** Technology

**Description:** Recent trends exhibit high interest in increased efficiency, fuel consumption, exhaust emissions and the power of automotive engines, which leads engine manufacturers/companies to further enhance engine productivity. In order to comprehend and capture the proper functioning of any engine, it is indispensable to have the knowledge of temperature and stress distribution of different parts of the engine while it is operative. The objective of this study was to apprehend the realistic temperature and stress variation on the exhaust and inlet valves while a turbo charged diesel engine is at high speed. A 3D model of the exhaust and inlet valves based on realistic dimensions was fabricated. The thermal and stress analysis was done using Finite Element Method by employing the tetrahedral meshing on the valve models.

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**Profile:** Dr. Adnan Khan was awarded his PhD from Rensselaer Polytechnic Institute in NY in 2007. His thesis was titled 'Parameterization for Some Multiscale Problems in Biology and Turbulence'. The work involved studying approaches to coarse graining of multiscale systems with applications to turbulent diffusion and protein dynamics. Prior to his doctoral work, he obtained an MS in Applied Mathematics at the University of Delaware in 2002 and a BE in Electrical Engineering from NED University of Engineering & Technology, Karachi in 1998. His current research interests involve modelling and analysis of biological systems, multiscale modelling and asymptotic analysis. Before joining LUMS, he has taught at Rensselaer Polytechnic Institute and University of Delaware. Besides his usual academic interests he is also interested in reading on subjects such as economics, philosophy, history and world literature.

**Title:** Optimal Dosing Strategies in Radiotherapy
**PI:** Dr. Adnan Khan
**Co-PI:** Dr. Sultan Sial
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 960,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Health

**Description:** Radiotherapy is an effective tool in the treatment of cancerous tumors. The effectiveness of each strategy depends on a number of factors, including the tumour volume and the surrounding organs at risk. The most common tool for determining a time-dose relationship in radiotherapy is the Linear Quadratic (LQ) model. In this study, determination of the optimal radiation dosing strategy, using the full mechanistic models was done. Moreover, it was aimed to look into whether such an approach leads to the optimal strategy being dependent on the dose ratio as implied by the LQ formalism.

# DEPARTMENT OF PHYSICS

Dr. Ammar Ahmed Khan
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**Profile:** Dr. Ammar Khan completed his PhD from the University of Cambridge. The focus of his PhD research was studying the application of disc-like (discotic) liquid crystals as whole transport layers in hybrid organic/in-organic dye-sensitized and perovskite solar cells. Furthermore, he also studied the interaction of liquid crystalline phases with two-dimensional graphene layers for display and lasing devices. Prior to his PhD, Ammar completed his Master of Philosophy (MPhil) degree in the Engineering Department at the University of Cambridge, as a member of St Edmund's College. His MPhil research was focused on the development of random lasers using Organosiloxane Smectic a liquid crystals as a distributed resonant cavity. Ammar is also a LUMS alumni and graduated from LUMS with a BS in Electrical Engineering.

At present, the focus of Dr. Ammar's research is understanding self-assembly mechanisms of liquid crystalline physical gels, and applying them to DSSCs to increase the stability and lifetime.
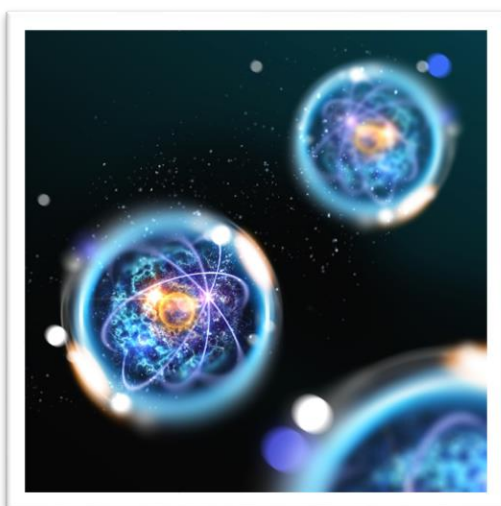
**Title:** Self-Assembled Liquid Crystalline Hole Transport Layers and Physical-Gels for Hybrid Dye Sensitized and Perovskite Solar Cells
**PI:** Dr. Ammar Ahmed Khan
**Co-PI:** Dr. Habib-ur- Rehman
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 14,363,818
**Project Initiated in:** 2019
**Duration:** 36 months
**Category:** Natural Sciences

**Description:** This project was aimed to conduct experimental as well as simulation studies on the application of self-assembling discotic liquid crystalline (DLC) materials to dye sensitized solar cells (DSSCs) and perovskite solar cells (PSCs). DSSCs and PSCs both suffer from stability challenges, due to evaporation of the electrolyte and degradation of the semiconducting materials, respectively. Solving these challenges (combined with their low fabrication costs) will make these technologies competitive with both silicon photovoltaics as well as fossil fuel based electricity generation. This research attempts to address both challenges using mesophasic materials in novel device architectures.
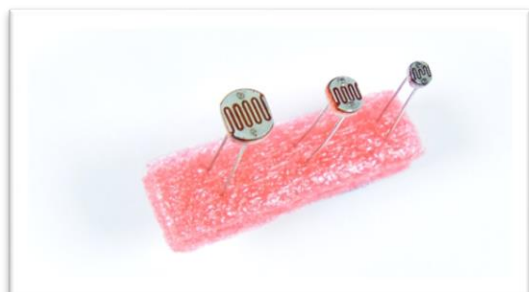
**Title:** Two and Three Dimensional Mixed-Halide Perovskite Solar Cells
**PI:** Dr. Ammar Ahmed Khan
**Co-PI:** Dr. Habib-ur- Rehman
**Sponsor:** Faculty Initiative Fund (LUMS)
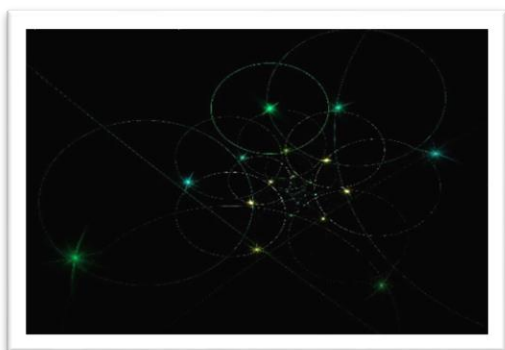**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Natural Sciences

**Description:** This project aimed to develop melt-filled-HTL (hole transport layer) photovoltaic devices using liquid crystalline organic semiconductors as the HTLs and Methyl-ammonium Mixed-Halide Perovskites as the light absorbing active layers for the solar cells. The liquid crystalline layers show fast charge transport, directed self-assembly and can be melt-processed at low-temperatures. The layers were doped by novel p-type dopants prepared in the Department of Chemistry at LUMS, and the optoelectronic properties of the doped-HTLs will be characterized. This research work took the project team closer towards the development of state-of-the-art hybrid photovoltaic devices, while also allowing them to develop local capability for versatile perovskite film preparation. The latter capability allows the team to support other research endeavours such as the fabrication of perovskite films with embedded colloidal quantum dots (collaborative external grant submitted to HEC as co-PI), as well as allows them to explore applications such as perovskite based X-Ray detectors.



**Title:** Smart Patterned Liquid Crystal Electrically-Modulated Optoelectronic Devices
**PI:** Dr. Ammar Ahmed Khan
**Co-PI:** Dr. Ata Ulhaq
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Natural Sciences, Technology

**Description:** This project aimed to use Liquid Crystals in a series of different device architectures to take advantage of their electrically tunable properties, as well as use the architectures themselves to control LC molecular alignment. Furthermore, the interaction of LCs with micro-structures (lithographically designed) as well as two-dimensional materials (2-D perovskites, graphene and molybdenum Disulphide) can be used in two days. Firstly, the alignment of the LC materials can be initialised differently depending on the surface. This allows study of various topological defects in the LC texture as well as control how light and applied AC fields interact with the LC layer. Secondly, the electrically tunable LC alignment was used to modulate characteristics as well as interactions of the underlying layer through a change in refractive index and low frequency dielectric permittivity, leading to optoelectronic control in photonic devices. The project was aimed to setup state-of-the-art LC micro-fabrication techniques at LUMS.

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**Profile:** Dr. Ata Ulhaq is an experimental Physicist, who works on growth and study of structures, which exhibit clear quantum character. His work is concentrated on developing specialised light sources using nanoscale structures, which can generate quantum light.

Such sources form an essential part of quantum communication and cryptography schemes. Another major stream of his work is optical control of isolated spins in nanoscale structures. Spin is a quintessential quantum entity and solid-state devices based on initialization and control of spin are one of the central ingredients of proposed quantum computation, metrology and simulation schemes.
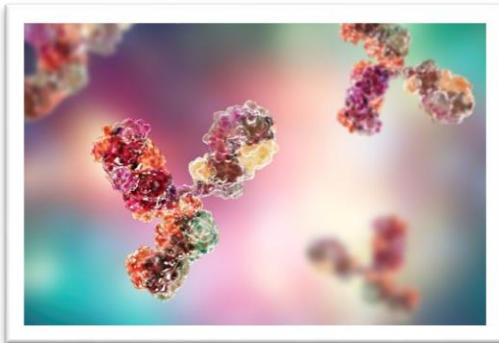
**Title:** Confocal Raman Imaging of Single Cancer Cells
**PI:** Dr. Ata Ulhaq
**Co-PI:** Dr. Amir Faisal
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 990,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health, Technology

**Description:** In this project, a non-invasive imaging technique capable of probing biochemical signatures within a single cancer cell was developed. The proposed imaging technique was based on Raman spectroscopy which is a well-known technique for non-invasive chemical analysis. Raman spectroscopy was coupled with a confocal microscopy configuration which enables chemical investigations on a micron scale. The project was highly interdisciplinary utilising expertise in Physics, Biology and computer programming. As a result of the project, LUMS has a state-of-the art chemical imaging facility which will be of immense value not only for cancer research but will also aid in research of the faculty and graduate students from different disciplines.

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**Profile:** Dr. Muhammad Faryad received his BSc degree in Mathematics and Physics in 2002 from the University of Punjab, MSc and MPhil degrees in Electronics from the Quaid-i-Azam University in 2006 and 2008, respectively, and PhD degree in Engineering Science and Mechanics from the Pennsylvania State University in 2012. He worked as a lecturer at the Quaid-i-Azam University from 2007 to 2009, as a postdoctoral scholar in the Pennsylvania State University from 2012 to 2014, and as an Assistant Professor at LUMS from 2014 till present. He is also serving as the chair of the Department of Physics since 2018.

