# ORIC Activities Report

Spring-2020

**Dated:** 21st October 2020

**Prepared by:**

Office of Research, Innovation and Commercialization (ORIC)

Capital University of Science & Technology, (CUST)

Islamabad

# Abstract

Capital University of Science & Technology (CUST), Islamabad since its foundation has always focused on providing quality higher education in the country. The University believes that nations can flourish through an active research culture and a continual process of knowledge building for productivity. The core objective of Office of Research, Innovation and Commercialization (ORIC) is to provide strategic and operational support to the university research activities, strengthen academia-industry linkages and promote entrepreneurship, technology-transfer and commercialization activities. ORIC at CUST is working under three major domains namely Research Operations, Technology Incubation & Innovation and Industrial Liaison.

Office of Research, Innovation and Commercialization is working on integration of research and education at all levels of the institution. ORIC at CUST have a central role in facilitating the University's research outcomes and Technology Incubation & Innovation activities. We are diligently working in translating research for the public's benefit by facilitating University faculty and students in doing quality research publications and increasing and diversifying external research funding.

We believe in continual capacity building of our students to satisfactorily equip them with modern tools and skills vital for the industry. In this regard numerous technical trainings, workshops and seminars are being conducted on regular basis to provide students, faculty members and professionals with the contemporary technical tools and skills. ORIC is also working on the establishment of CUST Business Incubation Center and commercialization of low risk, small investment and marketable project ideas.

A number of joint ventures are being done with industry through mutual collaborations. ORIC at CUST is continuously working on to build and maintain strong Academia-Industry Linkage with the focus on promoting and making CUST graduates the premium choice for the employers. The industrial visits are being arranged on continual basis where notable organizations are not invited on campus but the faculty also take keen interest to visit them regularly. ORIC at CUST is working to promote academic collaborations and to explore the areas of mutual interest and employment possibilities for CUST students.

ORIC Activities Report Spring-2020 showcases recent progress of ORIC in Spring-2020. The report presents the accomplishments and contributions of ORIC in accordance with its defined domains.

![Capital University of Science and Technology logo]

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To make research a top priority for a sustainable economic growth and future knowledge economy at Higher Education Institutions (HEIs), HEC aimed to establish pivotal centers at universities. These centers are known as Offices of Research, Innovation and Commercialization (ORIC). At Capital University of Science and Technology (CUST) Offices of Research, Innovation and Commercialization started its working in September 2017 under the patronage of Prof. Muhammad Mansoor Ahmed, Vice Chancellor, CUST.

Mission statement for ORIC at CUST as approved from BASR is entitled as "*To motivate and facilitate the university researchers to innovate and collaborate with the stake-holders leading to resource generation through commercialization*". Based on this mission ORIC operations have been divided into three major domains including:

**a)** Research Operations (RO)
**b)** Technology Incubation and Innovation (TII)
**c)** Industrial Liaison (IL)

## ORIC Activities Calendar Spring-2020

The list of activities and events performed by ORIC in Spring-2020 based upon the stated domains is given below.

| Month | Week | Events and Tasks | Domain |
|-------|------|------------------|--------|
| Feb-20 | 1 | i. Initial Draft of ORIC Newsletter Fall-2019<br>ii. Certificate Courses Registration and Procedures for Spring-2020<br>iii. CUST Testing Policy Follow-up with Vice Chancellor | RO, TII & IL |
| | 2 | i. Submission of Final Draft of ORIC Newsletter Fall-2019 to VC Office<br>ii. Designing/Drafting of Research Database Form<br>iii. FYPs Funding Certificate Distribution Ceremony<br>iv. Working on Business Plan Product showcase of funded FYPs in Spring-2019 | RO & TII |
| | 3 | i. 12th ORIC Research Committee Meeting<br>ii. Meeting with Directorate of Corporate Linkages (DCL) about Collaborations | RO & TII |

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| Mar-20 | | iii. Faculty targets update of FoC, FoE, FMSS and FoHS for Feburary-2020 | |
| | 4 | i. Graphic Designing of ORIC Newsletter Fall-2019<br>ii. Minutes of Meetings of ORIC Research Committee and DCL<br>iii. Updation of CUST PhD Repository | RO & TII |
| | 5 | i. Updation of CUST Research Database for Feb-2020<br>ii. Certificate Courses Management<br>iii. Timeline for Tissue Culture Project<br>iv. Notable Alumni Database | RO, TII & IL |
| | 6 | i. Timeline, Equipment's Identification for High Tech Lab for Pharmaceutical Department<br>ii. Submission of 8th Revision of Drone Detection Radar System Proposal to Ignite. Specifications, Budget and Business Plan Revised as per Evaluator Suggestions<br>iii. Updation of CUST Research Database for Feb-2020 | RO & IL |
| Apr-20 | 7 | i. Online meeting of ORIC with Col Mazhar, Director TEVTA and Mr. Hassam from National Instruments on proposal for Center of Excellence in Automotive Technology<br>ii. Updation of CUST Research Database for March-2020<br>iii. Proposal on "Investigation of COVID -19 in Pakistan by Integration of Artificial Intelligence and Epidemic Modelling Methods for Public Health Surveillance System" in collaboration with BS Department | RO & IL |
| | 8 | i. Updation of CUST Research Database for March-2020<br>ii. Proposal on "Investigation of COVID -19 in Pakistan by Integration of Artificial Intelligence and Epidemic Modelling Methods for Public Health Surveillance System" in collaboration with BS Department<br>iii. Literature Review for Center of Excellence in Automotive Technology | RO & IL |

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| | 9 | i. Quotation for Equipment's required for Tissue Culture Project<br>ii. Drafting of Agreement for Clients of Tissue Culture Project<br>iii. Proposal on "Investigation of COVID -19 in Pakistan by Integration of Artificial Intelligence and Epidemic Modelling Methods for Public Health Surveillance System"<br>iv. Presentation of proposed Concept Idea of Center of Excellence in Automotive Technology | RO, IT & TII |
| | 10 | i. Updation of ORIC Webpage<br>ii. Quotation for Equipment's required for Tissue Culture Project: Proposal Updated and Finalized<br>iii. Online Meeting with HoD Pharmacy Department for Initiating of Proposal for Pharmaceutical High Tech Industrial Lab | RO, TII & IL |
| | 11 | i. Proposal for Tissue Culture Project in Collaboration with Department of Biosciences Finalized and Submitted for Approval<br>ii. Online Meetings with HoD Pharmacy Department for Initiating of Proposal for Pharmaceutical High Tech Industrial Lab | TII & IL |
| May-20 | 12 | i. ORIC Progress Report Against HEC ORIC Requirements for VC Office<br>ii. Minutes of 2$^{nd}$ VLE Committee Meeting<br>iii. CUST Classes Held Summary Report<br>iv. Updation of CUST Research Database for April-2020 | RO |
| | 13 | i. Minutes of 4$^{th}$ VLE Committee Meeting<br>ii. CUST Classes Held Summary Report<br>iii. VLE Email Summary Table<br>iv. Schedule for Trainings Session for Faculty regarding Effective Online Teaching<br>v. ORIC Activities Calendar Summer-2020 | RO & TII |
| | 14 | i. Minutes of 5$^{th}$ VLE Committee Meeting<br>ii. CUST Classes Held Summary Report<br>iii. VLE Email Summary Table<br>iv. Work Order for Annual Report Printing<br>v. Certificate Design for Certificate Courses Attendees<br>vi. HEC Online Survey Analysis | RO & TII |

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| | 15 | i. Minutes of 6<sup>th</sup> VLE Committee Meeting<br>ii. CUST Classes Held Summary Report<br>iii. VLE Email Summary Table<br>iv. Online Training Session for CUST Faculty by Dr. Irfan Anjum Manarvi<br>v. Updation of ORIC Webpage | RO & TII |
| June-20 | 16 | i. Minutes of 7<sup>th</sup> VLE Committee Meeting<br>ii. CUST Classes Held Summary Report<br>iii. VLE Email Summary Table<br>i. Updation of CUST Research Database for May-2020<br>iv. Publication Data Shared with FMSS<br>v. Flyer Design and Advertisement of Training Session on Literature Review | RO & TII |
| | 17 | ii. Updation of CUST Research Database for May-2020<br>iii. CUST Classes Held Summary Report<br>iv. VLE Email Summary Table<br>v. Departmental Teams Formation for Online Exit Surveys<br>vi. Creation of Online Exit Survey Forms<br>vii. HEC Online Teaching Survey Report<br>viii. Online Training Session for Faculty and Students on Literature Review<br>ix. Online Session on Transition to Virtual Learning: Challenges vs. Adaptation | RO & TII |
| | 18 | i. CUST Classes Held Summary Report<br>ii. VLE Email Summary Table<br>iii. Minutes of 8<sup>th</sup> VLE Committee Meeting<br>iv. Updation of CUST PhD Repository<br>v. Exit Survey Forms Updated<br>vi. Newsletter Spring-19 Printed and Distributed<br>vii. Online Seminar on COVID-19 by Dr. Shaukat Iqbal Malik | RO & TII |
| | 19 | i. CUST Classes Held Summary Report<br>ii. CUST Exam Held Summary Report<br>iii. VLE Email Summary Table<br>iv. Faculty Website Profiles Survey<br>v. Research Group Poster of Dr. Majid Ali<br>vi. Faculty Research Group 5P's Data Update<br>vii. Payment Invoices of Certificate Courses<br>viii. Updation of ORIC Webpage | RO & TII |

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| July-20 | 20 | i. CUST Classes Held Summary Report<br>ii. CUST Exam Held Summary Report<br>iii. VLE Email Summary Table<br>iv. Faculty Research Report<br>v. Faculty Research Group 5P's Data Update<br>vi. Updation of CUST Research Database for June-2020<br>vii. Training Session on "Change Management and Implementation w.r.t. COVID-19"<br>viii. Updation of CUST PhD Repository | RO & TII |
| | 21 | i. CUST Classes Held Summary Report<br>ii. CUST Exam Held Summary Report<br>iii. VLE Email Summary Table<br>iv. Minutes of 9th VLE Committee Meeting<br>v. Annual Report 2019: Distributed at CUST and among 90 Universities across Pakistan<br>vi. Training Session on "Online Teaching Techniques"<br>vii. Updation of CUST Research Database for June-2020 | RO & TII |
| | 22 | i. CUST Classes Held Summary Report<br>ii. VLE Email Summary Table<br>iii. Collaboration Letter to PAEC<br>iv. Annual Report 2019: Payment Case to Account Office<br>v. Online Session on "Depression Managing During University Academic Tenure"<br>vi. Biosciences Proposal Update<br>vii. Response to 3rd Evaluator for DDR Proposal | RO, TII & IL |
| | 23 | i. CUST Classes Held Summary Report<br>ii. VLE Email Summary Table<br>iii. Online Meeting for Tech Flickers with Dr. Yousaf, Associate Dean Riphah University<br>iv. Compilation of Faculty Research Report for BASR<br>v. Collaborative Proposal for GCF with ERC, COMSATS Lahore<br>vi. Collaboration with HoD ME for Project Proposals with NESCOM | RO, TII & IL |

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| | 24 | i. CUST Classes Held Summary Report<br>ii. VLE Email Summary Table<br>iii. Minutes of 10th VLE Committee Meeting<br>iv. Data Collection for CUST Annual Report 2019-20<br>v. Tech Flickers Startup- Session with Personnel from Taxation Department<br>vi. Collaborative Proposal for GCF with ERC, COMSATS Lahore<br>vii. CS Projects Commercialization Meeting with CS and MS Faculty | RO, TII & IL |
| Aug-20 | 25 | i. CUST Classes Held Summary Report<br>ii. VLE Email Summary Table<br>iii. Minutes of 11th VLE Committee Meeting<br>iv. IFAC Technical Committees (TCs) Nomination Database<br>v. Data Collection for CUST Annual Report 2019-20<br>vi. Collaborative Proposal for GCF with ERC, COMSATS Lahore<br>vii. Minutes of FYPs Commercialization Meeting on CS Project Flex Tracker<br>viii. Updation of CUST Research Database for July-2020 | RO, TII & IL |
| | 26 | i. CUST Classes Held Summary Report<br>ii. VLE Email Summary Table<br>iii. IFAC Technical Committees Nomination Database<br>iv. Data Collection for CUST Annual Report 2019-20<br>v. Advertisement for Certificate Courses Fall-2020<br>vi. ORIC Proposals Dashboard<br>vii. Preparation for Optimization of In Vitro Culture of Plants - Project Execution Meeting<br>viii. Updation of CUST Research Database for July-2020<br>ix. Updation of ORIC Webpage | RO, TII & IL |

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| | 27 | i. CUST Classes Held Summary Report<br>ii. VLE Email Summary Table<br>iii. PAC Kamra Team Visit to CUST<br>iv. Working on CUST Annual Report 2019-20 (Chapter-1: Completed)<br>v. Advertisement for Certificate Courses Fall-2020<br>vi. Designing of ORIC Incubation Dashboard<br>vii. Updation of ORIC Proposals Dashboard<br>viii. Project Execution Meeting for Optimization of In Vitro Culture of Plants | RO, TII & IL |
| | 28 | i. CUST Classes Held Summary<br>ii. VLE Email Summary Table<br>iii. Working on CUST Annual Report 2019-20 (Chapter 02 Completed)<br>iv. Research Publications Report 2019-20 with CUST library<br>v. Meeting Coordinated Between CS Dept. and MS Dept. for Incubation of Joint Company<br>vi. Incubation Company Registration Process of Tech Flickers<br>vii. LCF Proposals Scrutiny<br>viii. HEC-TTSF 2020, CUST Nominations<br>ix. Call for Proposals of TTSF, Capacity Building Workshops and Related Faculty Queries Addressed | RO, TII & IL |

**Brief Overview of Activities Performed in Spring-2020**

The objective of ORIC is to develop, expand, enhance and manage the university's research program and to link research activities directly to the educational, social and economic priorities of CUST and the society. ORIC at CUST have a central role in facilitating the University's research outcomes and Technology Incubation & Innovation activities. The brief overview of activities performed by ORIC in Spring-2020 is given below.

# Research Operations

ORIC has the responsibility of guaranteeing that all research programs and policies reflect the core values of academic freedom, professional integrity, ethical conduct and full compliance with all policies, legal requirements and operational standards of the university. During its short span of time ORIC has worked in facilitating its faculty and students in doing quality research publications.

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## A. Submitted Research Proposals

The following table briefs the list of research proposals submitted by CUST faculty members in collaboration with ORIC to various funding agencies.

| Sr. No | Title | Principal Investigator/ Collaborator | Department | Submission/ Funding Agency |
|---|---|---|---|---|
| 1 | Towards the Application of Artificial Intelligence for Sustainable Livestock Management - A Pilot Project to uplift Socio-economic Conditions of Rural Women | Dr. Saira Ahmed | Management Sciences | Local Challenge Fund (LCF) |
| 2 | Behavioral Intervention for Sustainable Agricultural Practices: A Field Experiment for Water Conservation | Dr. Sabahat Haqqani | Management Sciences | Local Challenge Fund (LCF) |
| 3 | Current and Future Impact of Public Sector Secondary Education in Pakistan | Prof. Nayyer Masood | Computer Science | Local Challenge Fund (LCF) |
| | Bioremediation and Toxicity Reduction of Effluents by Indigenous Microbial Strains as well as Optimization of Bioreactor for sustainable Production of Third Generation Bioethanol | Dr. Arshia Amin Butt | Biosciences | Local Challenge Fund (LCF) |
| 4 | Project Concept Paper for Center of Excellence for Training, Testing and Facilitation in Electric Vehicle Technology | Prof. Aamer Iqbal Bhatti | Electrical Engineering | Planning & Development (P&D) Board, Punjab |
| 5 | Indigenous Development of Drone Detection Radar | Prof. Aamer Iqbal Bhatti | Electrical Engineering | Ministry of Education, Saudi Arabia |
| 6 | Collaborative Proposal for GCF with ERC, COMSATS Lahore | Prof. Aamer Iqbal Bhatti | Electrical Engineering | Grant Challenge Fund (GCF) |
| 7 | Revision Submission of Investigation of Drug Resistant Strains of Mycobacterium Proposal | Prof. Shaukat Iqbal Malik | Biosciences | Pakistan Science Foundation (PSF) |

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## B. Proposals Submission under HEC Local Challenge Fund (LCF)

The Local Challenge Fund (LCF) is a key element of the Higher Education Development in Pakistan Project supported by the World Bank and implemented by the Higher Education Commission (HEC) to support research projects that address locally relevant socio-economic issues and topics associated with Sustainable Development Goals (SDGs), and will provide funds to selected institutions based upon a competitive, peer-reviewed evaluation of proposals. Office of Research, Innovation and Commercialization have copiously facilitated researchers in their proposals submission and associated documentation for LCF.

## C. HEC NRPU Approved Research Projects

Higher Education Commission (HEC) have recently accepted two proposals submitted by CUST faculty researchers under National Research Program for Universities (NRPU). One of the approved proposals entitled "Preparation of Indigenous Manual Based Intervention for Lowering anxiety and Depression Levels among Pakistani Youth" was funded 14.63 Million PKR for a duration of three years. The project would be completed under the supervision of Dr. Sabahat Haqqani., Assistant Professor, MS Department CUST. The other accepted project was "Molecular Epidemiology and Prevalence of Antibiotic Resistance Genes in Smog Particulate Matter: Implications for Human Exposure in Pakistan". The principal investigator of the project is Dr. Arshia Amin Butt, Assistant Professor, BS Department, CUST. The total approved funding is 6.5 Million PKR for a duration of two years.

## D. Drone Detection Radar Proposal Revision Submissions

Due to the huge leaps in aerospace navigation and control on one hand and miniaturization on the other hand, the aerial threats are taking on new dimensions and shapes. New air vehicle categories such as Unmanned Air Vehicles (UAVs) and Drones have added a new flavor to the exhaustive categories of aerial threats such as wide variety of aircrafts and missiles. The advent of these new threats has posed a multitude of challenges to the air surveillance assets. Due to the miniaturization the limit on Radar Cross Section (RCS) to be detected has reduced considerably from 10 m$^2$ to 0.1 m$^2$, placing a huge requirement on the radar power and signal processing. To cope with these stringent requirements a new Drone Detection Radar System is proposed and submitted to Ignite National Technology Fund, Ministry of IT, Islamabad.

## E. Proposal for "Investigation of COVID-19 by Integration of Artificial Intelligence and Epidemic Modelling Methods for Public Health Surveillance System"

Globally, disease related health surveillance systems are playing a significant role in outbreak detection and response management of Infectious Diseases (IDs). However, in developing countries e.g. Pakistan, epidemic outbreaks are difficult to detect due to scarcity of public health data and absence of automated surveillance systems. This research will focus on development of infectious disease COVID-19 viewer. It is a blend of intelligent approaches to make use of real-time streaming data from Emergency Departments (EDs) for early
 outbreak detection of COVID-19 related to, health care resource allocation and epidemic response management etc.

## F. 12th ORIC Research Committee Meeting

The 12th ORIC Research Committee Meeting was held on March 05, 2020 and was chaired by Dean Research & Innovation, Prof. Aamer Iqbal Bhatti. The meeting started with the presentation of ORIC Activities Calendar Spring-2020 by Dean Research & Innovation. Before Research Committee members. He briefly discussed the list of research proposals submitted by CUST faculty members of almost all departments in HEC NRPU Programme. He acknowledged the efforts of faculty members and added that proposals submission itself is a big challenge and is worth to be appreciated. The meeting discussed ORIC policy draft to be presented in subsequent Executive Committee Meeting, CUST Commercialization Matrix formulated after Ideas Hunting Sessions held with various departments, and Certification Courses initiated by ORIC in Spring-2020.

## G. CUST Faculty Research Report

ORIC has compiled Faculty Research Report for presentation in meeting of Board of Advanced Studies and Research (BASR). The report depicts the recent progress of faculty in terms of department and year wise comparisons of publications (Journal and Conference) till 30th Sep 2020. The report also highlights faculty research groups 5ps data i.e. Projects, PhDs Produced, Prototypes Developed, Publications and Patents filed.

## H. Report of Faculty Missing Data on University Website

As per directions of VC Office, ORIC has compiled a comprehensive report regarding the missing data and updated information on CUST website. The faculty members' profiles were screened to see if some data is missing or outdated. Based on the report faculty profiles will be updated as per their recent achievements, expertise and experience.

## I. CUST PhD Repository Update

ORIC maintains a comprehensive database of PhD Graduates of CUST which includes all the details of PhD alumnus including name, thesis title, supervisor name and year with uploaded soft copies of thesis. The list is being updated on regular basis. Till now 169 PhD's are graduated in various disciplines including Management & Social Sciences, Computing, Engineering and Health & Life Sciences. ORIC has also designed a standard PhD Poster Template and is responsible for coordination and revision of posters sent by students. It is requirement for PhD students to submit a poster related to their research work.

## J. ORIC Proposals Dashboard

ORIC has designed a Proposals Dashboard which contains the data related to research proposals being worked on by ORIC in collaboration with other departments. The dashboard is divided in to following tabs/categories which contains a brief description about each proposal in accordance with its status:

1. Submitted
2. Submitted and Under Review
3. Under Final Revision
4. Approved

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## K. Up gradation of Research Database and Publications

The Research Database was updated including updation of university Journal and Conference Publications, MOUs signed and Research & Development Projects accomplished by CUST faculty in 2020 till date.

## L. Up gradation of ORIC Webpage

The webpage of ORIC was updated as per directions of Vice Chancellor. The data about Events, Collaborations, R & D Projects, Publications, PhD Repository and Downloads was updated.

## M. Design of Faculty Research Group Poster

The poster for Structural Material Research Group (SMaRG) was compiled by ORIC to display the research achievements of the group lead and major fields of research. The Research Center is headed by Engr. Prof. Majid Ali, Professor CE Department.

## N. Impact Factor Verification of Faculty Research Honorariums

It is core responsibility of ORIC to verify the Impact Factor of faculty research publication honorariums in accordance with the updated HEC Journal Recognition System (JRS). ORIC performs this activity on daily basis.

## O. PhD Posters Revision and Coordination

Office of Research, Innovation and Commercialization performs PhD Posters Revision and associated coordination with PhD scholars as per standard poster template. The posters are then displayed in various university blocks designated for specific departments. ORIC performs this task as a regular routine work.

# Technology Incubation and Innovation

Office of Research, Innovation and Commercialization not only accomplishes research and development operations but also ensures continual activities in terms of technology innovation and incubation. This is the foremost domain CUST is working. In this regard numerous technical trainings, workshops and seminars are being conducted on regular basis to provide students, faculty members and professionals with the contemporary technical tools and skills. The university is also working on establishment of Business Incubation Centers and commercialization of research leading to resource generation.

## A. Concept Proposal for Center of Excellence for Training, Testing and Facilitation in Electric Vehicle Technology

Office of Research, Innovation and commercialization has prepared a proposal for scale-up idea of "Center of Excellence for Training, Testing and Facilitation in Electric Vehicles Technology" for submission in Planning & Development Board, Punjab. The proposed center would execute the capacity building, training and professional growth of technical manpower

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and professionals through workshops, contemporary courses, and skills development in subsystems of 2-3 wheelers, 4 wheelers, heavy commercial vehicles and electric power trains in electric vehicles technology. The modernistic center will provide hands on training and education to practitioners, technicians and relevant personnel to design, develop and support various subsystems of EVs. Similar equipment's would also be employed for commercial testing and characterization of these subsystems to facilitate the newly growing industry of EVs. Collaborations and mutual associations would be made with local electric automobile industry through their problem solving, advisory/consultancy and joint R&D work.

## B. Online Seminar on Change Management with respect to COVID-19

Office of Research, Innovation and Commercialization conducted a series of Online Training Sessions/Seminars for Knowledge Building/Enlightenment of faculty members, research scholars and students about the most recent subject matters during COVID-19 Pandemic. The seminar entitled "Managing and Implementing Change with respect to COVID-19" was held on 09th July 2020. The session was held on Microsoft Teams under "ORIC Seminars Team". The resource person for the session was Dr. Muzaffar Asad, Assistant Professor, Department of Management and Marketing, University of Bahrain. The speaker educated the addressees about the current practices and methodologies adopted worldwide to effectively implement and adapt to the changes transpired as a result of COVID-19 pandemic.

## C. Virtual Seminar on SARS COVID-19

Office of Research, Innovation and Commercialization organized an interactive Online Seminar entitled "SARS COVID-19" on 17th June 2020. The session was held on Microsoft Teams under "ORIC Seminars Team". The resource person for the particular session was Prof. Dr. Shaukat Iqbal Malik, Professor, FHLS and Director VIS, CUST. The speaker discussed the various types of Corona Viruses with their brief history. He educated the addressees about the symptoms, testing methods with their effectiveness, precautionary measures and treatment procedures. A total of 45 participants including the senior faculty members, research scholars and students from various departments attended the seminar.

## D. Virtual Training Session on Recent Approaches in Literature Review

ORIC organized an Online Training Session entitled "Recent Approaches in Literature Review" on 09th June 2020. The session was held on Microsoft Teams under "ORIC Seminars Team". The objective of the particular session was to enlighten CUST faculty members, research scholars and students with the updated knowledge about the most recent practices in Literature Review. The resource person for the particular session was Dr. Lakhi Muhammad, Assistant Professor, Management Sciences Department, CUST. The session ended on a high note and proved to be a great source of knowledge and acquaintance to the participants, and research scholars in particular.

## E. Online Session on Depression Management in University's Academic Tenure

Office of Research, Innovation and Commercialization Conducted Training Sessions/Seminars on depression and load management for research scholars and students on

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continual basis. An online session entitled "How to Avoid Depression During University's Academic Tenure" was held on 21st July 2020. The session was held on Microsoft Teams under "ORIC Seminars Team" which is specifically created by ORIC for its Online workshops, seminars and similar activities. The objective of particular session was to educate students about how to cope with the depression and uneasiness during their academic period.

## F. Online Seminar on Teaching Techniques for Virtual Learning Environment

Office of Research, Innovation and Commercialization assisted and collaborated with Quality Enhancement Cell (QEC), CUST to conduct a series of Online Training Sessions/Seminars for Training of faculty members about the Virtual Learning Environment (VLE) and online education system during COVID-19 Pandemic. In this regard, the virtual session entitled "Online Teaching Techniques" was held on July 08, 2020. The session was held on Microsoft Teams under "VLE Seminar Team" which is specifically created for training/sessions/seminars related to online teaching. The resource person for the particular session was Dr. Ahsan Mahmood Ahmed, Assistant Professor, Department of Management and Marketing, CUST.

## G. Virtual Seminar on Transition to Virtual Learning: Challenges vs. Adaptation

Office of Research, Innovation and Commercialization assisted Quality Enhancement Cell (QEC), CUST to conduct a virtual training session entitled "Virtual Learning: Challenges vs. Adaptation" on June 12, 2020. The session was held on Microsoft Teams under "VLE Seminar Team". The objective of the particular session was to educate CUST faculty members about reality based challenges of virtual learning The resource person for the particular session was Ms. Maryam Khan, Lecturer, Department of Management Sciences, CUST. The participants included the faculty members across various departments.