**Title:** Specific Absorption Rates of Human Body Parts Illuminated by Mobile-phone Microwave Radiations
**PI:** Dr. Muhammad Faryad
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology, Health, Natural Sciences

**Description:** This project consisted of two parts. In the first part, model of the human body as an elongated sphere and compute the total absorbed power for plane wave radiation to model the effect of far-away sources (mobile phone tower, Wi-Fi transceiver etc.) was developed to study the effect of the size and composition of the human body as well as the frequency of the radiation. The second part of the project involves the modelling of the body with a head, abdomen, legs, and arms that is illuminated by a nearby source as a dipole antenna (like the one in mobile phones). The goal of the second part was to assess the absorption in different body parts when the antenna is placed in different locations near the body. The first part was implemented using the modal expansion approach using the spheroidal wave functions and the second part was accomplished using the finite element method. This study provided an assessment of health hazards associated with living in a sea of radiations and some general guidelines as to the optimal locations of the mobile phones near the human body to reduce the absorption of radiations.

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**Profile:** Dr. Muhammad Sabieh Anwar is Professor of Physics, Ahmad Dawood Chair and Dean at SBASSE. He helped establish the Department of Physics at LUMS and was among the principal founders of the School's experimental facilities and curriculum. Ideas from his physics instructional laboratories have been replicated in ten other Pakistani universities. He has played an important role in introducing innovative learning tools, mostly revolving around insightful home-grown physics experiments, in Pakistan's universities. His lectures are interspersed with in-class live demonstrations and are widely viewed over the internet. Dr. Sabieh's research interests encompass spintronics, magnetism and optics.
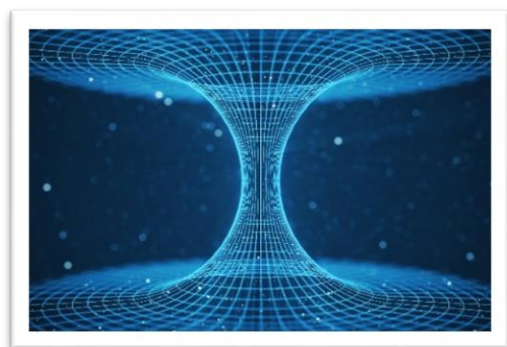


**Title:** First Steps Towards Establishment of a Laboratory for the Ultrafast Characterization of Spintronic, Photovoltaic and Quantum Materials
**PI:** Dr. Muhammad Sabieh Anwar
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 16,373,907
**Project Initiated in:** 2020
**Duration:** 24 months
**Category:** Natural Sciences

**Description:** This project aimed to establish an experimental facility that allowed characterisation of physical processes on the ultrafast (>femtosecond) time scales. This is achieved by a femtosecond laser oscillator in which the active medium is a titanium-sapphire single crystal. The seed pulse is split into two pulses, a pump beam that falls onto the sample of interest and a subsequent pulse, called the probe delayed by a time interval ranging from femtoseconds to nanoseconds that subsequently negotiates the out-of-equilibrium state of the material as a function of time. Spatial sampling of the beams will also give the possibility of spatial mapping of processes. The processes that were investigated as test experiments are novel and include some interesting aspects in the burgeoning field of Femtomagnonics. This work provided impetus to foray into topological materials and will also become the stepping stone for follow-up and alternative funding applications to purchase additional components that will allow a complete setup to be built that utilises higher energy pulses allowing us to access non-perturbative regimes and excitations far from equilibrium.
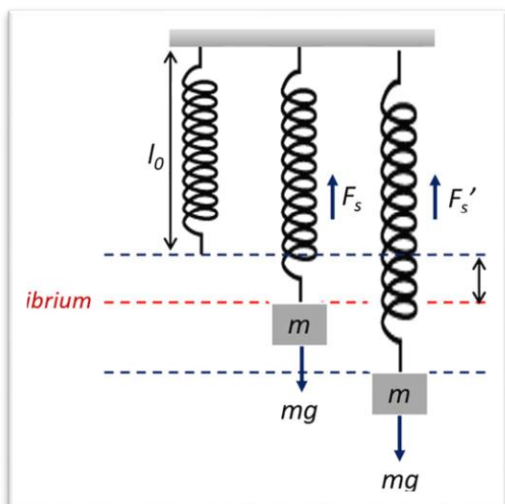
**Title:** Development of Physics Experimentation for PIEAS, Phase 1
**PI:** Dr. Muhammad Sabieh Anwar
**Sponsor:** Pakistan Institute of Engineering and Applied Sciences (PIEAS)
**Funding Amount:** PKR 100,000
**Project Initiated in:** 2018
**Duration:** 1 month
**Category:** Natural Sciences

**Description:** The Physlab has recently replicated three of its own in-house experiments for PIEAS, Islamabad. These include a very interesting apparatus to gauge energy conservation in two dimensions, tracking the simple harmonic motion of a mass attached to a spring using a webcam and a mind-boggling experiment of coupled harmonic oscillations called the Wilberforce pendulum.

The project yet again exhibits a never-ending commitment to foster a culture of practical exploration-oriented science not just at LUMS but all across Pakistan.



**Title:** Development of Physics Experimentation for PIEAS, Phase 2
**PI:** Dr. Muhammad Sabieh Anwar
**Sponsor:** Pakistan Institute of Engineering and Applied Sciences (PIEAS)
**Funding Amount:** PKR 210,000
**Project Initiated in:** 2018
**Duration:** 5 months
**Category:** Natural Sciences

**Description:** Physlab completes the second phase of the technology transfer project to PIEAS, Islamabad. In this phase, the institute has been supplied with experimental setups to study magnetism, thermodynamics, and low-temperature cryogenics. The technology transfer and indigenous development of scientific equipment for lab-scale research and physics instruction reiterate our commitment to self-reliance and we hope to see the similar passion for instrument-building in institutions across Pakistan. Instruments can become windows to the mind. A slavish attitude towards importing expensive equipment jeopardises are ability to readily, expediently and experiment with physics. It hampers learning, kills the desire to build and create new experiments and stifles the learning process.

**Title:** Design and Production of Scientific Equipment for Physics Teaching and Research
**PI:** Dr. Muhammad Sabieh Anwar
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 13,394,000
**Project Initiated in:** 2019
**Duration:** 24 months
**Category:** Business & Innovation, Education, Technology

**Description:** This project is a close synergy between an academic institution, LUMS, and one of Pakistan's most active small to medium scale mechanical and electromechanical industry, Usman Industries which is a descendant of Sun Engineers. This project aimed to create an array of scientific equipment and associated literature to assist in the twofold areas of (a) physics instruction inside the laboratory and (b) experimental research. Commercial-quality, low-cost, modular, reconfigurable laboratory experiments in all branches of Physics were designed in this project. These experiments conform to the guidelines proposed by the HEC in the revised physics curriculum from 2013. These were innovative, insightful and fascinating experiments. The idea was to keep the designs in full compliance with the open-source hardware model and the open source movement so that we could, through this project trigger the development of a community that could create experiments for their students.



**Title:** Design and Development of Electromagnetic & Thermodynamics Experimental Suite for PIEAS
**PI:** Dr. Muhammad Sabieh Anwar
**Sponsor:** Pakistan Institute of Engineering and Applied Sciences (PIEAS)
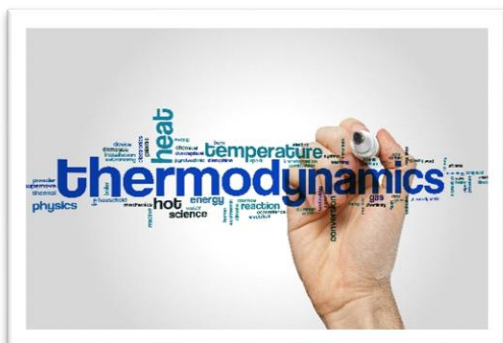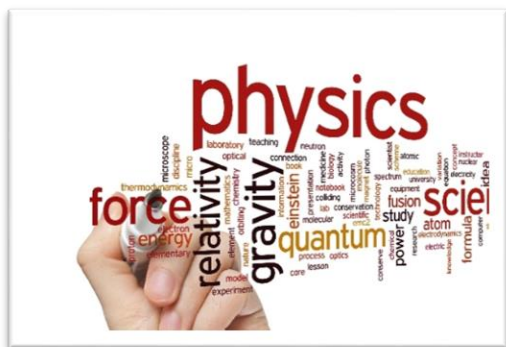**Funding Amount:** PKR 850,000
**Project Initiated in:** 2019
**Duration:** 6 months
**Category:** Technology

**Description:** The Physlab has recently replicated three of its own in-house experiments for the Pakistan Institute of Engineering and Applied Sciences (PIEAS), Islamabad. These include a very interesting apparatus to gauge energy conservation in two dimensions, tracking the simple harmonic motion of a mass attached to a spring using a webcam and a mind-boggling experiment of coupled harmonic oscillations called the Wilberforce pendulum. The project exhibits never-ending commitment to foster a culture of practical exploration-oriented science in Pakistan.

**Title:** Design and Development of Electromagnetic & Thermodynamics Experimental Suite for National University of Technology (NU-TECH)
**PI:** Dr. Muhammad Sabieh Anwar
**Sponsor:** NU-TECH
**Funding Amount:** PKR 1,810,000
**Project Initiated in:** 2019
**Duration:** 2 months
**Category:** Technology

Description: The project consisted of crafting seven experimental setups including:

- Craters in sand
- Newton's cradle observed by video tracking
- Oscillations observed through webcam
- Rotational mechanics and angular momentum
- Collisions on an air track and conservation of momentum
- Dynamics of water discharge through a cylinder
- Energy conservation in two dimensions

The equipment included home-grown data loggers (Physlogger), handcrafted apparatuses for rotational mechanics, home built mass balances (Physload), a linear air track with 3D printed gliders and home-made photo-gates for the study of conservation of momentum, webcams and software codes for video tracking simple harmonic motion, studying the mechanisms of crater formations and observing the transfer of energy and momentum in the famous Newton's cradle. All of the locally developed hardware has been crafted with the support of Qosain scientific under HEC's Technology Development Fund programme.