## H. Virtual Session on Difficulties faced by Students and Faculty in VLE Classes

Office of Research, Innovation and Commercialization in collaboration with Quality Enhancement Cell (QEC), CUST conducted a virtual session entitled "Difficulties faced by Students and Faculty during VLE Classes" on June 5, 2020. The session was held on Microsoft Teams under "VLE Seminar Team". The objective of session was to discuss and find solutions about major problems faced by students and faculty in CUST online education system. The resource person for the particular session was Dr. Irfan Anjum Manarvi, Professor, Mechanical Engineering Department, CUST. The participants included the faculty members across various departments.

## I. Certificate Distribution Ceremony of FYPs Business Plan Competition

The Certificate Distribution Ceremony of FYPs Business Plan Competition was held on 27th Feb 2020. The event was organized by Office of Research, Innovation and commercialization to instigate the students for their innovative project ideas and explicit business plans. Prof.

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Arshad Hassan, Dean FMSS was chief guest at the occasion. The faculty members'/project supervisors of award winning FYPs and students were present at the event. The chief guest and faculty members were briefed about the particular competition and the evaluation procedure adopted. Subsequently Dean FMSS was invited for certificate distribution among students. After the certificate distribution, Dean FMSS delivered a brief talk. He inspired the students about their endurance and highlighted the importance of business plans in present age of commercialization. He appreciated the efforts of students and highlighted the significance of marketing the product in the present age of commercialization.

## J. ORIC Presentation in Faculty Development Program

To showcase the recent progress report, and to enlighten the faculty members of EE department about Office of Research, Innovation and Commercialization and its role, Dean Research & Innovation, Prof. Aamer Iqbal Bhatti presented a faculty development session on 8th Sep 2020. Prof. Aamer Iqbal Bhatti presented the contribution of ORIC towards its stated domains i.e. Research Operations, Technology Incubation & Innovation and Industrial Liaison. He gave a brief overview about the various activities and events accomplished by ORIC and its future prospects.

# Industrial Liaisons

ORIC at CUST is continuously working on to build and maintain strong Academia-Industry Linkage with the focus on promoting and making CUST graduates the premium choice for the employers. ORIC is working in collaboration with various Departments to promote Academia-Industry Linkage. The industrial visits for either sides are being arranged on continual basis to promote academic collaborations and explore the areas of mutual interest and employment propensities for CUST students.

## A. Proposal for Optimization and Establishment of In Vitro Cultures of Potato, Banana and Ornamental Plants for Commercialization

In recent years, tissue culture techniques have become very famous and substitute tool for vegetative propagation of plants. As an emergent technology, the micro propagation of plants has influenced greatly both agriculture and industry by making sure the provision of plants to encounter the ever-growing world demand. It is contributing significantly to the progression of agricultural sciences in current eras and today they establish an essential tool in contemporary agriculture. It is due to that we can generate a huge number of clones from a solitary seed or explants, select required traits, reduce the amount of space needed for field trials and eradicate plant diseases through the vigilant assortment and sterile techniques. The main objective of the proposal is the enhancement in the production capacity and commercialization of potato, banana, tulip and araucaria through tissue culture techniques.

## B. Initiation of Certification Courses at CUST

Continuing Education and Certification Courses help an individual to showcase his competency, commitment for the profession, build expertise in his professional area, and helps with job advancement. These courses not only provide training on various aspects of

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subject but also deliver detailed knowledge and skills required to perform real-world job responsibilities. Keeping in view the significance of these courses for Industry personnel, Office of Research, Innovation and Commercialization (ORIC) initiated one semester long Certificate Courses in Spring-2020 for professionals and practitioners, who intend to develop on job skills and professional growth. The eligibility criteria for the particular courses was having minimum 16 years of education in the relevant discipline. The professionals from renowned R&D organizations were registered in four different courses.

## C. Collaboration with CS and MS Departments for Incubation of "Flex Tracker"

A series of meet ups of ORIC are held with CS and MS Departments for Incubation of "Flex Tracker". Flex Tracker is an application developed by CUST students and faculty that can be employed by various companies/organizations to track their vehicles or goods. This application can manage multiple services in one platform. The system is capable of dynamic stop and route configurations, comparison of followed route by driver with actual defined route, live location of vehicles on map, and over speeding notification to admin. The potential clients for flex tracker can be universities, schools, and goods distributer. After a deliberate discussion of ORIC with MS and CS departments, the participants agreed over the incubation of a company consisting of CUST faculty and students which would bring ownership among the team to sell their application. The proposed company team would consist of CUST faculty members with relevant students who would have privilege to be part of it. The collaborative sessions with departments are held on regular basis to make this dream reality, and a significant amount of progress has already been made

## D. Incubation of Tech Flickers

Office of Research, Innovation and Commercialization has initiated an incubation company entitled "Tech Flickers" at Capital University of Science & Technology, Islamabad. Dean Research & Innovation, Prof. Aamer Iqbal Bhatti have laid his special devotion to make this workroom possible. Tech Flickers is a SECP registered Start-Up incubated by two of the much endowed Computer Science graduates, Mr. Arslan Akram and Mr. Shoaib Ali in collaboration with ORIC. The company provides services in different areas of software development. The startup upholds the highest standards for project planning and execution, and is dedicated to delivering the perfect services for business needs on-time and on-budget. At present, Tech Flickers is successfully pursuing various projects in accordance with customer requirements. The company provides its services in following major domains:

- Web Development
- Graphic Designing
- SEO
- Web Security
- Malware Analysis
- Data Security
- Computer & Web Forensics
- Desktop Application Development

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# Additional Tasks

## Drafting of ORIC Newsletter Fall-2019

The third volume of ORIC Newsletter has been drafted and is under the graphic designing. The Newsletter briefly showcases the progress report of ORIC in terms of its stated domains i.e. Research Operations, Technology Incubation & Innovation and Industrial Liaisons. It also highlights workshops, seminars and other similar events accomplished by ORIC in Fall-2019. The Newsletter would be shared with all the university academic and administrative offices upon its publication

## A. Drafting, Editing and Publication of ORIC Activities Report Fall-2019

The ORIC Activities Book for Fall-2019 was compiled and published as per directions of VC Office. The book showcases the activities and events proceeded by ORIC as per its stated domains in the recent semester.

## B. Printing and Distribution of CUST Annual Report 2018-19

CUST Annual Report 2018-19 was compiled, published and distributed to around 100 universities across Pakistan by Office of Research, Innovation and Commercialization. The report was also internally disseminated to CUST offices and posted on website. The book provides information about every aspect of the university supported with facts and figures.

## C. Virtual Learning Environment (VLE) Committee Meetings

Virtual Learning Environment (VLE) Monitoring Committee was constituted, under the Dean Quality Enhancement Cell (QEC), to monitor all the online classes through a proper formal mechanism. All the matters relevant to VLE were discussed in twelve meetings of the committee held in Spring-2020 during COVID-19 pandemic. There was one member from ORIC which provided its full sustenance to VLE Monitoring Committee. It was core responsibility of ORIC to prepare meetings' minutes and communicate them to all departments and concerned offices.

## D. Virtual Learning Environment (VLE) Email

A special Email Account was created to facilitate students during online classes. The email address was communicated to all the university students. Various complaints including connectivity issues, assignment / quiz submission problems, etc. were received from students. The record of all these emails was maintained for audit. So far, more than 200 emails were received from students, and all of them were resolved effectively.

## E. Virtual Classes and Exams Held Summary Report

Office of Research Innovation and Commercialization maintained Class held Reports of Online Classes on daily basis during COVID-19 pandemic. The status of class attendance was also discussed in the VLE Monitoring Committee meetings. Different strategies were adopted at departmental level to increase the students class attendance. ORIC also prepared

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detailed exam held summary reports during the Mid Term and Final Term exams held for Spring 2020 semester. Overall, examinations were conducted successfully, maintaining the integrity of examinations and facilitating the students, and all issues were handled and resolved by the departments in a timely manner.

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

**WORLD BANK GROUP**

Local Challenge Fund

PROJECT OUTLINE

COVER SHEET

| | |
|---|---|
| **Institution Title** | Capital University of Science and Technology |
| **Institutional Address** | Capital University of Science and Technology |
| | Islamabad |
| **Title of Project:** | Towards the Application of Artificial Intelligence for Sustainable Livestock Management - A Pilot Project to uplift Socio-economic Conditions of Rural Women |
| **Principal Investigator** | Dr. Saira Ahmed |
| | Director, Directorate of Sustainability and Environment |
| | Assistant Professor, Faculty of Management & Social Sciences |
| | 0323-5666466 |
| | dr.saira@cust.edu.pk |

| | |
|---|---|
| **What is the Locally Relevant Socio-Economic Issue that the Proposal Addresses?** | Livestock has emerged as a significant sector in agriculture. Livestock play an important role in house-hold income of rural areas. As per Economic Survey of Pakistan (2019-2020), over 8 million rural families are engaged in livestock production and deriving more than 40 percent of their income from this sector. Women are mostly responsible for livestock management in rural areas. Based on their little knowledge on livestock management and other domestic responsibilities, they cannot make timely decisions for livestock management, thus affecting household income. We propose to empower these women by the use of technological innovation in livestock management. |

# I. EXECUTIVE SUMMARY

Pakistan is an agriculture economy and livestock sector contributes 60 percent to agriculture and 11.69 percent to national GDP. Women are mostly responsible for livestock rearing in rural areas of the country. Due to lack of female extension agents in the provincial livestock development departments, rural women do not get any formal training for livestock management. This project proposes the empowerment of rural women through technological innovations in livestock management. An Intelligent Decision Support System (IDSS) is proposed that will make use of Artificial Intelligence (AI) and Internet of Things (IoT) technologies to provide informed decisions on livestock management through a mobile app. The proposed IDSS will provide notifications and alerts to women farmers on health, feed and reproduction aspects of the livestock management. The mobile app will provide access to vaccination centers, veterinary facilities and feed suppliers. This will address the target 5.B of SDG-5 on gender equality that emphases on the use of enabling information and communication technologies for women empowerment.

An extensive capacity building program is also proposed to complement the technological solution for the development of skills and knowledge of rural women in livestock management. A series of outreach activities including seminars, workshops, farm visits, practical demonstrations, group discussions and one-on-one sessions on livestock management will be arranged for rural women. The participants will be provided the essential background knowledge and training on animal husbandry, animal health and disease management, animal breeding, ration formulation and fodder production. Emphasis will be given to develop the skills required for community-based small entrepreneurship models in dairy farming such as community-based milk selling system and production of value addition dairy products including cream, cheese and butter. Mobile app will be used to foster a culture of entrepreneurship in women farmers through exciting competitions for activities such as calf rearing and production of value addition dairy products.

The project will be executed in the district of Faisalabad through the academic collaboration of Capital University of Science and Technology (CUST), Islamabad; National University of Sciences and Technology (NUST), Islamabad; and University of Agriculture Faisalabad (UAF). The principal investigator (PI) of the project from CUST will provide expertise on the development of research activities related to women empowerment in the project. The co-principal investigator (co-PI) from NUST will lead the development of the technological solution including the IDSS and mobile app. The local co-PI from UAF will collaborate with other PIs to provide the required logistic support for the development and rollout of the technical solution within the rural women community in the district. The contacts of UAF with livestock and dairy development department, corporate farmers and district livestock extension wing will be used to launch the extensive capacity building program for rural women.

# II. PROJECT DESCRIPTION

**Research challenges:**

Agriculture contributes to 19.3 percent to national GDP and absorbs 40 percent of labour force. Livestock sector has a share of 60 percent in agriculture and 11.69 percent in national GDP [1]. Livestock plays an important role in socioeconomic development of rural population. Livestock yields including milk, butter, poultry and meat provide a regular source of income to farmers. Dairy animals are considered as a valuable asset to cover significant family expenditure in emergency situation. Women are mostly responsible for livestock rearing in rural areas. Their responsibilities include cleaning livestock sheds; feeding, milking and watering of animals; preparation of oil and butter; and looking after sick and expectant animals. Rural women perform these livestock management tasks in addition to child care, routine household errands and helping men in crop production. Rural women work up to 15 hours a day but their contributions are not appreciated due to patriarchal social norms in the society.

The issues related to health, feed and reproduction of livestock animals are the major constraints that affect the household income of rural farmers [2]. The men farmers in general and women farmers in particular do not have the required skills and knowledge to make informed decisions on livestock management. A comprehensive interdisciplinary training through hands-on workshops, awareness seminars and extension agents can provide for the capacity building requirements of the rural farmers. Evidence suggests that the capacity building of smallholder dairy farmers with improved extension services can significantly increase their farm income [3-4]. The training from provincial livestock department is normally provided to male members of the household due to social norms. The rural women who are mostly responsible for livestock management do not get any formal training for livestock rearing. Food and Agriculture Organization (FAO) of the United Nations recommends that the provincial governments of Pakistan must hire a large number of female extension agents for capacity building of rural women in livestock management [5].

**Aims & Objectives:**

This project aims to address the gaps in skills and knowledge of rural women in livestock management through the use of technological innovations. In particular, this project proposes the development of an Intelligent Decision Support System (IDSS) that makes use of state of the art technologies of Artificial Intelligence (AI) and Internet of Things (IoT) for precision livestock management. The proposed IDSS is to be made available through a mobile app to women farmers that will enable them to make informed decisions on livestock management. This will empower the rural women farmers to make critical decisions related to health, feed and reproduction of livestock animals. This will reduce the burden of labour intensive tasks of rural women and improve the livestock productivity to uplift the socioeconomic conditions of rural household. This is in line with the United Nations Sustainable Development Goal 5 **(SDG-5) on gender equality** [6]. **In particular, the target 5.B of SDG-5 is addressed that focuses on** *"enhance the use of enabling technology, in particular information and communication technology, to promote the empowerment of women."* **Expert list …..u r focal person….take decisions .pls be active.play this tactfully. U should ….u take responsibility…functional partnership**

Other SDGs being addressed include **SDG-8 for Decent Work and Economic Growth** and **SDG- 11 for Sustainable Cities and Livelihood**

## Methodology:

The proposed study will be conducted in district Faisalabad of Punjab province which is one of the major producers of livestock. The development of the proposed IDSS and its widespread rollout in rural women farmers will be achieved through the following methods.

- **Assessment of the training needs of rural women in livestock management**

A survey of the rural women farmers will be conducted to assess their knowledge and skills of livestock rearing. A good sample size will be chosen from all the tehsils for an accurate assessment of training needs of women farmers in the district. Questionnaires will be developed to evaluate the knowledge of women on health, feed and reproduction issues of livestock animals. Interviews will be conducted to assess their knowledge on the following livestock management issues.

- Animal husbandry (housing, space requirements and well-being of dairy animals)
- Animal health/disease management (treatment and vaccinations)
- Animal breeding (Artificial Insemination and natural breeding techniques)
- Ration formulation
- Fodder agronomic practices (silage production)
- Milk value addition (production of cream, cheese and other dairy products)

The data will be analysed to formulate a complete capacity building plan for rural women farmers in the next phase of the project.

- **Development of IDSS for precision livestock management**

The key part of the project will be the development of IDSS for precision livestock management. The proposed system will monitor the activities of livestock animals through intelligent sensors. The collected data will be relayed to a locally installed fog device. These fog devices are capable to host deep neural networks (DNNs) to make preliminary intelligent decisions on health, feed and reproduction for precision livestock farming [7]. The application of fog devices brings sustainability to the architecture of IDSS as most of the processing can be performed locally without forwarding it to the cloud. This is a required feature for operation in remote rural areas that have internet connectivity issues. In order to cater for severe connectivity issues in remote rural areas, Long range Wireless Area Network (Lora-WAN) architecture is proposed. The Lora-WAN devices can relay the data up to 10kms to a Lora-WAN gateway that can forward the data to cloud through internet. The cloud architecture is chosen for scalable deployment of IDSS in the future. Big data analytics are performed by the DNNs hosted at the cloud for intelligent decisions. The alerts and notifications are relayed to female farmers through a mobile application. The mobile app will also provide location based services for nearest vaccination centres, veterinary hospitals, recommended feed suppliers, artificial insemination centres, contact details of livestock officers and extension agents. The proposed architecture of the IDSS is shown in Figure 1.

Figure 1. Architecture of Intelligent Decision Support System (IDSS) for rural women farmers.

- **Capacity building of rural women farmers in livestock management**

A series of awareness seminars, workshops, dairy farm visits, practical demonstrations, group discussions and one-on-one sessions will be arranged for rural women farmers. Workshops will be arranged on the following topics for capacity building.

- Animal husbandry (housing, space requirements and well-being of dairy animals)
- Animal health/disease management (treatment and vaccinations)
- Animal breeding (Artificial Insemination and natural breeding techniques)
- Ration formulation
- Fodder agronomic practices (silage production)
- Milk value addition (production of cream, cheese and other dairy products)
- Dairy breeds and their selection
- Entrepreneurship opportunities in livestock farming
- Credit availability for livestock farming through government loan schemes

A massive train-the-female-trainers program will be launched. Based on active participation in the training workshops, a female from each village will be selected and given extensive training from professionals to become a trainer. These female trainers will then lead the capacity building operation in their villages.

These capacity building activities will take place before the IDSS is ready to go live for active deployment. A good sample of women farmers from the trainees will be selected to deploy the sensors on animals. A series of training will be given to the chosen women farmers on the use of IDSS for livestock management. The use of mobile app for health, feed and reproduction related tasks of livestock will be demonstrated in workshops. The videos of trainings provided in earlier phase will be made available through mobile app for reference. In order to check their knowledge and develop interest in livestock management, a number of interactive quizzes and games will be available within the mobile app.

In order to foster the entrepreneurship culture in rural women, extensive training on community-based dairy farming will be provided. Community based group marketing strategies for milk, cheese, cream and butter selling will be introduced. Mobile app will connect the rural women farmers to dairy cooperatives for small entrepreneurship models. Competitions between the participating women farmers on calf rearing, milk, cream and butter production will be arranged through mobile app to nurture the entrepreneurship culture. Exit surveys will be conducted on the socioeconomic gains and empowerment of rural women farmers.

## Project Integration:

The project proposes the development of an IDSS for livestock management to empower the rural women farmers. The IDSS developed in this research will use state-of-the-art technologies of artificial intelligence, internet of things, machine learning, computer vision, fog computing, cloud computing and big data analytics. In order to fully utilize the potential of technological innovation, a massive capacity building program has been proposed. Rural women will be trained for better livestock management through the use of technology. A culture of entrepreneurship among the rural women will be fostered. This will create a sustainable atmosphere for women empowerment after the project is completed.

## Partnerships:

This project will be executed through the academic collaboration of Capital University of Sciences and Technology (CUST), Islamabad; National University of Sciences and Technology (NUST), Islamabad; and University of Agriculture Faisalabad (UAF). The lead principal investigator (PI) from CUST will develop strategies on assessment of the training needs of rural women in Faisalabad district in collaboration with local co-principal investigator (co-PI) from UAF. Co-PI from NUST will develop the IDSS system in collaboration with local co-PI from UAF. Livestock research farm at UAF will be used for calibration, data collection and small-scale testing of the IDSS.

UAF has strong sectoral collaboration with District Livestock Officer (DLO), cooperative farm managers and district livestock extension wing. These contacts will be utilized to launch the capacity building program by the local co-PI from UAF. PI from CUST will be part of the capacity building program to ensure that SDG's key performance indicators (KPIs) on women empowerment are included in the program. Co-PI from NUST will be leading the team of trainers providing trainings on IDSS and mobile app during the capacity building program.

## Project Dissemination Strategy

Our multi-tier sustainability project shall not only fil the gap of gender inequality in sustainable livelihoods and the usage, but will also pave paths for better management of livestock n other districts of the country.

The successful outcomes shall be disseminated with a concrete outreach policy which is as follows:

## 1. Policy Engagement

Results shall be presented before and discussed with:
- Parliamentary Standing Committee on gender empowerment and youth.
- Relevant government ministries such as those dealing with Kamyaab Jawaan program etc.
- Youth and gender empowerment committees at the provincial level.

## 2. Policy Dissemnination
- Ideas and policy recommendations to be presented in preliminary and final national seminars respectively to include all local stakeholders and members of the civil society.
- Dunya News TV network has been taken on-board for electronic media coverage.
- Social media coverage shall be provided by the Directorate of Sustainability & Environment, CUST.
- Conclusive policy reccomendations gathered from the policy engagement phase shall be incorporated into the final consolidated report.
- Based on our findings and policy engagement, the project case-study (from inception to implementation) will be show-cased as an international peer-reviewed publication, with due recognition of funding to Higher Education Commission (HEC) and the World Bank Group.

**WORLD BANK GROUP**

**Local Challenge Fund**
**PROJECT OUTLINE**
**COVER SHEET**

| Institution Title | Capital University of Science and Technology |
|---|---|
| Institutional Address | Expressway, Kahuta road, Zone 5 |
| | Islamabad |
| Title of Project: | LCF:  **Behavioral Intervention for Sustainable Agricultural Practices: A Field Experiment for Water Conservation** |
| Principal Investigator | Dr. Sabahat Haqqani |
| | Department of Management and Social Sciences |
| | Assistant Professor |
| | +923365282232 |
| | sabahat.haqqani@cust.edu.pk |

| What is the Locally Relevant Socio-Economic Issue that the Proposal Addresses? | The proposal addresses socio-economic issue of water shortage through proposing behavioral intervention for efficient use of water by local farmers. According to International Monetary Fund (IMF) Pakistan is ranked third in countries facing water shortage. It will cross absolute water scarcity line (< 500m$^3$/ person) by 2025 (Ashraf, 2016). This shortage of water is adversely affecting agriculture sector of Pakistan which is the largest contributor to GDP (24%). Although technological advancements have been made in agriculture sector continuously, farmer's preference for traditional methods and lack of knowledge, familiarity and advice along with lack of insight for long term cost benefit analysis is posing major hurdle in effectively utilizing technology for proficient use of water resource. In order to address this issue the proposed project will design an indigenous Behavioral Insight program targeting efficient use of water by farmers. The feasibility and efficacy of this program will be tested through field experiment with the local farmers in Rawalpindi district of Punjab province. The project will aid in addressing SDG 6 (Ensure availability and sustainable management of water and sanitation for all; target 6.4 & 6.b). Agriculture is one of the biggest water consuming sectors in Pakistan and an effectual management of water resource will not only help to address SDG 6 but will also contribute to promoting sustainable agriculture practices (SDG 2, Target 2.4). |
|---|---|

# I. EXECUTIVE SUMMARY

According to International Monetary Fund (IMF) Pakistan is ranked third in countries facing water shortage which is adversely affecting all sectors, especially agriculture. Agriculture plays a crucial role in developing economies like Pakistan by enhancing financial growth and progress; potentially reinforcing environmental sustainability and community development (World Bank, 2007). It constitutes the largest sector of economy in Pakistan contributing approximately 24 percent of Gross Domestic Product (GDP); and is a major source of foreign exchange income (Pakistan Bureau of Statistics, 2019). According to Pakistan Agriculture Research Council (PARC) one of the biggest challenge in increasing yield of crops is water management. Pakistani community is facing this challenge for more than a decade now. Although technological advancements have been implemented in agriculture sector continuously, a major hurdle in success of these efforts is the farmer's preference for traditional methods and lack of knowledge, familiarity and advice along with lack of insight for long term cost benefit analysis (Aslam, 2016). An innovative approach of Behavioral insight based programs to increase agri-environmental efficiency have been researched with promising results in many regions of the world (e.g., Center for Behavioral and Environmental Agri-environmental Research, 2019; The Behavioral Insights Team, 2019; Dinar, Ashraf & Reints, 2017; Linder, Lindahl, & Borgström, 2018). Therefore, this study proposes to develop and implement a behavioral insight intervention to enhance water sustainability in agriculture sector. The project will contribute towards SDG 6 (Ensure availability and sustainable management of water and sanitation for all, target 6.4 & 6.b). Agriculture is one of the biggest water consuming sectors in Pakistan and an efficient management of water resource will not only help address SDG 6 but will also contribute to promoting sustainable agriculture practices (SDG 2, Target 2.4). It is a 2 year project that will be conducted in two phase: phase I: intervention development and Phase II: feasibility and efficacy of intervention. The multidisciplinary team has complementary expertise in behavioral and psychological interventions, economics, hydrology, sustainable agriculture, development, and water sustainability. PI and Co-PI will contribute to both phase 1 and 2 including preparation and delivery of intervention. The sectoral and local partners will aid in development and adaptation of intervention in accordance with the local farmer needs. They will also providing access to the field and conduct measurement of change in water usage pattern as a result of intervention. Sectoral partners will also ensure integration of the intervention within the local network of their host institute, National Agriculture Research Center. It is anticipated that with the current situation of water crisis in Pakistan this study can lay an innovative and founding step in sustaining the resources, and advancing research and intervention on addressing water shortage issue in agriculture sector of Pakistan.

# II. PROJECT DESCRIPTION

***The research challenge and anticipated impact:***

While behavioral insights from behavioral sciences have been informing programs and policies in many domains (including nutrition, economics and health care), its usefulness has largely went unnoticed in agriculture and agri-environmental sector. Owing to the benefits that can be achieved through the power of behavioral insights the Organization for Economic Co-operation and Development has recommended nudging the decisions, attitudes and behavior to achieve Sustainable Development Goals (OECD, 2018).

For sustainable development, agriculture plays a crucial role in developing economies like Pakistan by enhancing financial growth and progress; potentially reinforcing environmental sustainability and community development (World Bank, 2007). It constitutes the largest sector of economy in Pakistan contributing approximately 24 percent of Gross Domestic Product (GDP); and is a major source of foreign exchange income (Pakistan Bureau of Statistics, 2019). This major contribution of agriculture is achieved because of *Pakistan's* primary natural assets of arable land and water; which are limited and prone to degradation because of improper management, austere environmental conditions and changing climate (Lal, 2018). Although the agricultural productivity of cereal grain has increased between 1960 and 2018 from 45 to 201 million, far greater challenges lie ahead in terms of water availability for irrigation, much of which is attributed to inefficiency in management of this resource (Lal, 2018; Pakistan Agriculture Research Center, 2019).

According to Pakistan Agriculture Research Council (PARC) one of the biggest challenge in increasing yield of crops is water management. Pakistani community is facing this challenge for more than a decade. In 2003 its per capita availability of water was 200 $m^3$ less than the international standard of 1500 $m^3$ and it has been on the decrease ever since (PARC, 2019). It is predicted to decrease to 500 $m^3$ in 2025 (Ashraf, 2016). This situation is being complemented by competing water demands of rapidly growing domestic and industrial sectors. According to PARC as compared to USA (1.56 kg m-3) China (0.82 kg m-3, and India (0.39 kg m-3) water productivity for cereals is very low in Pakistan (0.13 kg m-3) which is attributed to conventional irrigation methods and poor agronomic practices. Research has indicated that adoption of modern technology can result in efficient use of water resources leading to best yields of crops like cotton, wheat, rice and sugarcane (Aslam, 2016). However, among the hurdles in adoption of modern technologies are the farmer's preference for traditional methods and lack of knowledge, familiarity and advice along with lack of insight for long term cost benefit analysis (Aslam, 2016). From the literature review presented so far it can be discerned that to increase the efficiency and productivity of the irrigation systems and agronomic practices more concentrated efforts are required that not only focus on technological and agricultural aspect but also on behavioral domain.