# MUSHTAQ AHMAD GURMANI SCHOOL OF HUMANITIES AND SOCIAL SCIENCES (MGSHSS)

# DEPARTMENT OF ECONOMICS

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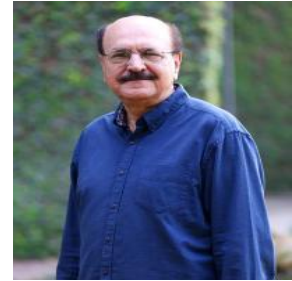
**Profile:** Dr. Abid Aman Burki is an economist, policy analyst and a Professor of Economics at LUMS. He has also been the Graduate Programme Director Economics at LUMS from 2002 to 2020. He is a faculty member of the LUMS Economics Department since 2002. From 2003 to 2010, Dr. Burki was Director of the Centre for Management and Economic Research at the University. Prior to joining LUMS, he has been a Professor (1999-2002) and Head of Economics Department (2000 − 2002) at the Quaid-i-Azam University where he has held other academic positions since 1985. He has also taught at the Kansas State University and Bahauddin Zakariya University.

His main current research areas are in technical efficiency and productivity, dairy sector, health sector, agriculture sector, industrial sector, inequality and poverty. He has authored and co-authored more than 100 articles, book chapters and professional reports. His academic research has appeared in *World Development*, *Energy Economics, Applied Economics, Journal of Economics & Business, Land Use Policy, Journal of Development Effectiveness, Economics Bulletin, Pakistan Development Review* and other journals.

**Title:** Addressing Yield Gap of Dairy Farms to Increase Productivity in Selected Districts of Punjab: A Spatial Analysis
**PI:** Dr. Abid Aman Burki
**Co-PI:** Ms. Kinza Emad
**Sponsor:** Tetra Pak
**Funding Amount:** PKR 6,060,500
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Economic Development

**Description:** The project focused on studying the gap analysis between model farm that has optimal productivity (could be taken from a global standard) and farms within the subject area. Practical recommendations were also made for increasing efficiencies. Furthermore, this study explores detailed routes to milk market with the aim to investigate where the agents supply milk, how they supply and at what cost. It is also desirable to seek micro-data of the livestock census possessed by the Livestock Department.

**Title:** Exploring Dimensions of Inequality in Pakistan
**PI:** Dr. Abid Aman Burki
**Co-PI:** Ms. Kinza Emad
**Sponsor:** Chanan Development Association (CDA)
**Funding Amount:** PKR 1,800,000
**Project Initiated in:** 2019
**Duration:** 5 months
**Category:** Behavioural Studies

**Description:** The purpose of the study was to clearly understand multiple dimensions of inequality in Pakistan and to identify various patterns of exclusion. The findings of the study influenced and shaped national development discourse among policymakers and informed programmes aimed at mitigating the challenges of rising inequality in Pakistan.

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**Profile:** Dr. Agha Ali Akram is an Assistant Professor in the Department of Economics at LUMS. He received his Doctorate in Environmental Economics (2014) and Masters in Environmental Management (2008) from Yale University. Prior to joining LUMS, he was a Visiting Fellow at Yale University (2016-2017) and a Postdoctoral Fellow at Evidence Action (2014 - 2016), where his research delved into the impact of seasonal income support programmes on mitigating hunger risk in Bangladesh and the impact of innovative conditional cash transfer mechanisms on improving vaccination rates in Pakistan.

Dr. Ali's research explores themes in public health, including drinking water quality, mental health, nutrition and family planning. His work uses field experiments to test innovations in these research areas, both in Pakistan and outside.

**Title:** A Randomized Controlled Trial to Assess Effectiveness of the In-Home Growth Monitoring Tool (GroMoTo) in Addressing Childhood Stunting
**PI:** Dr. Agha Ali Akram
**Sponsor:** Shahid Hussain Foundation/Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,563,000/999,500
**Project Initiated in:** 2018
**Duration:** 26 months

**Category:** Behavioural Studies, Health

**Description:** The study was focused on caregivers from disadvantaged communities in developing countries that do not receive adequate, direct, and regular feedback on the growth-trajectory of children in their care. To this end, this project proposes a solution, an easily implementable, flexible, and low cost in-home growth monitoring tool called GroMoTo and intends to test its effectiveness with an open-label randomised controlled trial. GroMoTo requires community health workers (CHWs) to help caregivers measure their children's height, record those measurements on a poster-sized chart installed inside the home, and help caregivers understand where their children stand in relation to healthy growth norms. The major goal of the proposed project was to demonstrate feasibility of GroMoTo while generating evidence to support a bid for a larger trial.

**Title:** Keeping it Fresh: Impact of Temperature and Humidity Regulating Storage Technology on Tomato Street Vendors in Pakistan
**PI:** Dr. Agha Ali Akram
**Co-PI:** Dr. Saher Asad
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Economic Development, Technology

**Description:** The main aim of this project was to first develop and then study the impact of a low-cost storage technology on shelf life, profit margin and market behaviour of street vendors selling tomatoes in Pakistan in order to improve food security and ensure a continuous supply of fresh food. Results from this study were leveraged to apply for larger sources of funding to test the idea at a larger scale.



**Title:** Youth Readiness Initiative
**PI:** Dr. Agha Ali Akram
**Co-PI:** Dr. Saher Asad
**Sponsor:** Innovations for Poverty Action (IPA)
**Project Initiated in:** 2019
**Duration:** 1 month
**Category:** Economic Development, Health

**Description:** The overarching aim of this proposal was to develop an improved understanding of the broader mental health benefits of the Youth Readiness Intervention (YRI) among peers and caregivers of youth receiving the intervention in Sierra Leone.

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**Profile:** Dr. Ayesha Ali is an Assistant Professor in the Department of Economics, MGSHSS. She recently obtained her PhD in Economics from the University of Toronto, Canada in 2016 after completing her MA in International Policy Studies from Stanford University, MA in Economics from University of British Columbia and Bachelor's in Economics & Finance from McGill University, Canada.

Dr. Ali's current research is in the field of development and energy economics with a special focus on electricity markets and electricity demand in developing countries. Her PhD dissertation examined the effect of electricity shortages on household income and employment in Pakistan. She is also working on a project examining the development policies of dynastic politicians in Pakistan. Prior to starting her PhD, she worked as an Economic Policy Consultant for the World Bank and USAID. Her research interests include Energy Economics, Consumption and Political Economy.
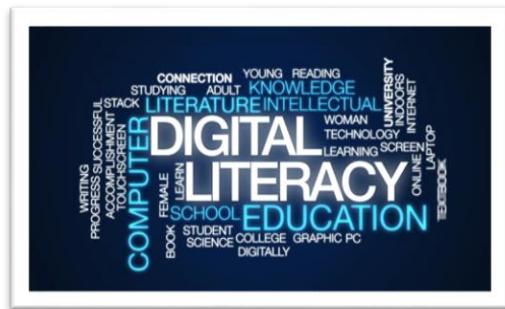
**Title:** Understanding the Impact of Digital Literacy on Misinformation in Pakistan
**PI:** Dr. Ayesha Ali
**Co-PI:** Dr. Ihsan Ayyub Qazi
**Sponsor:** Facebook
**Funding Amount:** PKR 6,986,250
**Project Initiated in:** 2019
**Duration:** 48 months
**Category:** Technology

**Description:** This project aimed to answer two questions: (i) among populations with low digital literacy, how do users perceive, consume and engage with non-textual misinformation (such as audio deepfakes)? And what is the role of prior beliefs and analytical ability in forming perceptions about the accuracy of misinformation? And (ii) How can we educate users to identify non-textual misinformation (e.g., audio messages impersonating public figures). A survey and experiment for measuring the role of prior beliefs and analytical reasoning in determining beliefs about non-textual misinformation was conducted. To measure the perceived accuracy of misinformation, users were presented with news stories (true and false news presented as audio deepfakes), randomly varying the content and the personality. Finally, the researchers designed and experimentally evaluated an educational intervention for low digital literacy populations that relies on key influencers within communities to disseminate awareness messages.

**Title:** Understanding the Impact of Misinformation on Political Views in Pakistan
**PI:** Dr. Ayesha Ali
**Co-PI:** Dr. Ihsan Ayyub Qazi
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 995,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology, Political Sciences

**Description:** The proliferation of mobile phones in developing countries has led to the widespread use of social media and messaging services, such as WhatsApp, Facebook and Twitter, making them an important source of news as well as platforms for social and political activity. The nation is concurrently observing an increasing trend in the spread of misinformation on such platforms meant to mislead users as evidenced by a slew of recent events. In this project, a randomised control experiment was conducted to understand how factors, such as diversity in the social network and characteristics of news stories, affect the spread of misinformation on social media and impact users' political preferences in a developing country like Pakistan. The results of this project can also help to understand what can be done to improve the design and user experience of social media applications to counter the spread of misinformation.

**Title:** Understanding the Impact of Deep Fakes on the Spread of Political Misinformation
**PI:** Dr. Ayesha Ali
**Co-PI:** Dr. Ihsan Ayyub Qazi
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology, Political Sciences

**Description:** Since the advancement of industrial age, the use of social media has rapidly enhanced, however with its perks comes its disadvantages as well. One of them is dissemination of misinformed political facts. This trend is expected to be exacerbated with recent advances in artificial intelligence that have given rise to a new technique called deepfakes, that allows any individual's voice or video to be accurately faked. A distinctive feature of deepfakes is that they are able to replicate key sources of an individual's identity with which people generally associate trust. Thus, deepfakes can make it highly challenging for determining the legitimacy of information presented online and more so for users in developing countries with lower levels of literacy. In this project, a series of lab experiments were conducted to understand how factors, such as format of the news (deepfakes or text messages), the content of news, and the individual emulated in a deepfakes, affect users' beliefs and sharing behaviour. The results of this project can help understand how deepfakes are perceived and acted upon by users, which can help provide ways to identify deepfakes (especially among populations with lower levels of digital literacy) guide potential policies and regulations around deepfakes.

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**Profile:** Dr. Faisal Bari is an Associate Professor of Economics at LUMS. He is also the Dean and Director of Academic Programmes at the Syed Ahsan Ali and Syed Maratib Ali School of Education at LUMS. His current teaching interests are in the areas of economics of education, game theory, microeconomics and industrial organization. His research interests are also in the same areas. He writes a fortnightly column for the daily *Dawn*.

**Title:** Improving Contraceptive Uptake: Improved Access, Cost of Children and Social Anxiety
**PI:** Dr. Faisal Bari
**Co-PI:** Dr. Agha Ali Akram
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Health, Social Sciences

**Description:** Pakistan's contraceptive prevalence rate (CPR) is amongst the lowest in the South Asia region, at just 26%. In urban Punjab, the CPR is 32%, which is driven by condom usage at 14%. This low-rate is a product of several challenges both on the supply-side and the demand-side. In light of these facts, a supply-side and demand-side intervention was proposed in this project. The supply-side intervention will provide improved anonymised access to condoms through an on-demand home-delivery service taking advantage of low-cost intra-city delivery. It was hypothesised that the anonymised and discrete nature of door-step delivery will increase demand. The demand-side intervention will aim to increase demand for contraceptive use using a counselling session for cost-accounting of child expenditures to help parents understand the full costs of a child to them. It was further hypothesised that the costs of having children are not fully understood by people, especially the poor. By understanding the high-cost of children, couples may reduce the likelihood of having more children by increasing contraceptive use, thereby addressing the population explosion issue.