Many programs have been introduced at governmental and non-governmental level to tackle this issue such as training farmers to use systems like drip irrigation system, furrow bed irrigation system and other modern technologies (Pakistan Agriculture Research Center, 2019). However, it is imperative to understand that the eventual large-scale adoption of any methodology/ technology is dependent on changes in farmers' behavior (Amishi, & Ravichandran, 2017). Behavioral insight based programs to increase agri-environmental efficiency have been researched with promising results in many regions (e.g., Center for Behavioral and Environmental Agri-environmental Research, 2019; The Behavioral Insights Team, 2019; Dinar, Ashraf & Reints, 2017; Linder, Lindahl, & Borgström, 2018). Behavioral insight programs propagate that when faced with change people are prone to 'inertia'; leading to status qou bias. Thus, changing their choice architecture and presenting new choices as default option can be helpful in adopting sustainable practices (Ferraro, Messer & Wu, 2017).

*Anticipated impact:*

This study aims to generate new and important insights into human factors involved in adopting sustainable agricultural practices in Pakistan along with valuable tools generated from behavioral insights based intervention for water conservation by the farmers. This study will directly aid in addressing SDG goal 6 (Ensure availability and sustainable management of water and sanitation for all, target 6.4 & 6.b). Owing to the fact that agriculture is one of the biggest water consuming sectors in Pakistan, an efficient management of water resource will not only help address SDG 6 but will also contribute to promoting sustainable agriculture practices (SDG 2, Target 2.4).

With the current prediction of water crisis in Pakistan this study can lay an innovative and founding step in sustaining the resources. Thus, it intends to contribute to helping Pakistan in achieving Sustainable Development Goals through using behavioral insights in agriculture sector. The research is estimated to immediately benefit participating farmers in terms of effective use of water thus reducing water wastage thus increasing water availability for other farmers leading to better crop yield. It is anticipated that the toll generated and tested as result of this project will be used in future for those in the surrounding areas through by introducing behavioral techniques like modelling. In the long run it will also provide a model/ framework for future replications for applied agricultural researchers, behavioral scientists and economists as a behavioral modification tool for efficient use of water resources.

## Objectives

Following are the objectives of this study:

1) To design an indigenously developed Behavioral Insight intervention for efficient water use by Pakistani farmers.
2) To test the feasibility of Behavioral Insight intervention to be used with farmers.
3) To test the efficacy of the behavioral insight intervention for effective water management by the farmers.

## The methodology

Owing to the evidence of utility of Behavioral Insight programs in agriculture, water resource management and agri-environmental sector, this research proposes (1) to design an indigenous Behavioral Insight program for efficiently managing the use of water with insights from behavioral science into program designs for cereal grain farmers (2) use field experiments to test the feasibility and efficacy of the program in enhancing water management by the farmers. The study will be conducted in two phases. In phase 1 (10 months), intervention will be prepared based on systematic literature review by the multidisciplinary teams of all collaborators. The prepared draft of the intervention will be reviewed by an expert panel consisting of consortia of anthropologist, sociologist, psychologist, hydrologist, 2 representative local farmers. Cognitive interviews will be conducted with 10 local farmers to test the comprehensibility and applicability of the intervention within the local context. In phase 2 (second years of the project) a pilot study will be conducted to test the feasibility of the intervention where change in perception and cognition of the farmers will be measured over the period of two months. This will be followed main study consisting of field experiment over the period of 8 months. To deliver the intervention workshops will conducted with the local farmers. For the purpose of analyses, data will be gathered on change in pattern of water use and farmers' attitude, intentions, past and present behavior from both control and

experimental group. Structural Equation modelling will be used for analyses. Other contextual variables such as environmental conditions and farmers' education will also be considered in the analyses. The results of the study will be prepared in the form of seminars, conference presentations, research report, and article publication.

**Project integration:**

As mentioned earlier the first objective of the study will be targeted in Phase I of the study. The methodology employed in this phase will ensure stepwise progress of the project. The targeted end product at the end of the first year is a manualized Behavioral Insight Intervention; both in electronic and paper form. To ensure consistent progress of the project monthly meetings will be organized among all collaborators where components of the intervention will be designed and reviewed in accordance with the local circumstances of the farmer, feasibility of administration, sustainability, likelihood of integration within the existing water resource programs of the sectoral collaborator (Climate Energy And Water Research Institute at National Agriculture Research Center) and local collaborator (Lead Pakistan).

Phase II of the study will not only ensure field testing of the intervention, it will also provide a model framework for advancing behavioral research and intervention in agriculture. In this proposed project where an effort is made to utilize an innovative approach in water management research, field experiment conducted in collaboration with sectoral and local corroborators will ensure the assimilation of the project in the existing broad research domain of water management within agriculture sector. It will also aid in advancement of water management knowledge and tools.

**Partnerships:** This project will be conducted by a multidisciplinary team having complementary expertise in behavioral and psychological interventions, economics, hydrology, sustainable agriculture and development, and water sustainability; required for conducting this interdisciplinary project. The PI, the two Co-PIs and collaborates will contribute to the behavioral insight intervention development from behavioral economic and agricultural perspective. The intervention will be delivered by PI and Co-PIs. The sectoral collaborators will ensure the suitability of the intervention to be implemented within the existing agricultural practices through their host institute (National Agriculture Research Center). They will also be contributing to the scientific integrity of the intervention during field experiments and help in providing objective measure of change in pattern of water usage as a result of intervention. The local collaborators will ensure community adaptability of the intervention and facilitate the community outreach. Owing to their expertise in agriculture and water sustainability they will aid in construction of the intervention in from sustainability perspective. Where the behavioral, economics and agricultural expertise of PI and Co-PI will ensure construction of Behavioral Insight intervention, the diverse and extensive experience of the collaborator will help in ensuring successful conduction of the project.

**WORLD BANK GROUP**

HEC

## Local Challenge Fund

## PROJECT OUTLINE

## COVER SHEET

| Institution Title | Capital University of Science and Technology |
|---|---|
| Institutional Address | Kahuta Road, Zone V, Islamabad |
| | Islamabad |
| Title of Project: | Current and Future Impact of Public Sector Secondary Education in Pakistan |
| Principal Investigator | Prof. Dr Nayyer Masood |
| | Computer Science |
| | Head of the Department/ Professor |
| | Tel. # 0333-6103920 |
| | Email: nayyer@cust.edu.pk |

| What is the Locally Relevant Socio-Economic Issue that the Proposal Addresses? | In the last two or three decades, a clear paradigm shift can be observed regarding the choice of Public or Private schooling system. Up till mid-80s, most of the secondary schools were Public sector or Government administered. So, we would find children from all classes of society going to the same schools that produced a good mix-up providing a strong base for quality education and training. These Government schools were functioning as nurseries to provide manpower for the different sectors of the country. Later on, things started changing drastically due to different reasons. A strong perception (which might be true even) started to build that education level at Government schools was depleting. The perception grew so strong that it created a vacuum in the field of quality education that provided a chance to private sector to sneak in and they started filling the gap. Today the situation is that any person who can afford to pay fees, prefers to send his children to private schools mainly due to their perceived quality education. The Government schools have mainly become the destiny of less-privileged children or those belonging to poor families. Although, in last few years the Government has put special focus on improving the quality of education at government |
|---|---|

schools; however, still government schools fall behind the private schools in terms of board results.

This research focuses to analyze whether the students from government schools are progressing in their professions. The focus here is to collect data from various fields of life and analyze the trends regarding the career growth. The outcome of this research will be to develop an automated framework that will help to better understand the contribution of the government schools in one's own career growth as well the contribution towards the betterment of the country by achieving high standards in the profession.

# I. EXECUTIVE SUMMARY

Education is a major arear among Sustainable Development Goals (SDGs). Education sector is the largest sector in terms of government jobs in Pakistan. In this era of science and technology, only those nations can strive for excellence who have best education system. Today we cannot waste our resources, instead we have to utilize our resources up-to maximum level. Whether they may be human resources, time, money, material or other resources. It can be attained through effective use of our educational system. Countries in the world are now rated on the basis of their quality of human resources and not on the basis of natural resources. In fact, it is Education that changes the whole scenario.

In the context of Pakistan, we see a paradigm shift in the last couple of decades. A couple of decades ago, people used to prefer to send their children to government schools. Therefore, at that time, government educational institutions were the main contributor to produce the human resource that took part in the development of the country. However, statistics have changed significantly in the last two decades. Since people who can afford to pay fees preferred private schools over government schools due to their perceived quality education. With the passage of time, the quality of education at government schools degrades substantially due to lack of budget. Although, in last few years the Government has put special focus on improving the quality of education at government schools; however, still government schools fall behind the private schools in terms of all quantifiable outcome measures.

In government schools of Pakistan millions of students are still studying and what are they studying, is a million-dollar question. However, this system does not allow the students to think critically, develop creatively, and act independently. Therefore, the focus of this research is to study whether the students from government schools are progressing in their professions. Besides, based on the analysis an automated framework will be designed that will predict the level of progress of any individual student based on its academic background and other relevant personality characteristics.

**Research Objectives:**

O1: Current status of contribution of our public sector education system in socio economic sectors of Pakistan.
Q2: Trend analysis of the role of public sector education system in last 50 years.
O3: Prediction of future status of public sector education in socio-economic sectors of the country.
O4: Recommendations to improve the chances of public sector students in socio-economic sectors.
O5: Designing of an automated framework to predict individual's performance in one's career.

# II. PROJECT DESCRIPTION

Career growth is very important for everyone. No matter what profession a person belongs to, he/ she has a desire and wish to reach the peak of his/ her career. That is why there is no denying the importance of career growth. Numerous studies have been conducted, the main purpose of which is to find out the factors and parameters that play a vital role in the professional growth of any individual. In this regard, several parameters were identified. For example, a human's personality, education, job performance, food and nutrition, perceived organizational commitment and geographical influences, etc., [1, 2, 3]. However, so far, no such study has been conducted that examines how and to what extent an educational institution has an impact on a person's professional growth. Therefore, in this project where other parameters shall be considered and analyzed but **the focus will be on understanding the relationship between the type of educational institute and professional growth.**

In the context of Pakistan, educational intuitions can be divided into two main types: Private and Public sector schools. As per Pakistan Economic Survey Report 2013-2014, approximately 74% of students were attending public sector and 26% of students were attending private sector schools in rural areas of Pakistan; on the other hand, 41% of students were attending the public sector, and 59% of students were attending private sector schools in urban areas [4]. This ratio has been changed in favor of private schools over the last 5 years.

Soon after the independence of Pakistan, although private schools played a more important role; but, when educational institutions were nationalized in the 1970s, for the next couple of decades, basically the same people in every field who were educated in public sector schools remained on top positions [5]. But in the late 1990s, where private schools raised their standards, public schools seemed to decline [6]. So, parents who could afford to pay began to send their children to private schools. But not everyone can afford to pay for private schools with high standards. That is why there are many children who attend government schools. **This gives reason to another dimension of this project is to understand whether an automated system can be developed that can efficiently predict how far the children who are currently studying in public schools can go in their careers. Another objective of this project is also to identify the skills and competencies that are necessary for career growth but only provided by private schools.** The absence of these aspects in public sector schools may cause hindrance in the career growth of their students.

## Methodology
This project will be divided into the following phases:
1. Selection of target professions
2. Data collection
3. Data mining and analysis
4. Career growth prediction framework

The first phase is to identify the professions that are directly related to education and the educational institution. In the Armed Forces, for example, it does not matter what educational institution a person comes from because the institution itself trains its own people, so everyone has an equal opportunity for growth. Similarly, for the hardworking class and those involved in trading, it does not matter how much or where the education is obtained. Therefore, it is essential to identify the target profession. In the same phase, we shall also look at the various perceptions of growth pertinent to each profession. To this end, we may also split a professional domain into three tiers of leadership. The first tier will represent the top

leadership; the second tier will represent the middle-ranked leadership and the third tier will represent the lowest level leadership. This quantization of leadership will help in the better coarse level prediction of an individual's growth.

The second phase is the data collection, which in fact is a multifaceted process; because, each step of this process requires different knowledge and skills. At a broad level, the data collection phase can be divided into three steps: (i) population sampling, (ii) development of data collection methods, and (iii) data collection. It is very important that the data collected represents the entire population. In this regard, various sampling techniques will be analyzed, and an efficient approach will be designed and developed. Sampling plays a critical role in any research based on user studies because recruiting representative research subjects vary with the choice of sampling technique and thus overall research outcome may suffer due to inefficient selection of the sampling technique. Once valid subjects are identified the next step will be to conduct surveys. In this regard, survey forms shall be designed. But these forms will be designed to identify all the important parameters, especially questions related to education and educational institution.

After collecting substantial data, the next step will be its analysis. In contrast to the existing career growth analysis approaches in which statistical inference is primarily used; data mining will be employed in this project. Today, data mining and extraction of hidden information from the available data are among the basic research fields whose applications we find abundantly in science, engineering, and education, etc. The strength of data mining lies in the fact that in statistical inference, the hypothesis is first made, and then its accuracy or inaccuracy is determined based on data; however, data mining is the other way around i.e., patterns and hypothesis are automatically extracted from the data. Various data mining approaches will be designed and developed that can identify the hidden trends within the data. The same analysis will result in different projections to see what impact the background of the educational institutes will have on a person's career. Next, Machine Learning will be integrated to develop an automated framework that when applied to new data will predict an outcome- in this case, the level of career growth of an individual.

Another dimension of this research is to provide recommendations to the concerned government authorities so that required transformations can be applied to the public sector schools so that the students studying in these schools can grow like others in their professions.

## Research challenge

1. **Predicting career growth** based on career-center data is still in its earliest stages and considered as multi-variate complex problem.
2. **Data collection**: there is currently no dataset that can show the relationship between educational background and career growth; therefore, the creation of this kind of dataset is a big challenge.
3. **Parameter selection**: Theoretically various parameters have been identified in the literature that affects the career profile of an individual; however, the selection of 'best' parameters that really contribute the most in career growth and have the scientific justification is also an important and challenging task.
4. **Prediction framework**: designing a robust framework that can intelligently predict the career progress of an individual based on the selected parameters is another critical yet challenging task as there is no such framework that has been proposed so far.

**Project Beneficiaries**

1. Ministry of Federal Education and Professional Training
2. Ministry of Planning, Development & Special Initiatives
3. Higher Education Commission
4. Academia and Industry

**Project integration**



Figure 1: Basic modules

**Partnerships**

*1. Capital University of Science and Technology (CUST)*

CUST will be focusing on three aspects of the project. The first and foremost task is to obtain substantial and reliable data. In this regard, questionnaires and survey forms shall be prepared on the basis of which all other phases on this project will be developed. Second, real data will be collected by liaising with various organizations. Third, using various innovative and cutting-edge technologies such as big data, predictive analytics, data mining, and deep learning, an automated framework will be designed to make suggestions and recommendations for the improvement in public sector institutions. Also, considering the educational background and other personality parameters of any individual, the framework will assist in predicting to what extent the individual will progress in its career.

*2. Islamia University Bahawalpur (IUB)*

The Co-PI from IUB is from the area of Education Training that is why IUB will contribute in the perspective of formal aspects of secondary education specially in the current era. What traits should be focused in the secondary education to build a balanced personality of students. These formal descriptions of traits will be compared with the realities on ground that will help to identify the shortcomings and to build some suggestions for future improvements/betterments.

### 3. Board of Intermediate & Secondary Education, Bahawalpur

BISE, Bahawalpur is the sectoral partner. BISE will contribute to validate the project's findings. Furthermore, BISE will also facilitate in generating real dataset which is an essential component of the project.

**WORLD BANK GROUP**

**HEC**

## Local Challenge Fund

## PROJECT OUTLINE

## COVER SHEET

| Institution Title | Capital University of Science and Technology |
|---|---|
| Institutional Address | Zone V, Kahuta Road |
| | Islamabad, Pakistan |
| Title of Project: | LCF: Bioremediation and Toxicity Reduction of Effluents by Indigenous Microbial Strains as well as Optimization of Bioreactor for Sustainable Production of Third Generation Bioethanol |
| Principal Investigator | Arshia Amin Butt |
| | Department of Bioinformatics and Biosciences |
| | Assistant Professor |
| | Tel. # 03325375929 |
| | Email: arshia.butt@cust.edu.pk |

| What is the Locally Relevant Socio-Economic Issue that the Proposal Addresses? | - Waste management<br>- Bioremediation of Eutrophic lake present in vicinity of university<br>- Optimization of protocol for effecient waste management<br>- Biofuel production from waste (Algae isolated from waste) |
|---|---|

# I. EXECUTIVE SUMMARY

With global shortages of fossil fuels, especially oil and natural gas, a major focus has developed worldwide on renewable biofuel production. As an active supporter of SDG (Sustainable development goals) we intend to work on third generation indigenous biofuel producing strains of Algae. We also intend to use extensive biofuel sources present in the campus vicinity for screening of efficient indigenous bacterial and fungal strains.

Campus being situated besides a big canal where biomass is heavily accumulated because of weeds, submerged plants, local organic waste by cattle and stray animals we feel the responsibility to exploit our expertise for waste management developing consortia of indigenous bacterial, fungal and algal strains with most efficient bioremediation capabilities. Pilot scale biofuel production methods will also be optimized by using genomically identified strains.

Now a day, biofuel is driving important attention because of being not only a renewable energy source but also non-toxic, biodegradable and its impact on environment and climate (Singh, A.K., 2018). They can be broadly defined as solid, liquid or gas fuel consisting of or derived from biomass i.e. biological material from living organisms. The most popular forms of biofuels are biodiesel and bioethanol. Others are green diesel, vegetable oil, biogas and syngas. According to their development, biofuels are categorized in three generations on the basis of production techniques and raw materials (http://biofuel.org.uk/types-of-biofuel.html).

- First generation biofuels: from sugar, starch, vegetable oil or animal fats.
- Second generation biofuels: from non-food crops.
- Third generation biofuels: from Algae.

**Sustainable development goals**

Our aims are aligned with following two SDG's:

**Goal no. 6:** Ensure sustainable consumption and production patterns specifically target 6.3
By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

**Goal no. 7**: Ensure access to affordable, reliable, sustainable and modern energy for all

*No Local or Sectoral Partner*

**WORLD BANK GROUP**

**Local Challenge Fund**

**PROJECT OUTLINE**

**COVER SHEET**

| | |
|---|---|
| **Institution Title** | Capital University of Science and Technology |
| **Institutional Address** | Zone V, Kahuta Road |
| | Islamabad, Pakistan |
| **Title of Project:** | LCF:  Bioremediation and Toxicity Reduction of Effluents by Indigenous Microbial Strains as well as Optimization of Bioreactor for Sustainable Production of Third Generation Bioethanol |
| **Principal Investigator** | Arshia Amin Butt |
| | Department of Bioinformatics and Biosciences |
| | Assistant Professor |
| | Tel. # 03325375929 |
| | Email: arshia.butt@cust.edu.pk |

| | |
|---|---|
| **What is the Locally Relevant Socio-Economic Issue that the Proposal Addresses?** | - Waste management<br>- Bioremediation of Eutrophic lake present in vicinity of university<br>- Optimization of protocol for effecient waste management<br>- Biofuel production from waste (Algae isolated from waste) |

## II. PROJECT DESCRIPTION

## Bioremediation and Toxicity Reduction of Effluents by Indigenous Microbial Strains as well as Optimization of Bioreactor for Sustainable Production of Third Generation Bioethanol

Now a day, biofuel is driving important attention because of being not only a renewable energy source but also non-toxic, biodegradable and its impact on environment and climate (Singh, A.K., 2018). They can be broadly defined as solid, liquid or gas fuel consisting of or derived from biomass i.e. biological material from living organisms. The most popular forms of biofuels are biodiesel and bioethanol. Others are green diesel, vegetable oil, biogas and syngas. According to their development, biofuels are categorized in three generations on the basis of production techniques and raw materials (http://biofuel.org.uk/types-of-biofuel.html).

- First generation biofuels: from sugar, starch, vegetable oil or animal fats.
- Second generation biofuels: from non-food crops.
- Third generation biofuels: from Algae.

### Biofuel Production and Waste Management

As sustainable production of renewable energy is a hot topic of global debate and now it is clear that first and second-generation biofuels are limited in their ability to achieve targets for biofuel production, climate change mitigation and economic growth. Despite the potential they also have others drawbacks such as requirement of massive quantities of agriculture land, raw material and water for irrigation (Barnwal BK., et al., 2005). Wastewaters derived from municipal, agricultural and industrial activities potentially provide cost-effective and sustainable means of algal growth for biofuels. In addition, there is also potential for combining wastewater treatment by algae, such as nutrient removal, with biofuel production Pittman,J.K (2011) The third-generation biofuels i.e. Algae biofuel definitely deserve more research and faster development because they certainly have a lot of more advantages than disadvantages and could provide reliable source of energy in years to come. Algae contain carbohydrates, lipids, proteins and their photosynthetic and lipid accumulating potential makes them a suitable candidate for bioenergy. Algal biomass is used in the production of biofuels like biodiesel, bioethanol, biobutanol, and biohydrogen etc. Apart from bioenergy production from algae, industrially important co-products or value added products also extracted from microalgae. Environmental application of microalgae for wastewater treatment and $CO_2$ sequestration was also reported (Mathemani, T., 2019).

### Algae biofuel production

A number of algae production technologies are currently under development. It could be:

1) Open Pond Systems
2) Fermentation
3) Hybrid systems
4) Integrated systems
5) Excretion processes

There is no single way to grow algae at commercial scale and this versatility is one of algae's strengths. In most cases, the approach taken is designed solely to maximize algae growth for production of fuel chemicals or other industrial products. As proposed by Park J.B.K (2010) algal production and recovery of wastewater nutrients as algal biomass is limited by the low carbon: nitrogen ratio of wastewater, so one proposed method for enhanced bioremediation and recovery could be addition of $CO_2$ in day time and to reduce the harvesting cost it will be followed by A lab-scale optimized rotating algal biofilm (RAB) cultivation system with specific harvest frequency, rotation speed, and $CO_2$ levels. An open pond raceway retrofitted with a pilot-scale RAB system resulted in a much higher biomass productivity when compared to a control open pond Gross, M., et al (2013).

**Phytoremediation and the potential of sustainable biofuel production**

Important bioremediation agents and are already being used by many wastewater facilities. The major effect of releasing wastewater rich in organic compounds and inorganic chemicals such as phosphates and nitrates is mainly eutrophication (Godos et al., 2009). This is a global problem that can be solved by the use of bacterial and fungal strains for waste management and microalgae when the wastewater is used as feed for microalgal growth. The potential for algae i.e., *Chlorella, Scenedesmus, Phormidium, Botryococcus, Chlamydomonas* and *Spirulina* in wastewater remediation has been reported and efficacy of this method is promising.

The use of microalgae is desirable since they are able to serve a dual role of bioremediation of wastewater as well as generating biomass for biofuel production with associated carbon dioxide sequestration. In addition, wastewater remediation by microalgae is an eco-friendly process with no secondary pollution as long as the biomass produced is reused and allows efficient nutrient recycling (Bhatt, N. C., 2014; A. Fathi et al., 2013; Mobin, S., 2014).

**Integration of disciplines**

As was partly described by Allen, J (2018) improving the fundamental understanding of algae-based biofuels and bioproducts operation requires integration of Microbiology, biotechnology and engineering. The aspect of Microbiology will mostly involve understanding the capabilities of strain and/or communities of strain (Bacterial, fungal and algal), cultivation with optimized growth and stability, maintenance, and carbon capture, as well as the protection of algal culture from contamination by bacteria and competing algae/cyanobacteria. Biotechnology will play its optimizing lab scale bioreactor and play role in supplying resources, $CO_2$, light, and energy, integration of energy, extraction and conversion of biomass into fuels and bioproducts, waste and co-product processing with possible recycling, mass and energy balances, cost analysis, and sustainability assessments.

The project will be extended later on to check field scale applicability of strains along with their bio stimulants in open systems.

**Sustainable development goals**

Our aims are aligned with following two SDG's

**Goal no. 6:** Ensure sustainable consumption and production patterns specifically target 6.3
By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

**Goal no. 7:** Ensure access to affordable, reliable, sustainable and modern energy for all
**Problem Statement**

With global shortages of fossil fuels, especially oil and natural gas, a major focus has developed worldwide on renewable biofuel production. As an active supporter of SDG (Sustainable development goals) we intend to work on third generation indigenous biofuel producing strains of Algae. We also intend to use extensive biofuel sources present in the campus vicinity for screening of efficient indigenous bacterial and fungal strains.

Campus being situated besides a big canal where biomass is heavily accumulated because of weeds, submerged plants, local organic waste by cattle and stray animals we feel the responsibility to exploit our expertise for waste management developing consortia of indigenous bacterial, fungal and algal strains with most efficient bioremediation capabilities. Pilot scale biofuel production methods will also be optimized by using genomically identified strains.

**Aims and Objectives**

1) Use of available biomass to screen indigenous bacterial and fungal strains
2) Screening of bacterial and fungal strains for enhanced biodegradation and bioremediation capabilities
3) Algae production by using open pond system
4) usage for utilization of biomass as source of biofuel production
5) Identification of efficient bacterial, fungal and algal strains by sequencing for their desired properties
6) Whole genome sequencing of selective (Most efficient strains for complete genome profile)
7) Consortia development with most efficient capabilities of biodegradation of biomass
8) Pilot scale optimization of lab scale bioreactor
9) Targeted product screening (ethanol and methanol)
10) Screening of products

No: 20-13723/NRPU/RGM/R&D/HEC/2020                    Dated: 2$^{nd}$ September 2020

**Principal Investigator**
**Arshia Amin Butt,**
Capital University of Science and Technology,
Islamabad

Subject: **Proposal Acceptance Notification & Completion of Related Formalities Prior to Award**

Dear Applicant

Reference your research proposal submitted to HEC for funding vide **Project No 13723 /Title "Molecular epidemiology and prevalence of antibiotics resistance genes in smog particulate matter: implication for human exposure in pakistan"** with the total cost of Rs. 6549895/- & for the duration of 24 months under **National Research Program for Universities – NRPU Call 2020.**

I am pleased to inform you that the above referenced research proposal has been accepted for funding as per recommendation by HEC Scientific Review Panel. The evaluation results in redacted form are enclosed vide Annex – I for information please.

The following formalities are required to be completed prior to finalization of the award and signing of Grant Agreement between HEC, the University/ DAI (receiving the Grant) and the PI:

- Revised proposal as per reviewers comments and feedback provided in the evaluation results
- A fiduciary and procurement plan
- Detailed Implementation Plan (Gantt chart, activities, deliverables, timelines); information may be valuable for evaluation of achievement/outcome either targets achieved or not as part of project oversight.
- Revised Budget as per attached 'Financial Rules Governing Competitive Research Grants' that would be finalizad after negotiation with PI before final approval from competente Authority.
- Appointment letter from the PI & Co-PI to confirm their affiliation with DAI
- Last pay slip of PI and Co-PIs for finalizing the personnel cost in Budget.