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**Profile:** A Fulbright Scholar, Dr. Hadia Majid holds a PhD in Development Economics from The Ohio State University. Her research interests include economics of the household, parental decision-making, and human capital acquisition. Her earlier work evaluates the Mexican conditional cash transfer program at the intra-household level, the micro-impacts of the Lahore Metro bus, and the impacts of inequality on public goods access and charitable giving. Currently, she is focused on labour markets. Here, her projects include mapping various aspects of the female labour force participation in Pakistan over the past 30 years, examining the constraints and vulnerabilities of women in the urban informal economy, the status of Decent Work in rural Pakistan for men and women, the links between macroeconomic growth and gendered employment, the impact of BISP on women's labour market outcomes and decision-making, and workplace harassment among female factory worker.



**Title:** Transforming Women's Lives: An Evaluation of the Impact of BISP on the Socio-Economic Well-Being of Women
**PI:** Dr. Hadia Majid
**Co-PI:** Ms. Syeda Warda Riaz
**Sponsor:** Punjab Commission for Status of Women (PCSW)
**Funding Amount:** PKR 495,000
**Project Initiated in:** 2018
**Duration:** 3 months
**Category:** Social Sciences

**Description:** This study was focused on identification of whether the cash transfer given as a part of the Benazir Income Support Program (BISP) has resulted in improved outcomes for women. A range of socio-economic outcomes were measured, all of which have a bearing on the overall well-being of women. Specifically, it estimated the effect (if any) of receiving BISP on the ownership of time-saving durable assets to gauge the contribution of BISP in reducing time poverty for women.

**Title:** Online Teaching Platforms: A Panacea to Pakistan's Educational Woes?

**PI:** Dr. Hadia Majid
**Co-PI:** Dr. Agha Ali Akram
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Economic Development, Education

**Description**:  In the face of a spiralling upward demand for education, the pressure on students to secure top marks in national matriculation and intermediate exams is tremendous. In this scenario, there is a rise in students resorting to tuition centres which may act either as substitutes for or complements to the conventional education system. This study proposed an online education platform that would connect students to classes provided by teachers known to deliver results. It fills the vacuum for those students that lack access, while also supplementing access to quality material to those who are looking to score well on their exams.

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**Profile:** Dr. Karrar Hussain completed his PhD in Economics from University of South Carolina (USC). He did his Masters in Public Administration International Development (MPA-ID) from Harvard Kennedy School. He has worked as a post-doctoral fellow at University of California at San Diego. He was a research fellow at Evidence for Policy Design (EPoD), Harvard Kennedy School. His research interests include development theory and policy, experimental and behavioural economics.



**Title:** Brexit and Trade Mis-invoicing in Developing Countries: Quasi-Experimental Evidence from Pakistan
**PI:** Dr. Karrar Hussain
**Co-PI:** Ms. Zara Liaqat
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 700,000
**Project Initiated in:** 2020
**Duration:** 3 months
**Category:** Behavioural Studies, Political Sciences, Trade

**Description:** In this project, theoretical and empirical evidence measuring the scale of under-invoicing in the context of a developing country was offered. Further, it involved an introduction of a simple estimation technique whereby Brexit is treated as a quasi-natural experiment affecting the cost of imports through a depreciation of the pound.

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**Profile:** Dr. Kashif is a Fulbright Scholar and has a Masters and PhD in Economics from Florida State University. His research areas include applied economics, applied macroeconomics, time-Series econometrics and microfinance. Dr. Malik started working in the area of microfinance in 2012. Since then he has won a number of research grants to explore and empirically test risk-sharing products. He is currently implementing three randomised control trials (RCT) of an equity-based asset finance product in collaboration with researchers from University of Oxford and a microfinance institutional partner, such as Akhuwat and NRSP. One of the studies was successful in securing one of the most competitive funding awards-from Innovation for Poverty Action (IPA), funded by Bill and Melinda Gates Foundation, as part of their financial inclusion programme that aims to test innovative new models for poverty alleviation through financial inclusion.



**Title:** Socio-economic Impact of Coca-Cola Beverages Pakistan Limited (CCBL) on Pakistan's Economy
**PI:** Dr. Kashif Z. Malik
**Sponsor:** Coca-Cola
**Funding Amount:** PKR 1,897,500
**Project Initiated in:** 2019
**Duration:** 2 months
**Category:** Behavioural Studies, Trade

**Description:** The primary objective of this study was to explore and measure the economic impact of CCBPL on Pakistan's economy in terms of income, job creation and tax contributions. The study also assed the direct and indirect effects CCBPL has produced in the economy. It employed input-output analysis to measure the economic impact. Further, the Social Accounting Matrix was used to measure the direct, indirect and induced impact of CCBPL on the nation's economy.

**Title:** Providing Affordable Housing for Low-income Households Using Shared-ownership Contracts
**PI:** Dr. Kashif Z. Malik
**Co-PI:** Mr. Muhammad Meki
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Economic Development

**Description:** Providing innovative solutions to the shortage of affordable housing for the poorest members of society is a critical policy challenge in many countries, especially in Pakistan, which faces a shortage of 10 million housing units. This project aimed to develop an innovative housing finance product, based on the principles of ownership and risk sharing in Islamic finance, and in collaboration with one of the largest and fastest growing microfinance institutions in Pakistan, Akhuwat. The objective of this project was to develop an innovative risk-sharing product that is financially sustainable and may in the future help provide affordable housing to millions of low-income households.

Dr. Muhammad Farooq Naseer

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**Profile:** Dr. Farooq Naseer is a development economist with interests in education, human development, and political economy. He regularly teaches quantitative research methods (econometrics) to undergraduate and graduate students at LUMS. Earlier, he has also taught development, data science and microeconomics. His work often requires the use of empirical methods with rich micro-data from household and community surveys to study issues ranging from poverty and vocational skills to political competition and learning outcomes in schools. He is actively engaged in several research collaborations that deal with policy impact, and continues to present his work at international as well as local academic and policy forums.
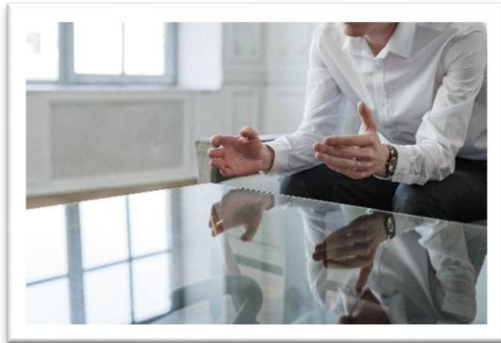
**Title:** Hiring of Firm for Technical Advisory Services for Tracer Study 2018

**PI:** Dr. Muhammad Farooq Naseer

**Sponsor:** Punjab Skills Development Fund (PSDF)

**Funding Amount:** PKR 1,227,692

**Project Initiated in:** 2018

**Duration:** 14 months

**Category:** Economic Development

**Description:** The objective of this assignment was to collect data to get a sense of the mid-programme impact of the SDP, as well as tracing PEOP graduates, with respect to employment and income generation results, and to gather feedback from employers.

**Title:** Technical Expertise for the Project 'World Bank Tracer Study under DLI-5'

**PI:** Dr. Muhammad Farooq Naseer

**Sponsor:** Abacus Consulting

**Funding Amount:** PKR 1,006,154

**Project Initiated in:** 2019

**Duration:** 3 months

**Category:** Economic Development

**Description:** The project was used to identify the relevance of Technical and Vocational Educational Training (TVET) education in preparing students for their transition to the labour market. In this instance, the Graduate Tracer Study included a standardised and centralised survey of graduates from Punjab Skills Development Fund (PSDP) supported TVET institutions approximately 6 months after graduation.

Dr. Rashid Memon
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**Profile:** Dr. Rashid Memon continues to pursue interests in the role of social identity in economic interaction using survey and experimental data. His current work focuses on post-recruitment discrimination in a lab setting. In collaboration with Professor Sheheryar Banuri, He is exploring how colleagues and supervisors may undervalue the merit of members of subaltern groups. In another study, he is exploring whether the success of members of subaltern groups generates a backlash from colleagues. He remains interested in the link between political identity, labour rioting violence and economic outcomes.

**Title:** Cheating and Social Norms
**PI:** Dr. Rashid Memon
**Sponsor:** Utah State University
**Funding Amount:** PKR 197,995
**Project Initiated in:** 2018
**Duration:** 2 months
**Category:** Behavioural Studies

**Description:** The purpose of the research was as follows: 1) To understand the role played by social norms with dishonesty; 2) To examine the relationship between the perception of prescriptive social norms of different types (consequentialist, deontic, etc.) with descriptive norms and behaviour. 3) To examine how prescriptive social norms and sanction mechanisms for transgressions of social norms vary according to social distance and in societies with complex structures of extended family networks.

**Title:** Backlash against Women due to Quotas and Anti-Harassment Policies: Evidence from the Lab.
**PI:** Dr. Rashid Memon
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 770,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Behavioural Studies

**Description:** This study outlines a lab experiment to measure backlash to policies that empower subaltern groups, in this case, women. In a unified framework, the experiment allows us to ask a series of questions about discrimination and backlash, of which two are original and push the frontiers of knowledge in this field; the others provide local (but new) evidence to old questions.

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**Profile:** Dr. Turab Husain's research interests have ranged from migration theory and policy, poverty and rural development to trade and development. Recently published research has been on industrial policy, migration and remittances, prospects of trade with India, and on Pakistan's experience at dispute settlement within the WTO. His teaching interests are in development theory, international trade, macroeconomics and trade and development.



**Title:** Pakistan Research on Current Economic Environment for SMEs
**PI:** Dr. S. M. Turab
**Co-PI:** Ms. Nazish Afraz
**Sponsor:** Facebook
**Funding Amount:** PKR 20,096,681
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Economic Development

**Description:** The project was focused on understanding the use of Facebook and online platforms by small and medium businesses in Pakistan. It also explored the barriers and challenges faced by businesses in using social media effectively for business marketing and growth. The study also helped in documenting and analysing the policy landscape affecting use of social media and online platforms by SMBs in Pakistan and understand provincial differences in policies and their implementation.