You are requested to communicate your response/ information to this office as required above on or before 15$^{th}$ September 2020.

Regards


Afeefa Irshad
Dy. Director (RGM)


**Copy for information to:**

1. Vice Chancellor, Capital University of Science and Technology, Islamabad
2. Director ORIC, Capital University of Science and Technology, Islamabad

No: 20-13121/NRPU/RGM/R&D/HEC/2020                    Dated: 2nd September 2020

**Principal Investigator**
**Sabahat Haqqani,**
Capital University of Science and Technology,
Islamabad

Subject: **Proposal Acceptance Notification & Completion of Related Formalities Prior to Award**

Dear Applicant

Reference your research proposal submitted to HEC for funding vide **Project No 13121 /Title "Preparation of Indigenous Manual Based Intervention for Lowering Anxiety and Depression Levels among Pakistani Youth"** with the total cost of Rs. 14683990/- & for the duration of 36 months under **National Research Program for Universities – NRPU Call 2020.**

I am pleased to inform you that the above referenced research proposal has been accepted for funding as per recommendation by HEC Scientific Review Panel. The evaluation results in redacted form are enclosed vide Annex – I for information please.

The following formalities are required to be completed prior to finalization of the award and signing of Grant Agreement between HEC, the University/ DAI (receiving the Grant) and the PI:

- Revised proposal as per reviewers comments and feedback provided in the evaluation results
- A fiduciary and procurement plan
- Detailed Implementation Plan (Gantt chart, activities, deliverables, timelines); information may be valuable for evaluation of achievement/outcome either targets achieved or not as part of project oversight.
- Revised Budget as per attached 'Financial Rules Governing Competitive Research Grants' that would be finalizad after negotiation with PI before final approval from competente Authority.
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- Last pay slip of PI and Co-PIs for finalizing the personnel cost in Budget.

You are requested to communicate your response/ information to this office as required above on or before 15th September 2020.

Regards


Afeefa Irshad
Dy. Director (RGM)


**Copy for information to:**

1. Vice Chancellor, Capital University of Science and Technology, Islamabad
2. Director ORIC, Capital University of Science and Technology, Islamabad

# Proposal / Application

## for

## ICT-Related Grant

## for

## Innovative Product Development



## Indigenous Development of Drone Detection Radar



## Dr. Muhammad Faisal Iqbal

# Read carefully before filling the form.

1. Please do not alter the layout of the application form. Information must be filled in the spaces provided, under set format.
2. Guidance notes in various fields should not be deleted.
3. Required information should be duly filled in the specified fields.
4. Required heads/fields which are not relevant to the project should be marked **N/A** (Not Applicable) or left blank and should not be deleted.
5. Specifications, justifications, purposes must be provided against each item in the Budget file.
6. Please do not change the formulas in the budget sheets.

## List of Abbreviations and Acronyms

| | |
|---|---|
| EE | External Evaluators |
| ICT | Information and Communication Technologies |
| IPR | Intellectual Property Rights |
| PM | Project Manager |
| PD | Project Director |
| PDO | Project Director's Organization |
| | *"Project Director's Organization" means the person, company, partnership, undertaking, concern, association of persons, body of individuals, consortium or joint venture which receives funding from the Company to execute a research and/or development project."* |
| R&D | Research and Development |

## List of Abbreviations and Acronyms Used by PD in the Proposal

(Please add abbreviations and acronyms in the table below, if any.)

**Application for ICT-Related Development Grant for Innovative Product Development –**

**Guidelines and Forms**

### Introduction

Ignite – National Technology Fund) was created in January 2007 by Ministry of IT with the vision to transform Pakistan's economy into a knowledge-based economy by promoting efficient, sustainable, and effective ICT (IT and Telecommunications) initiatives through synergic development of industrial and academic resources. Collaborative efforts between academia, research institutions, and industry are greatly encouraged to ensure that local economy can reap the monetary benefits of investment in development activities. This organization has significant funds available for proposals that are geared towards creating ICT related technologies.

Development grants will be awarded for high-level and promising ICT-related development projects by individuals or groups from academia or industry actively involved in development of such products individually or collaboratively. These projects should be based on either a universally known technology or a new technology developed by the applicant and should be aimed at achieving economically viable systems, products, or processes beneficial to the nation.

The grant will cover the honoraria of the Project Director and Project Managers, salaries of professional developers at market rate, stipends for student assistants, and supporting staff. It will also cover travel(s) within and outside the country for project-related activities. The grant may be used to purchase very specific unavoidable equipment kept to the bare minimum, consumable materials, and other items needed for the project.

### Submission Procedure

Duly filled application forms complete in all respects along with any documents should be submitted online through Ignite's website www.ignite.org.pk. A hard copy should also be submitted by registered post or by fax at our mailing address given below. On receipt of the applications the proposals will be evaluated internally as well as externally as laid down in our policy documents. The PD may need to revise the proposal in the light of the evaluator's recommendations.

There is no deadline for submission of the application forms for Unsolicited Projects. The deadline for Solicited Projects will be given in the RFPs whenever floated.

### Joint Funding

The project proposal may be jointly funded by Ignite and other funding agencies/industry. The efforts to obtain joint funding will be at the discretion of the Project Director's Organization (PDO) to which Project Director belongs. However, any such information must be provided to Ignite.

### Funding Agreement

A written agreement will be made between Ignite and PDO. The PDO will undertake to administer the grant according to the agreement and to provide laboratory space, and other facilities necessary for the project. The equipment purchased from the grant of Ignite for the approved project will remain the property of Ignite and shall be returned to Ignite after completion of the project. The grantee is required to submit a final narrative and accounts within one month of the completion of the project. The IPR issues will be sorted according to the policy in vogue.

**For further information, please contact:**

Solicitation and Evaluation Department,
Ignite – National Technology Fund,
6<sup>th</sup> Floor, HBL Towers,
Jinnah Avenue, Blue Area, Islamabad
Tel.: (+92-51) 921 5360 - 65
Fax: (+92-51) 921 5366
Website: www.ignite.org.pk

**Table of Contents**

**Description**
**Page #**

# Section – 1

## 1.1    Project Identification

**Reference Number:**

(for office use only)

**Project Title:**

Indigenous Development of Drone Detection Radar

**Short title of the Project:**
*(Short title or name of the project in one or two words e.g. "YouTube".)*

Drone Detection Radar

**Slogan of the Project:**
*(Please describe the project in one sentence e.g. "The world's leading video-sharing service".)*

Safe Skies.

**Project Director (PD):**

| | |
|---|---|
| Name: | **Dr. Muhammad Faisal Iqbal** |
| Designation: | Associate Professor |
| Organization: | Capital University of Science and Technology, Islamabad |
| Mobile # : | 03218577222 | Tel. # : | 051-111555666-126 |
| Email: | faisal.iqbal@cust.edu.pk |

**Project Manager(PM):**

| | |
|---|---|
| Name: | **Prof. Aamer Iqbal Bhatti** |
| Designation: | Professor |
| Organization: | Capital University of Science and Technology, Islamabad |
| Mobile # : | 03008568722 | Tel. # : | 051-111555666-181 |
| Email: | aib@cust.edu.pk, aamer987@gmail.com |

**Contact Person:** (If different from PD.)

Name: _____

Designation: _____

Organization: _____

Mobile # : _____ Tel. # : _____

Email: _____

## Project Director's Organization (PDO):

*(Please indicate the name, address, telephone and fax of the Project Director's Organization. The Project Director should belong to this organization.)*

| | |
|---|---|
| Name: | **Capital University of Science and Technology** |
| Address: | Kahuta Road Zone-V , Sihala, Islamabad |

Legal Status  ❑ Public Ltd. Co.   ✔ Pvt. Ltd. Co.   ❑ Sole Proprietorship   ❑ NGO

❑ Other (please specify):

| | | |
|---|---|---|
| Registration #: | | *(Please attach certified copy)* |
| National Tax #: | 7153859-2 | *(Please attach certified copy)* |
| Tel. # : | +92-051-111555666 | Fax # : +92-0514486705 |
| Website: | www.cust.edu.pk | |

## What technology is core to your product? *(Please mark X where applicable.)*

[  ] 3D/4D Printing                         [  ] Augmented Reality / Virtual Reality

[  ] Big Data, Artificial Intelligence       [  ] Blockchain

[  ] Cloud                                   [  ] Neurotech

[  ] Robotics                                [  ] Shared economy

[  ] The Internet of Things                  [  ] Wearables, Implantables

[x] Others (specify):     Radar/Digital Signal Processing/Microwave Engineering

## What is the target market(s) for the products? *(Please mark X where applicable.)*

[  ] Automotive, aviation, marine            [  ] Business, marketing, finance

[x] Defence, security, safety                [  ] Education and training

[  ] Environment, water management           [  ] Entertainment, tourism, sport/recreation

[  ] Food, livestock, agribusiness           [  ] Healthcare

[ ] Infrastructure, housing & transport          [ ] Mining equipment technology & services

[ ] Oil, gas, energy                             [ ] Textiles, clothing, footwear

[ ] Others (specify): _____

**Which Sustainable Development Goals (SDGs) are covered by the products?** *(Please mark X where applicable.)*

[ ] 1. No Poverty                                [ ] 2. Zero Hunger

[ ] 3. Good Health & Well-Being for people       [ ] 4. Quality Education

[ ] 5. Gender Equality                           [ ] 6. Clean Water & Sanitation

[ ] 7. Affordable & Clean Energy                 [ ] 8. Decent Work & Economic Growth

[x] 9. Industry, Innovation & Infrastructure     [ ] 10. Reduced Inequalities

[ ] 11. Sustainable Cities & Communities         [ ] 12. Responsible Consumption & Production

[ ] 13. Climate Action                           [ ] 14. Life Below Water

[ ] 15. Life on Land                             [ ] 16. Peace, Justice & Strong Institutions

[ ] 17. Partnerships for the Goals

**Please select innovation level of the proposed project.**

[ ] Global Innovation                            [x] Local Innovation

**Do you have any co-investment for the proposed project?**

[ ] Yes                    [x] No

If Yes, how much investment would be shared by partner(s)?          %

**Do you need business mentors?**

[ ] Yes                    [x] No

If Yes, how much time would you need for the mentorship?          hours/week

**How did you hear about us?** *(Please mark ☑ where applicable)*

[✔] www.ignite.org.pk    [ ] Ignite Brochure    [ ] Ignite Rep    [ ] Event/Seminar

[ ] Google               [ ] Social Media       [ ] Print Media   [ ] Word of Mouth

[ ] Other (specify): _____

**Other Organizations Involved in the Project:**

*(Please identify all affiliated organizations collaborating in the project, and describe their role/contribution to the project. A letter of intent from the organization(s) involved in the proposed project must be provided.)*

**Industrial/Commercial Organizations:**

| # | Organization Name | Role / Contribution |
|---|---|---|
| 1. | Bismillah Electronics | Bismillah electronics will manufacture and provide these parts<br>• Antenna<br>• Tripod stand<br>• Rotary mechanism<br>• Cabling<br>• Power supply |
| 2. | | |

**Academic Organizations:**

| # | Organization Name | Role / Contribution |
|---|---|---|
| 1. | | |
| 2. | | |

**Funding Organizations:**

| # | Organization Name | Role / Contribution |
|---|---|---|
| 1. | Nil | |
| 2. | | |

**Key Words:** *(Please provide a maximum of 5 key words that describe the project. The key words will be incorporated in our database.)*

- Microwave Engineering
- Digital Signal Processing
- Radar Technology
- Communication Technology

**Project Status: (Please mark X)**

[x] New        [ ] Modification to previous project

**Planned Duration:**               24 months

**Proposed Budget:**               PKR 22,878,887* /-

(*The cost may vary with change in the dollar rate)

**The Problem:**

*(Please describe the problem / opportunity / gap / need that you want to address/solve. **Maximum 300 words.**)*

Ensuring the safety and security of vital city installations, critical buildings, airports and public events against the threat of drones of small size and signature is of paramount concern to any city management. Such areas should be secured not only from the ground threats but also from aerial threats. Drones are one of the main threats that can be employed for surveillance or targeting the sensitive locations due to its low cost and easy availability. In Pakistan no radar

system is yet utilized to detect and localize these threats (drones). Existing Radars in Pakistan are designed for detection of larger targets with incapability of detecting small targets that have small Radar Cross Section (RCS).

The widespread use of drones adds a new dimension to the aerial threats encountered by critical installations and public events. A recent attack on Venezuelan President [1], a drone with explosive material landing on the roof of Japanese Prime Minister's office [2], and a drone crash landing in front of a German Chancellor [3] are just a few examples. The low cost and easy availability of drones make them a serious security threat [4]. The existence of Drone Detection Radar can be found in the international market but cannot be acquired locally because of exorbitant costs, jamming vulnerability and cyber-security. The proposed project provides an indigenous, low cost and economical Drone Detection Radar avoiding the risk of cyber-security and jamming.

Purpose built Drone Detection Radar is a new concept in the family of ground-based surveillance radars. The radio frequency is designed to enhance small target cross sections and low velocities. State of the art radar signal processing is employed for detection and classification of drones.