The research was nationwide and covered all four provinces of Pakistan and the federally administered regions (Islamabad and Gilgit Baltistan). Focus groups were conducted in each province, 15-17 in total, and capture a diversity of types of businesses as well as small and medium business owners. A desktop analysis of existing policies was used to analyse existing legislation and in-depth interviews with select business leaders and policymakers will help ascertain the efficacy of these policies.

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**Profile:** Dr. Saher Asad has been working as an Assistant Professor of Economics at LUMS. She received her PhD in Economics from George Washington University in 2015. In her research, she collected novel data sets in Pakistan and utilised them to study the socio-economic impacts of modern information and communication technologies (ICTs) in Pakistan.

**Title:** Newsworthy or Trustworthy? The Impacts of Increasing Competition in the Pakistan News Media Industry
**PI:** Dr. Saher Asad
**Co-PI:** Dr. Ayesha Ali
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Behavioural Studies, Economic Development, Education, Telecommunications

**Description:** In this project, firstly quantitative indicators of news media quality were developed, and the performance of these indicators were compared to the traditional viewership measures using a randomised experiment. Viewers were randomly assigned to evaluate news content using the assessment tool developed under this project, and the traditional subjective viewership indicator. Results from this study addressed the question of the relationship between news media quality indicators and demand. In the second step, the impact of news channel entry on the quality of programing in incumbent channels was studied. Here the quality of content was assessed using archives of talk shows and news bulletins shown by the incumbent channels around the time of new channel entry. This was accomplished using the quantitative assessment tools designed in the first step. The results from the second phase of the project were used to determine the causal impact of increase in competition on indicators of quality.

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**Profile:** Dr. Sanval Nasim is Assistant Professor of Economics at LUMS. His primary research field is environmental and natural resource economics. His research work includes behavioural experiments on air pollution forecasts and information based pollution mitigation interventions, optimal control modelling of water resources, and cost benefit analysis of clean technology adoption. He obtained his PhD in Environmental and Natural Resource Economics from the University of California, Riverside in 2015 and a BA in Economics Mathematics and in History from Colby College in 2008.

**Title:** Do Pakistanis Value Air Pollution Information? Should They?

**PI:** Dr. Sanval Nasim

**Co-PI:** Arman Rezaee-University of California, San Diego

**Sponsor:** Faculty Initiative Fund (LUMS)/ International Growth Centre (IGC)

**Funding Amount:** PKR 990,000/ 11,832,839

**Project Initiated in:** 2019

**Duration:** 20 months

**Category:** Behavioural Studies, Environment

**Description:** This project explored the issue of air pollution in Pakistan—a pressing topic in the country. Through an experimental design (randomised controlled trial), the project advances knowledge about Pakistanis' willingness to pay for air pollution information, as well as their ability to forecast air pollution, and how these values depend on complementary avoidance information. The project contributes to active literatures in economics, environmental sciences, and climate change adaptation that lack good measures of such important values. The study of forecasting also advances the more general literatures on belief formation and updating, and on investment decision-making in the developing world.
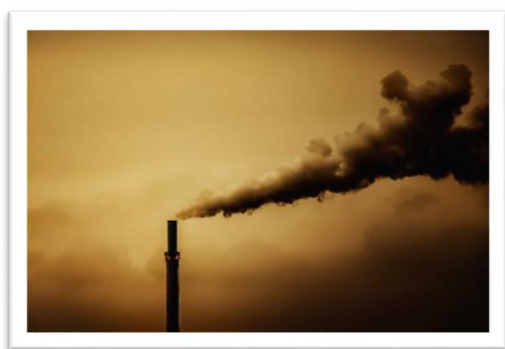
**Title:** Air Pollution Lahore
**PI:** Dr. Sanval Nasim
**Sponsor:** Multiple sponsors
**Funding Amount:** PKR 2,869,002
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Environment

**Description:** Air pollution caused an estimated 135,000 deaths in Pakistan in 2015 alone. While strategies to avoid the harmful effects of air pollution have taken hold in parts of the developing world, they have yet to take hold in Pakistan. In this research, the citizen's perceptions towards the provision of air pollution were tested in Lahore. To do so, an interdisciplinary, international research team has designed an SMS-based service that will provide day-ahead forecasts from an industry-leading air pollution monitor to citizens in one neighbourhood of Lahore. This service was used to experimentally measure willingness to pay for air pollution forecasts and citizens ability to forecast air pollution, and tested how these values depend on forecast noisiness. This research could be instrumental in helping policymakers design policies to measure and disseminate information about air pollution and to seek to decrease air pollution.

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**Profile:** Dr. Ali Hasanain is an Associate Professor and the Head of the Economics Department at LUMS. Dr. Hasanain's research focuses primarily on how public service delivery can be improved through reform initiatives, particularly through technological progress and improvements in the media. He also studies how information and communication technologies (ICT) can improve market functioning. Dr. Hasanain's research has been featured in The Guardian, Economist, Huffington Post, various World Bank blogs, VoxEU, VoxDev, Herald, Friday Times, Dawn, and other media outlets, as well as been the topic of the feature story of the World Bank's global website. He is a member of Evidence in Governance and Politics (EGAP), a Senior Research Fellow at the Mahbub ul Haq Research Centre, a member of the research board of PRIME Institute, a Fellow of the Consortium of Development Policy Research (CDPR), and a faculty advisor at the Technology for People Initiative. From 2014 to 2016, he was a Global Leaders Fellow at Oxford and Princeton universities.
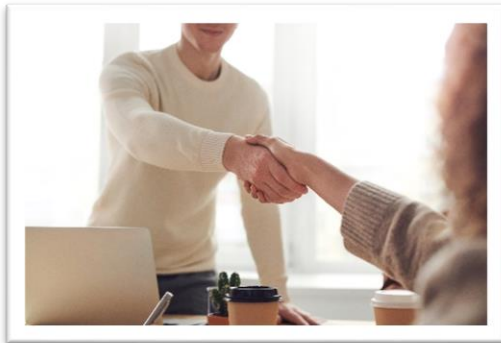
**Title:** Pakistan at Hundred

**PI:** Dr. Syed Ali Hasanain

**Sponsor:** World Bank

**Funding Amount:** PKR 5,589,601

**Project Initiated in:** 2019

**Duration:** 4 months

**Category:** Economic Development

**Description:** The project was based on how mindshare is won by a steady stream of connected content. The initiative must therefore plan a series of outputs, each meant to reinforce what has preceded it. To achieve this goal of steady output, the initiative delivered 10 large events, as well as a stream of nearly 20 video interviews. There were two areas that could be improved: first, while events held at LUMS were both cheaper and quicker to organise, the need to diversify the venues and audiences of the policy events is understandable; second, the project needed more content in Urdu to aid accessibility. The project delivered five off-site events in collaboration with other universities. The project also conducted interviews during these events to continue to build the Pakistan@100 video library.

**Title:** Using Automated Event Detection to Reduce Data Collection Costs with an Application to the BFRS Dataset
**PI:** Dr. Syed Ali Hasanain
**Co-PI:** Dr. Muhammad Fareed Zaffar
**Sponsor:** International Growth Centre (IGC)
**Funding Amount:** PKR 4,043,534
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Economic Development, Technology

**Description:** The project aimed to replicate and extend the BFRS dataset using machine learning and algorithm techniques. The BFRS dataset codes political violence from 1988 to 2011. It proposed to create a similar dataset from 2010 to the present day by automating categorisation of events using textual analysis with pattern recognition. The automation will streamline the process and, once developed, the tool provides quick updates without incurring any additional cost. The project also aimed to create the capacity for the construction of similar datasets on subjects other than violence. It streamlined the process of classification by developing a machine-learning tool that automatically identifies the kind of event reported and categorises it as such.
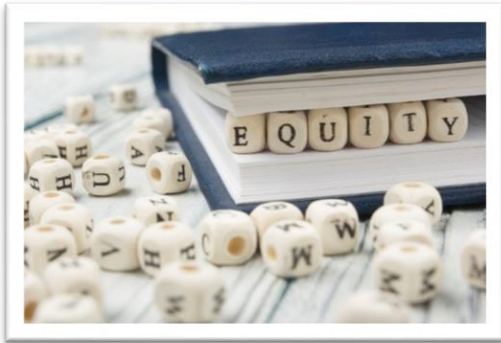
Dr. Syed M. Hasan
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**Profile:** Dr. Syed M Hasan is Associate Professor in the Department of Economics, LUMS. His primary research interest and teaching field is urban and regional economics and public economics. Dr. Hasan obtained his PhD in Economics from Ohio State University in 2014. His doctoral research focused on spatial policy instruments and firm's productivity. Under the broad theme of sustainable development, Dr. Hasan also has interest in research on resilient cities. In this context his research focuses on areas related to water conservation, economic cost of congestion and energy choices by households and related carbon emissions in large urban centres of Pakistan. Dr. Hasan has several publications in international peer-reviewed journals. In 2007 he did he Master's in Public Finance from GRIPS, Tokyo, Japan. Prior to joining the academia, Dr. Hasan has worked in the civil service of Pakistan.

**Title:** Microequity for Micro-enterprises: Encouraging Female Entrepreneurship with a Transportation Asset
**PI:** Dr. Syed M. Hasan
**Co-PI:** Dr. Kashif Zaheer Malik
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Business and Innovation

**Description:** Access to finance is often listed as one of the most important constraints on the growth of microenterprises in developing countries, and exclusion rates from financial services and entrepreneurship are often even higher for women. This project was intended to focus on female entrepreneurs and help them enter a non-traditional sector: rickshaw driving. It was intended to help train females on how to become rickshaw drivers, and then provide them with equity-based financing to purchase the asset. An exploratory field experiment using a randomised controlled trial (RCT) was employed, where it was intended to conduct detailed baseline and follow-up surveys, as well as using high-frequency sales data generated by an app and administrative data from our microfinance institutional partner, to investigate the success of the intervention and the impact on a range of different business and household outcomes for the female entrepreneurs.

# DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

Dr. Ali Usman Qasmi
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**Profile:** Dr. Ali Usman Qasmi, Associate Professor (History) at the Mushtaq Ahmad Gurmani School of Humanities and Social Sciences, joined LUMS in January 2012. He received his PhD from the South Asia Institute of Heidelberg University in March 2009. Before joining LUMS, he was a Newton Fellow for post-doctoral research at Royal Holloway College, University of London. He has published extensively in reputed academic journals such as Modern Asian Studies and Journal of Islamic Studies. He is the author of Questioning the Authority of the Past: The Ahl al-Qur'an Movements in the Punjab (Karachi: Oxford University Press, 2011). His second monograph, The Ahmadis and the Politics of Religious Exclusion in Pakistan (London: Anthem Press, 2014), was the recipient of Karachi Literature Festival (KLF) Peace Prize in 2015. Dr. Qasmi has co-edited several edited volumes as well, which include Revisioning Iqbal as a Poet and Muslim Political Thinker (Heidelberg: Draupadi, 2010), The Shi'a in Modern South Asia: Religion, History and Politics (New Delhi: Cambridge University Press, 2015) and Muslims against the Muslim League: Critiques of the Ideas of Pakistan (New Delhi: Cambridge University Press, 2017).
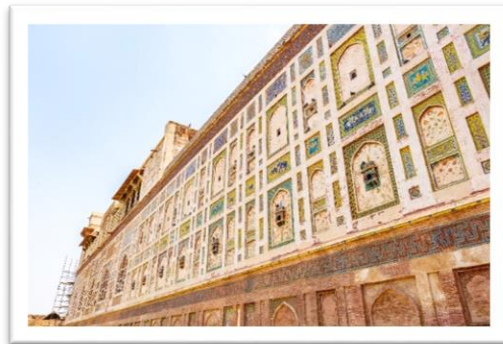
**Title:** Walking in the City: Mapping Everyday Life in Lahore
**PI:** Dr. Ali Usman Qasmi
**Co-PI:** Dr. Suleman Shahid
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Technology, Arts and Heritage

**Description:** This project was part of a course that was offered at LUMS in Fall 2020. It aims at understanding the meaning of dwelling in the context of Lahore's social, cultural, religious and political milieus. There have been various representations of Lahore's historical past in academic works and imagining of its rich life in arts and literature. The city has primarily been approached as the provincial capital of the Mughal Empire with a fascination for the relics of Mughal architecture that adorn the city. For others, Lahore lies at the vortex of a sacred geography – home to various Sufi shrines and their connecting silsila networks from beyond the Oxus to the heartland of Hindustan. From Milton's description of Lahore as the centre of Oriental riches to Persian poetry glorifying Lahore for its virtuosity, Lahore has been at the heart of various poetic imaginations as well. For the modern period, Lahore is a quintessential colonial city dotted with symbolic structures of British political power and its attendant civilizational mission.

Dr. Gwendolyn Sarah Kirk
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**Profile:** Dr. Kirk's research centres on language ideologies and popular culture in Pakistan, and more broadly on the instantiation of language and power in cultural forms. Her current book project addresses questions of language, performance, and aesthetics in Lahore's Punjabi film industry. She researches and writes about Pakistani film and television in both contemporary and historical perspectives, with particular emphasis on language, ethnicity, class, and gender. Her other interests include semantics and performative genres in South Asian literature as well as links between global politics and South Asian librarianship. A founding member of the Punjabi Boliyan Research Initiative (PBRI), her work also addresses language shift and dialect variation in Punjab.

**Title:** Punjabi Boliyan Research Initiative
**PI:** Dr. Gwendolyn Sarah Kirk
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 906,700
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Social Sciences, Arts and Heritage

**Description:** This project seeks to document and analyse dialect variation in Punjab and its connections with geography, education, social mobility, and other social factors. Although Punjabi is the language of the most populous and powerful ethnic group in Pakistan, as a language it has been historically marginalised and largely excluded from domains of usage such as government, business, and education. This project established an online database of field recordings and findings in order to make them accessible to Punjabi speakers worldwide. Again, although Punjabi is roughly the 11th most widely spoken language in the world, such data are extremely scarce; while we do not posit that Punjabi itself is an endangered language, the mixture of language marginalisation and rapid language shift have impacted and will continue to impact the language and its speakers.

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**Profile:** Dr. Mohammad Waseem is Professor of Political Science at Department of Social Sciences, LUMS. He was Chairman of the International Relations Department, Quaid-e-Azam University, and Islamabad. He has written on ethnic, Islamic, constitutional, electoral and sectarian politics of Pakistan. His books include: Politics and the State in Pakistan (1989), The 1993 Elections in Pakistan (1994) and Strengthening of Democracy in Pakistan (co-authored with S.J. Burki) (2002). He also edited the book Electoral Reform in Pakistan (2002).



**Title:** Re-imagining Federalism in Pakistan
**PI:** Dr. Mohammad Waseem
**Co-PI:** Dr. Asma Ul Husna Faiz
**Sponsor:** Higher Education Commission (HEC)
**Funding Amount:** PKR 1,250,000
**Project Initiated in:** 2019
**Duration:** 36 months
**Category:** Political Sciences

**Description:** This project deals with the issue of federalism in Pakistan. The point at the heart of the debate is the requisite level of provincial autonomy that is commensurate with the requirements of a strong and stable federation. The methodology of research into the present enquiry incorporates three periods for study of federalism: i) historical dimension, since the debate about the ideal form of federation for Pakistan goes back to pre-independence days; ii) the contemporary dimension, as the controversy about the potential of the 2010 18th Amendment to meet the financial requirements of the federation has reappeared; and iii) the futuristic dimension, as the new PTI government after the 2018 elections is poised at a juncture where it may feel obliged to address the question of re-defining federalism both inside and outside the parliament during the following months and years. This project has the promise of bringing out a first-class book, probably first of its kind, on the structural and operational dynamics of federalism in Pakistan.

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**Profile:** Dr. Nadhra Khan's primary area of research and interest is 19th Century Sikh Art and Architectural Ornament in the Punjab, but she also focuses on Mughal Art and Architecture (16th to 18th century). Her work emphasises the significance of the Sikh period as the last episode of century's old indigenous art and architectural tradition before annexation of the Punjab by the British in 1849 that changed, among other things, the visual culture of the Punjab forever. A research project that started with one Sikh funerary monument or *samadhi* built to honour Maharaja Ranjit Singh has led her to study almost all major monuments dateable to this period, including the Golden Temple Amritsar, Sikh period *havelis* and various other *samadhis*. Her current research includes the impact of Sikh architectural vocabulary on subsequent British Raj architecture in the Punjab and the deep impact of British art and craft education on traditional art and craft practices.
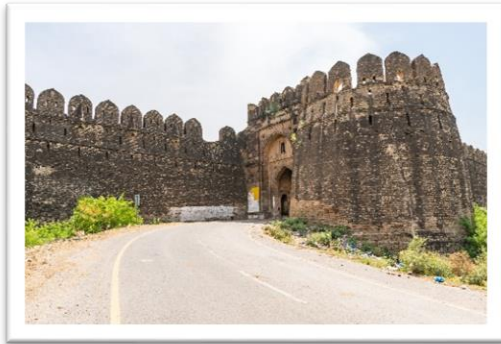
**Title:** Consultancy Services for Lahore Fort Shah Burj Project
**PI:** Dr. Nadhra Shahbaz Naeem Khan
**Sponsor:** Aga Khan Cultural Service Pakistan (AKCSP)
**Funding Amount:** PKR 800,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Arts & Heritage

**Description:** The project involves a detailed analysis of the Shah Burj apartments, especially the Sheesh Mahal and Naulakha pavilions. This would include references of their construction and usage in Mughal chronicles, history of their occupation and interventions by the Sikh rulers of the Punjab in the nineteenth century as well as their state duration of the British military occupation of the Lahore Fort. Decorative techniques were used in these pavilions such as pietra-dura or semi-precious stones inlaid in white marble, mirror-mosaic and frescoes were also elaborated.

**Title:** The Sikh Artefact Catalogue and the Web Portal
**PI:** Dr. Nadhra Shahbaz Naeem Khan
**Co-PI:** Dr. Murtaza Taj
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Technology, Arts & Heritage

**Description:** This project focuses on facilities that Pakistani museums offer to their visitors and viewers, which are extremely limited. The two major problems are limited accessibility, and inaccurate/incomplete labels and descriptions. To address the first issue, the aim was to digitise museum items and develop an online catalogue featuring them. Since simple photographs cannot correctly present all aspects of an artefact, the target was to create 3-D models of each objects. Furthermore, their historic significance and correct description will not only be presented in the online catalogue, but will also be shared with the concerned museum/gallery authorities to be displayed with the actual objects. To increase awareness about these object and the rich culture of Pakistan they testify, a printed version of this catalogue will also be made.

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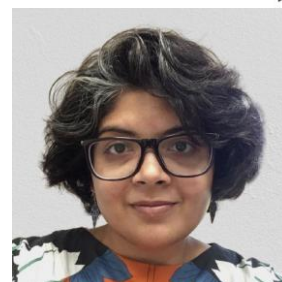
**Profile:** Dr. Sameen A. Mohsin Ali is Assistant Professor of Political Science at the Mushtaq Gurmani School of Humanities and Social Sciences. She completed her PhD in Politics and International Studies from SOAS University of London in 2018 and has a Masters in Comparative Politics (Research) from the London School of Economics and Political Science as a Commonwealth General Scholar. Her work on bureaucratic and party politics in Pakistan has been published in World Development and Commonwealth and Comparative Politics.

Dr. Ali's research and teaching interests include governance, state capacity, bureaucratic performance, and party politics in South Asia, public health governance, and the politics of donor engagement in LMICs. She teaches a range of courses, including Introduction to Political Science, Introduction to Comparative Politics, Politics of Pakistan, and Governance and its Discontents.



**Title:** Understanding Pakistan's Immunisation Problem: a Transactional Approach
**PI:** Dr. Sameen A. Mohsin Ali
**Co-PI:** Dr. Samia Waheed Altaf
**Sponsor:** Shahid Hussain Foundation
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 15 months
**Category:** Health

**Description:** The project addressed three of the areas (1) Healthcare and health promotion amongst vulnerable groups; (2) New approaches to understanding and reducing infectious diseases in Pakistan, and; (3) Health leadership - decision-making and autonomy in Pakistan's healthcare. This project analysed the prevalent situation through a creative, multidisciplinary framework drawn from the social sciences, moving beyond the usual narrow, technical, operational, and management lenses.

**Title:** Understanding Pakistan's Immunisation Problem II: a Transactional Approach
**PI:** Dr. Sameen A. Mohsin Ali
**Co-PI:** Dr. Samia Waheed Altaf
**Sponsor:** Shahid Hussain Foundation
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 20 months
**Category:** Health

**Description:** This project supported the government's focus on improving children's health by concentrating on immunisation. The project focuses on a health system approach to study the immunisation in Punjab in particular, and Pakistan in general, meaning that the project considered how larger institutional structures and power dynamics in the health sector (public, private, and semi-autonomous; centralized versus decentralised, etc.) can influence immunisation policy, delivery, and implementation.



**Title:** Understanding Pakistan's Immunisation Problem: a Transactional Approach
**PI:** Dr. Sameen A. Mohsin Ali
**Co-PI:** Dr. Samia Waheed Altaf
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2020
**Duration:** 12 months
**Category:** Health, Political Sciences

**Description:** This project proposed custom designed interventions that work with the government's immunisation programme in Punjab and Kasur to provide health workers and families with readily available, properly contextualized health education regarding vaccinations. In addition to working with vaccinators and lady health workers, these interventions take a community specific, human-centric approach by drawing on the respected position that older women hold within their families and communities, using their influence to support the work of health workers and enhance parents' knowledge of immunisation.

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**Profile:** Dr. Tania Saeed is Associate Professor of Sociology at the Mushtaq Ahmad Gurmani School of Humanities and Social Sciences. She is trained as a qualitative researcher with a focus on Comparative and International Education, examining education in relation to securitisation, citizenship and social justice. Her work ranges from exploring Islamophobia and securitisation in the context of universities in the UK, to the increasing securitization of education in Pakistan. Her more recent research explores ideologies of exclusion within educational institutions: the first project focuses on school curriculum, textbooks and teaching through a qualitative exploration of government, low fee private and refugee schools in Pakistan; the second project focuses on neoliberalism and Higher Education in Pakistan, examined through student, academic and administrative narratives of the changing university in relation to internationalisation and global competition.

**Title:** GCRF Development Award: Education, Justice and Memory Network
**PI:** Dr. Tania Saeed
**Co-PI:** Dr. Sameen A. Mohsin Ali
**Sponsor:** University of Bristol
**Funding Amount:** PKR 6,814,175
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Education

**Description:** The proposed Education, Justice and Memory Network (EdJAM) comes together in order to contribute towards Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education and to promote lifelong learning opportunities for all. A crucial part of SDG4 is its target 4.7, which specifies the kinds of skills, knowledge and attitudes that education should develop in all learners and includes knowledge and skills to promote a culture of peace and non-violence.

**Title:** UKRI GCRF: Education, Justice and Memory Network (EdJAM)
**PI:** Dr. Tania Saeed
**Co-PI:** Dr. Sameen A. Mohsin Ali
**Sponsor:** University of Bristol
**Funding Amount:** PKR 7,126,425
**Project Initiated in:** 2019
**Duration:** 48 months
**Category:** Education

**Description:** The Education, Justice and Memory (EdJAM) network comes together in order to contribute towards Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education and to promote lifelong learning. EdJAM will support researchers in Cambodia, Colombia, Pakistan, Uganda and elsewhere in the global south, and researchers in the UK who are early in their career to develop their research capacity, to share new knowledge, and to shape future research agendas. It will commission research to identify and learn from creative approaches to teaching about the violent past through a series of small grants that will produce both academic and creative outputs (e.g. curriculum resources, museum displays, photo exhibits, online materials). EdJAM will also commission large grants to explore outcomes of creative approaches to teaching about the past, developing new ways of measuring progress towards SDG target 4.7.

Dr. Waqar Zaidi

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**Profile:** Dr. Waqar Zaidi is Associate Professor of History at the Department of Humanities and Social Sciences at LUMS. His research focuses on the relationship(s) between technology and international relations in the twentieth century. Current research interests include scientific and technological internationalism, aviation, atomic energy, arms control, and A.I. He has published across a wide range of history and STS journals, and has a book forthcoming with Cambridge University Press in 2020, titled Technological Internationalism and World Order: Aviation and Atomic Energy, 1920-50.

**Title:** Pakistan International Airlines, 1955-2018

**PI:** Dr. Waqar Zaidi

**Sponsor:** Faculty Initiative Fund (LUMS)

**Funding Amount:** PKR 470,000

**Project Initiated in:** 2019

**Duration:** 12 months

**Category:** Social Sciences

**Description:** This project examined development of PIA from its formation in 1955 through to its golden years and eventually decline from the 1970s onwards. By placing this development within the political, social, and economic currents of its time, the project provided much needed historical context for current political debates about the crisis at PIA and how it can be resolved.

# SHAIKH AHMAD HASSAN SCHOOL OF LAW (SAHSOL)

Prof. Marva Khan
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**Profile:** Ms. Marva Khan holds an LL.M degree from Harvard Law School, prior to which she completed her BA-LL.B from LUMS. After securing the Fulbright Scholarship, she left to pursue an LL.M during which time, she worked as an Article Editor with the Harvard Human Rights Journal (HHRJ), and also participated and presented during the Systemic Justice Conference, 2015 held at the Harvard Law School. Her LL.M thesis, supervised by Professor Mark Tushnet, constituted a comparative constitutional analysis of the explicit and implicit limitations on freedom of speech, by analysing the jurisprudence emanating from Pakistan's superior judiciary, and the First Amendment jurisprudence emanating from the Supreme Court of the United States. Her main areas of research interest includes comparative constitutional law, and particularly its overlap with human rights.

**Title:** Topological Atlas: Mapping Contemporary Borderscapes
**PI:** Prof. Marva Khan
**Sponsor:** Goldsmiths, University of London
**Funding Amount:** PKR 1,160,422
**Project Initiated in:** 2019
**Duration:** 9 months
**Category:** GIS, Law & Policy

**Description:** The project's purpose was to assess how mapping can be used to represent borders as topological entities through the experience of those who encounter them. The focus of this project was to answer this question by assessing Pakistan's legal framework with respect to illegal immigration out of Pakistan, by looking at relevant laws, case law, and practical experiences of state officials, and lawyers who are privy to information regarding Pakistani citizens migrating out of Pakistan (or attempting to), legally and illegally towards Europe. The research was two-fold: searching for statutory law and case law on illegal immigration and also illegal smuggling from Pakistan, primarily to or towards Europe.

Dr. Muhammad Azeem
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**Profile:** Dr. Muhammad Azeem completed his BSc Electrical Engineering, from the University of Engineering and Technology, Lahore. Being involved in activism against child labour at the time, he became impressed by the media writings of Asma Jahangir and others. He started writing in the media and completed an LL.B, at the University of the Punjab, Lahore. He practiced law and public interest litigation around issues concerning workers and peasants in the lower and High Court for 6 years. He wrote three books which were quite popular in Pakistan. At Osgoode Hall Law School, Toronto. In 2014, he successfully defended his PhD in Law, from Osgoode Hall Law School on the topic, "The weaknesses of the 'good governance' paradigm: a study of the judiciary in Pakistan."

**Title:** Labour Law for Global Value Chains (GVCS) and CPEC Projects in Pakistan
**PI:** Dr. Muhammad Azeem
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 820,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Law and Policy

**Description:** This project is an attempt to develop such Global Supply Chains (GSCs) Law from Below. That is, the project developed a code for decent work conditions in GSCs production in Pakistan through a socio-legal study. The project accommodated all advanced and accepted protocols of work conditions by GSCs from manufacturer's guidelines and codes also. This way, the Code gets legitimacy and acceptance from foreign investors. This code also serves as a benchmark for CPEC projects.

Prof. Sikander Ahmed Shah
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**Profile:** Professor Sikander Shah is a pioneering member of the Shaikh Ahmad Hassan School of Law, LUMS. He obtained a BA in Economics and a Juris Doctorate (Cum Laude) from the University of Michigan, Ann Arbor. He has held visiting faculty positions at the Temple Law School, the Wayne State Law School and the University of Michigan Law School and holds the position of adjunct faculty at the Maurer School of Law, Indiana University Bloomington. Professor Shah served as the Legal Advisor to the Ministry of Foreign Affairs, while he was on sabbatical in 2012-2013. Professor Shah's teaching and research interests are focused on Public International Law, International Human Rights Law, International Humanitarian Law, Corporate Governance and Constitutional Design.

**Title:** Development of International Refugee Law Curriculum for Academia and Broader Advocacy Outreach in Pakistan
**PI:** Prof. Sikander Ahmed Shah
**Co-PI:** Prof. Uzair Kayani
**Sponsor:** United Nations High Commissioner for Refugees (UNHCR)
**Funding Amount:** PKR 2,086,350
**Project Initiated in:** 2018
**Duration:** 2 months
**Category:** Law and Policy

**Description:** The purpose of the project was to develop a refugee law course contextualised to the situation in the Asia/Pacific region and more specifically to Pakistan. The refugee law course is foreseen to be developed and piloted at LUMS, and is intended to be used in advocating for inclusion of the Refugee Law as a standardised course for LL.B students country-wide. Introduction of the course to other reputed institutions will also be explored. It is also foreseen to provide support to UNHCR in the formulation of protection and solutions advocacy strategies with multifarious stakeholders.

**Title:** Project to Develop Business' Respect for Human Rights through US/Pakistan Cooperation
**PI:** Prof. Sikander Ahmed Shah
**Co-PI:** Prof. Uzair Kayani
**Sponsor:** American Bar Association (ABA)
**Funding Amount:** PKR 15,307,854
**Project Initiated in:** 2018
**Duration:** 24 months
**Category:** Law & Policy

**Description:** The project aimed to increase the Pakistani legal profession's knowledge and awareness of the responsibility of businesses to respect human rights through U.S. and Pakistani cooperation, with two primary objectives: 1)Pakistani students will gain a thorough understanding of Business and Human Rights and therefore will be willing to advise and work on this area; and 2) Pakistani lawyers will be equipped to effectively advise businesses on how to respect human rights and communities and remedy violations of human rights by businesses in Pakistan. Thereby, providing an understanding, academic and legal exposure to students and the legal fraternity in Pakistan. The project will introduce Business and Human rights at the university level.



**Title:** International Refugee Law Curriculum-design Finalisation Project for Academia and Broader Advocacy Outreach in Pakistan
**PI:** Prof. Sikander Ahmed Shah
**Co-PI:** Prof. Uzair Kayani
**Sponsor:** United Nations High Commissioner for Refugees (UNHCR)
**Funding Amount:** PKR 2,846,028
**Project Initiated in:** 2019
**Duration:** 5 months
**Category:** Law and Policy

**Description:** The project developed a refugee law course contextualised to the situation in the Asia/ Pacific region and more specifically to Pakistan which was then piloted at LUMS, and is intended to be used in advocating for inclusion of the Refugee Law as a standardised course for LL.B students country-wide. The study is aimed to be a vital protection and advocacy tool that not only bridges the knowledge and awareness gaps on refugee protection and solutions, but, in the long term, has tremendous potential to develop refugee-friendly protection network(s) within academia, among lawyers and judges and other practitioners concerned with refugees and related issues.



**Title:** Justice System Support Programme
**PI:** Prof. Sikander Ahmed Shah
**Co-PI:** Prof. Uzair Kayani
**Sponsor:** Adam Smith International (ASI)
**Funding Amount:** PKR 1,821,880
**Project Initiated in:** 2019
**Duration:** 3 months
**Category:** Law & Policy

**Description:** The Justice System Support Programme (JSSP - Aitemaad) aimed to support the Government of Pakistan's rule of law reforms and improved criminal justice system performance. The programme is being managed by the UK's Department for International Development as part of its Pakistan Rule of Law (RoL) Programme 2016-20. The expected outcome of the programme is increased public confidence and trust in rule of law.

**Title:** Legal and Regulatory Strategies for the Coordination and Commercial Oversight of Pakistan's Response to COVID-19
**PI:** Prof. Sikander Ahmed Shah
**Co-PI:** Prof. Uzair Kayani
**Sponsor:** Hanns Seidel Foundation (HSF)
**Funding Amount:** PKR 1,645,000
**Project Initiated in:** 2020
**Duration:** 6 months
**Category:** Law and Policy

**Description:** As the name suggests, the project targets the major challenges that Pakistan faces in combating the pandemic, and on the other hand it will supplement the existing National Action Plan against COVID-19 by identifying the gaps in its policy elements, addressing the human rights concerns relating to its implementation, and suggesting imperative additions. Under the current scenario, this project is of high significance as it allow the federal and provincial governments, and agencies to both ensure the protection of human rights and conduct containment and treatment measures in a manner conducive to countering COVID-19.

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**Profile:** Dr. Zubair Abbasi is an Associate Professor at the Shaikh Ahmad Hassan School of Law, LUMS. His research focuses on the relationship between sharia and state law in South Asia, Middle East, and Western Europe; Islamic law and jurisprudence (usul al-fiqh) in contemporary world; and comparative law, family law and constitutional law.

Dr. Abbasi completed DPhil in Law at Oxford University. In his doctoral thesis titled, 'Sharī'a under the English Legal System in British India: Awqāf (Endowments) in the Making of Anglo-Muhammadan Law', he explored the formation of Muslim Personal Law in British India. His current research project explores the process of judicial Islamisation of laws in Pakistan by examining the judgments of the Federal Shariat Court—a special court mandated to exercise Islamic judicial review. This project analyses the sources, methodologies, and methodological tools used by the judges of the Federal Shariat Court and evaluates the impact of Islamisation of laws upon the legal system in Pakistan. At LUMS, Dr. Abbasi teaches Islamic Jurisprudence, Family Law, Contract Law, and Comparative Corporate Law and Governance.

**Title:** Living Within the Limits Prescribed by Allah: Judicial Application of Hudood Laws in Pakistan
**PI:** Dr. Zubair Abbasi
**Sponsor:** Faculty Initiative Fund
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Law & Policy

**Description:** This study was the first comprehensive and systematic empirical research on Hudood Ordinances. It revealed how Hudood laws were applied by the courts and show the frequency of the application of each of the Hadd offence: extra-marital sex (zina), false accusation of extra-marital sex (qazf), theft, and drinking of alcohol. This study was based on the analysis of the reported judgments of the Federal Shariat Court (FSC) and the Shariat Appellate Bench, Supreme Court (SAB) related to the Hudood Ordinances. This study highlights the actual application of Hudood laws in Pakistan during the past forty years. It will make a significant contribution to the literature by showing that how Hudood laws were applied by the courts and what new legal principles were developed during the application of these laws. This study also contributed to the two mainstream academic debates: i) the role of Islamic law within the modern national state; and ii) the compatibility of Islamic criminal law with international human rights standards.

**Title:** Changing Structures of Islamic Authority (CSIA's) Muslim Youth and Islamic Knowledge
**PI:** Dr. Zubair Abbasi
**Sponsor:** Oxford University
**Funding Amount:** PKR 578,978
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Social Sciences

**Description:** The project focused on the enhancement of capacity of the courts to improve performance management and to conduct research for systemic improvements related to expeditious case disposal.



**Title:** Women's Rights to Matrimonial Property Under Muslim Family Laws in Pakistan, Bangladesh and United Kingdom
**PI:** Dr. Zubair Abbasi
**Sponsor:** Faculty Initiative Fund
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2018
**Duration:** 12 months
**Category:** Law & Policy

**Description:** Based on the doctrinal analysis of the sources of Muslim family law and empirical data, this research project explored the possibility of the recognition of women's right to matrimonial property under Muslim family laws in Pakistan, Bangladesh and United Kingdom. In Pakistan and Bangladesh, the recognition of women's unilateral right to no-fault judicial divorce (*khula*) is a significant step forward towards gender equality under Muslim family law. The recognition of this right, however, remains partially ineffective because a wife has to forgo her dower to avail judicial divorce (*khula*). In this way, she is made to pay a heavy financial cost for dissolving her marriage.

# SYED AHSAN ALI AND SYED MARATIB ALI SCHOOL OF EDUCATION (SOE)

Dr. Soufia Anis Siddiqi
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**Profile:** Dr. Soufia Anis Siddiqi work is anchored in broad-spectrum qualitative research methods that can help explain the political economy of educational experience in the Pakistani context. Specifically, she investigates how system design engenders inefficiencies and frictions that contribute to contested notions of identity in sites of learning, and their implications for effective service delivery.
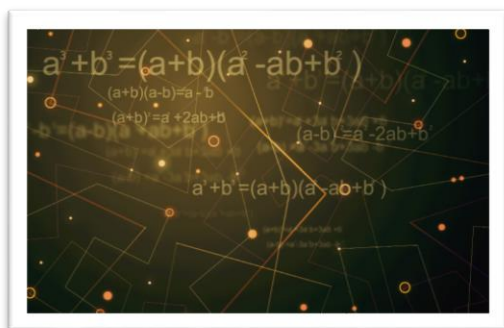


**Title:** Contested Identities; Competing Accountabilities: the Making of a 'Good' Pakistani Public School Teacher
**PI:** Dr. Soufia Anis Siddiqi
**Sponsor:** University of Pennsylvania
**Funding Amount:** PKR 6,822,272
**Project Initiated in:** 2020
**Duration:** 15 months
**Category:** Education

**Description:** The study employed Principles for the RISE Programme's PET-A Research to map the teacher identity against their accountability. Besides that, Elite Interview (a qualitative technique that involves one-on-one interviews with key stakeholders in a research context) and bunch of Ethnographic Interviews will also be carried out. The reason behind shortlisting this research for this issue is that it has a potential to positively change the education system in Pakistan by targeting the root cause of the issues, i.e., the school teacher. Therefore, this research holds a great deal of importance in developing a sustainable and reliable educational system in the country.

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**Profile:** Dr. Tahir Andrabi is a Professor of Economics at Pomona College where he teaches courses in economic development, game theory, international economics and empirical microeconomics. He is the co-founder and Director, Social Policy and Public Goods Program of Centre for Economic Research in Pakistan (Lahore). He has also been a visiting scholar at MIT, a research associate at LSE and a consultant for the World Bank. From 1999-2000, he served as a member of the tax and macroeconomic committees of the economic advisory board of the government of Pakistan.

He has published extensively in major economics and education journals. In 2007, his work on religious education in Pakistan received the George Bereday Award for the best paper published in Comparative Education Review in 2006 from the Comparative and International Education Society. Dr. Andrabi holds a Doctorate in Economics from the Massachusetts Institute of Technology and is a graduate of Swarthmore College.

**Title:** Assistant Education Officers (AEOs) Training Pilot Project
**PI:** Dr. Tahir Raza Shah Andrabi
**Co-PI:** Dr. Mariam Chughtai
**Sponsor:** Mott MacDonald
**Funding Amount:** PKR 55,401,465
**Project Initiated in:** 2019
**Duration:** 9 months
**Category:** Education

**Description:** As the name indicates it is a pilot project where LUMS faculty would play an important role in training these AEOs. The project was considered highly significant since it enhanced the education ecosystem of the Punjab using a curriculum and delivery approach distinct to any training programme that has targeted them before. The project aimed to optimise the existence of a significantly young, educated, motivated segment of education managers (AEOs) in the Punjab whose sphere of influence extends beyond a singular school unit, but is small enough to remain manageable at a size of 10-12 schools per AEO. Further it effectively trained AEOs to lead by example through their mentoring and managerial abilities because of their unique position in the education hierarchy forwards linkages into the school directly, and backwards linkages up the provincial education hierarchy through the District Education Authority.
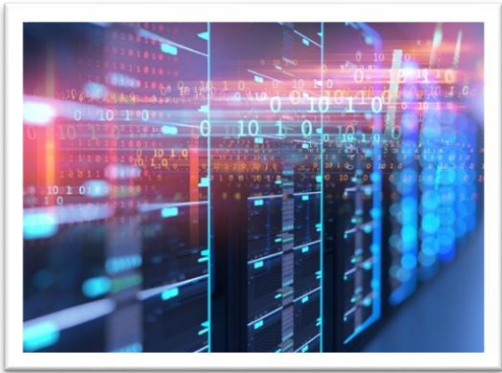
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**Profile:** Dr. Yasira Waqar is an Assistant Professor at the School of Education, LUMS. During her career, she has taught university level courses in Education Technology and Research, and has worked as a consultant on several national and international projects. She holds a Doctorate in Instructional Technology from Columbia University, MA in Computing in Education from Columbia, B.Ed from University of Denver, and a BS in Speech Pathology from University of Nevada. Her research focuses on meaningful use of technology to augment student learning, and in applying cognitive psychology to inculcate thinking skills in students. She is also a former US Certified school teacher, with several years of teaching experience at The Lahore American School and public schools in Denver. Yasira is also a trained speech language pathologist and has worked closely with children with special needs in Pakistan and UAE.



**Title:** Thinking in the Digital Age
**PI:** Dr. Yasira Waqar
**Co-PI:** Dr. Suleman Shahid
**Sponsor:** Faculty Initiative Fund (LUMS)
**Funding Amount:** PKR 1,000,000
**Project Initiated in:** 2019
**Duration:** 12 months
**Category:** Education

**Description:** The project proposed to host a two-day design workshop on 'Design for teaching computational thinking and STEM.' This workshop will provide practitioners and researchers from schools in Pakistan a platform to share their current practices, identify challenges and brainstorm solutions to integrate computational thinking within STEM.

# Team OR

| Dr. Saad Azmat | Hamza Habib | Sohaib Iftikhar | Muhammad Faisal | Muhammad Najam Ul Ain |

| Aonia Masood | Faiza Shah | Naeem Siddique | Muhammad Yahya | Khawaja Muhammad Awais |

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