**Following are some of the well-known (identify the best known if possible) existing solutions to this problem. Their known strengths and weaknesses are also provided.**

*(Maximum 200 words.)*

Table 1.1.1 shows the competitive products for Drone Detection Radar system manufactured in various countries. Knowing the fact that Radar technology is a sensitive and expensive technology therefore it poses a barrier for our local industry or corporate sectors to invest in such systems financially. Rigorous export control regulations of the developed countries may not allow us to procure such systems. Above all if we are able to purchase the Drone Detection Radar there always will be threat of cyber security and jamming.

| S.No | Product | Drone Range | Country | Price |
|------|---------|-------------|---------|-------|
| 1 | Kelvin Hughes Sharp Eye SxV Radar | 5 km | United Kingdom | |
| 2 | Elvira Radar | 3 km | Netherlands | |
| 3 | Low altitude target searching radar (zn-L01) | 30-3500 meters | China | $425,000 |
| 4 | Spotter RF C950 | 1350 meters | Denmark | |
| 5 | SQUIRE | 6,000 meters | Netherlands | |

Table 1.1.1 Existing Products

**Our solution will address the following weaknesses of above-mentioned solutions.**

*(Maximum 200 words.)*

Traditional radars are designed to detect larger targets and are incapable of detecting drones with small radar cross section. Considering the threats posed by these drones, there is a serious need to develop indigenous radar technology for drone detection. It must be added foreign made radars are not suitable for Pakistani cities on the account of high prices, cyber-security and jamming

vulnerability and an indigenous solution is required. Although these radars are commercially available, the techniques and algorithms used in them are not open to public. In order to develop these radars in Pakistan, we need to design our own techniques.

By designing the radar system indigenously in Pakistan, we'll be confident that it is fully under our own control and is not vulnerable to malicious access by the adversary. On the other hand, radars procured from any foreign country will always be prone to such attacks as the hardware and software is developed by a foreign company. They may leave hooks in the system which allow them to tap into the system anytime. Such threat will not be present in the proposed radar. Hence, the radar will be cyber secure.

**We will use the following techniques to achieve improvements mentioned above.**

*(Maximum 200 words.)*

Researchers at CUST have extensive experience in RADAR design (reference phased array radar). The product idea is the off-shoot of the research in radar systems being carried out at CUST for a decade. The research culminated in the successful demonstration of Pakistan's first ever phased array radar [5]. We will leverage our expertise and will use local industry to develop the radar system so that there is no dependence on the foreign country. Using local resources will also enable us to achieve low cost.

Detecting a drone is particularly challenging. The bodies of drones are generally not metallic and thus their RCS is very small. These drones also fly at lower altitude and speeds and thus their signature is not much different from radar clutter. New techniques are required to distinguish drones from the clutter. We will explore machine learning algorithms to cater for this problem. Machine learning algorithms and techniques have been employed for deployment in radars in detecting and classifying targets [9][10][11]. Machine learning approaches generally can help in detection of targets in highly cluttered environment by distinguishing the features of targets and clutters. An offline training of the ML algorithm will be done where the algorithm will be trained using example signatures for both presence and absence of the target. Once offline trained, it will be employed for real time drone detection. In particular, we'll explore the use of deep learning techniques (Deep Belief Networks or Convolutional Neural Networks) for drone detection and classification. Deep learning algorithms are simply artificial neural networks which use multiple layers to progressively extract higher details of information from the raw input. In the context of radar, the lower level of information may include detecting direction of the drone and higher levels may extract drone type based on the cross section. Of course, performance of the neural network depends on the quality of the labeled data set used for training the network. We aim to generate this data set synthetically (using target models) as well getting radar calibration data (generated in anechoic chamber) of known targets using known sensors.

We'll also explore leveraging doppler shift caused due to rotor movement in addition to drone's own movement in order to identify these objects. We also intend to use Swerling's model for target identification in order to cater for varying RCS of the drones. Swerling model is the standard model used for modeling targets. These target models are used for evaluation of different detection and identification algorithms. We'll utilize it while exploring our detection algorithms. Radar cross-section (RCS) measures the target's reflection of signals in the direction of radar receiving antenna. A targets RCS is defined as the ratio of its effective isotropically reflected power to the incident power density.

Target RCS fluctuates in both amplitude and phase. Amplitude fluctuation, called scintillation, results in variations in received target echo power. Phase fluctuation, called glint, affects the wave fronts echoing from the target.

There are many models of RCS fluctuation. The most commonly used are those of Marcam and Swerling. Five Marcum/Swerling models describe the behavior of a wide verity of targets. Swerling case 1 targets exhibit large fluctuations, typically several orders of magnitude, with the fluctuation occurring slowly. They are modeled as several scatterers of approximately equal radar cross-section. Case 1 is generally good fit for complex targets such as aircrafts to radars without pulse-to-pulse frequency agility, at either long ranges or flying towards or away from the radar. In either case, there is little aspect change over the look. Swerling case 1 seems to be an appropriate model for drones.

**Synopsis:**

*(A brief description of the idea, in non-technical language, explaining product benefit, target market, basic technology, commercial partners, investors, and potential customers. **Maximum 200 words.**)*

After a century of development and practice the science and art of air surveillance has become a well-established technology. However, due to the huge leaps in aerospace navigation and control on one hand and miniaturization on the other hand, the aerial threats are taking on new dimensions and shapes. New air vehicle categories such as Unmanned Air Vehicles (UAVs) and Drones (both fixed and rotary wing) have added a new flavor to the exhaustive categories of aerial threats such as wide variety of aircrafts and missiles.

The advent of these new threats has posed a multitude of challenges to the air surveillance assets. Due to the miniaturization the limit on Radar Cross Section (RCS) to be detected has reduced considerably from 10 sq m to 0.1 sq m (a twofold decrease!), placing a huge requirement on the radar power and signal processing. The air sensors of future would have to incorporate huge diversity simultaneously addressing the challenges of both long range and miniature class cross sections.

To cope with these stringent requirements a new Drone Detection Radar System is proposed. An adapted image of the proposed Drone Detection Radar System is shown in Figure 1.1.1 and Table 1.1.2 highlights the proposed product specification.



Figure 1.1.1 Adapted image of the proposed Drone Detection Radar System

**Product Specifications:**

| Specification | Value/Comment |
|---|---|
| Detection Range | 2.5 km for a small UAV (0.1 m RCS) |
| Range Resolution | 50 m |
| Probability of Detection | 0.9 |
| Probability of False Alarm | 1e-6 |
| Pulse Width | 0.3 microsec |
| Pulse Repetition Frequency | 5.5 kpps |
| Pulse Integration | 1024-point FFT |
| Scan Time | 5.0 sec |
| Antenna | Parabolic shaped Reflector with feed 0.8 m |
| Frequency | 5.4-5.9 GHz |
| Output Power | 25 W |
| RF bandwidth | 3 MHz |
| Rotational Speed | 12 RPM |
| Elevation Mechanically controlled | ±10˚ |
| Azimuth Coverage | 360˚ |
| Elevation Beam width | 20 Degree |
| Receiver Architecture | Super heterodyne |
| Pedestal and Mechanical assembly Power Supply | 220VAC and +24VDC |
| Onboard radar signal processing | CACFAR, Pulse Doppler, Pulse Integration |
| Receiver Noise Figure | 3 dB |
| Dimension of the RF and DSP Housing | 12inch x 0.5inch x 0.5inch |
| Items supplied | RF/DSP Housing, Telescopic Tripod, Antenna, 10 m ethernet cable, ruggedized laptop, all the connected cables, power supply with charger |
| Mobility | Roof Mountable Version |

Table 1.1.2 Drone Detection Radar System Specification

# RAPID RESEARCH GRANT (RRG)

## PROJECT TEMPLATE COVER SHEET

| | |
|---|---|
| **Proposal Reference No.** (Not for completion by applicant) | |

| | |
|---|---|
| **Title of Project:** | Investigation of COVID -19 in Pakistan by Integration of Artificial Intelligence and Epidemic Modelling Methods for Public Health Surveillance System |
| **Duration of Project:** | 12 Months |
| **Total Budget Requested** | PKR 13.728 Million |

| | |
|---|---|
| **Institution Title** | Capital University of Science and Technology |
| **Institutional Address** | Kahuta Road Zone-V Sihala |
| | Islamabad |
| | Pakistan |
| **Principal Investigator** | Dr. Sahar Fazal |
| | HoD/Associate Professor |
| | Biosciences |
| | 051-111555666-296 , +923345222518 |
| | sahar@cust.edu.pk |
| | 3630214687364 |

| | |
|---|---|
| **To which Priority Thematic Area(s) does the proposal respond?** | Development of Infectious Diseases Surveillance Systems |

# TABLE OF CONTENT

## Contents

# I. EXECUTIVE SUMMARY

**Project Overview (Max 500 words)**

It should clearly identify the Priority Thematic Area, and justify how the proposed project will contribute to address the challenges associated with COVID-19 outbreak in national context in accelerated time frame in national context. The broad research objective should be briefly described, as well as the activities to be undertaken to achieve the project goals. In addition, the roles of partners – academic and sectoral[1]– that will contribute to the success of the proposed project should be identified

Globally, disease related health surveillance systems are playing a significant role in outbreak detection and response management of Infectious Diseases (IDs). However, in developing countries e.g. Pakistan, epidemic outbreaks are difficult to detect due to scarcity of public health data and absence of automated surveillance systems.(1)In health care, the constant increase of computer data led professionals, hospitals and states to take into consideration the management of Big Data (BD) requiring Artificial Intelligence (AI) and sophisticated technical platforms to run the information systems (IS) of hospitals together with extra-hospital data from connected devices. It is challenging to apply conventional statistical methods to medical data with large dimensionality (such as textual and image data). (2) In many cases the underlying assumptions of traditional statistical-based methods are breached when we are dealing with high dimension data with complexity. Most classic statistical methods are unable to handle Big Data problems, because emerging infectious disease outbreak related data exists in various formats and exhibits different limitations and assumptions.(2,3,4) In recent research to handle Big Data, AI and machine learning methods have so far shown promising outcomes in a disease related context, recent research using AI and machine learning methods is used to track down rodent reservoirs of future zoonotic diseases,(5) predict Extended-Spectrum B-Lactamase (ESBL) producing organisms,(6) and control of tuberculosis (TB) and spreading of gonorrhea disease etc. spreads, has been in place.

AI and machine learning methods could also be used by two different learning strategies to collect BD of pandemic COVID-19 across the Pakistan by supervised learning (SL) and unsupervised learning (UL). Supervised learning SL is the task of inferring a function from label training data, including Decision Tree, Random Forest, Artificial Neural Network (ANN) and Bootstrap Aggregating which could handle the classification and regression problem efficiently in medical data efficiently. All these methods could be useful in improving the accuracy of diagnosis and suggesting the appropriate treatment for patients. For effective data integration, management, and knowledge extraction of COVID-19, a comprehensive data management system is needed. Epidemic modelling methods have already played an important role in disease transmission propagation and policy advice etc.(7,14,15) Epidemic models typically categories into phenomenological and mechanistic modelling studies, where a mechanistic model may be designed in different forms, such as a simple homogeneous compartmental model or with the consideration of host heterogeneities, multi-pathogen and multi-host situation, temporally forced model, spatial model etc.

This research will focus on development of infectious disease COVID-19 viewer, which is a visual analytics decision support system for infectious disease surveillance. It is a blend of intelligent approaches to make <u>a</u> use of real-time streaming data from Emergency Departments (EDs) for early outbreak detection of COVID-19 related to, health care resource allocation and epidemic response management etc.

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[1] Sectoral stakeholders can include private enterprise (including, but not limited to, large multinationals and regional or local SMEs), relevant Ministries, government agencies, public authorities, chambers of commerce, trade groups, policymakers and other appropriate stakeholders.

Project Goals:
- To investigate epidemic models by Phenomenological and Mechanistic Modelling studies.
- To investigate the correlation of population behavior with the COVID-19 outbreaks.
- To investigate infectious disease outbreaks associated with digital behavior patterns through web search patterns (such as Google Trend) during outbreak period.
- To determine the classification and regression problem of COVID-19 in via medical data

## II.  THE ACADEMIC TEAM AND SECTORAL COLLABORATORS

**Capacity of Project Team &  their Role  including Academic & Sectoral Partners (Max 250 words)**

Use of surveillance system in public health is of significance importance for those who are responsible for preventing and controlling disease. It involves collection, analysis, and interpretation of data and its timely dissemination. The COVID-19 epidemics signifies the critical role of surveillance in protecting individuals.

The team members have a strong background knowledge in bioinformatics and in epidemiology.

Computational development and analysis area will be covered by the academic team that has blend of researchers in field of modeling, simulation, analysis and biology.

Information and data that is required for health surveillance system and epidemiological modeling will be collected from the hospitals.

### Table: Academic Collaborators

In this Table, list primary researchers, including the Co-PI and other collaborators, who will participate in the proposed project.  All collaborators must have been contacted prior to submission of the proposal and letter of commitment will be required.

| Name | Dr. Hina Ahsan | Highest Degree Obtained | MS biomedicine/PhD scholar |
|---|---|---|---|
| Position/Title | Asst. Professor | Department | Pharmaceutics department |
| Male/Female | Female | Institution | Riphah institute of pharmaceutical sciences, Riphah international university |
| Tel. # | 00923335584214 | Email | hina.ahsan@riphah.edu.pk |
| Disciplinary expertise | clinical pharmacy, community pharmacy, molecular epidemiology | | |
| Name | Dr. Aamer Iqbal Bhatti | Highest Degree Obtained | PhD |
| Position/Title | Professor | Department | Electrical Engineering |
| Male/Female | Male | Institution | Capital University of Science and Technology |
| Tel. # | +923008568722 | Email | aamer987@gmail.com |

| Disciplinary expertise | Control Systems, Signal Processing and AI | |
|---|---|---|
| Name Dr. Shaukat Iqbal Malik | | Highest Degree Obtained  PhD |
| Position/Title Professor | | Department Biosciences |
| Male/Female  Male | | Citizenship Pakistani |
| Tel. # +923325472974 | | Email  drshaukat@cust.edu.pk |
| Disciplinary expertise  Molecular Biology & Human Genetics, Cancer Cytogenetics, Micro-arrays Gene Expression & Data Analysis | | |
| Name Dr. Iqdus Naveed Malik | | Highest Degree Obtained  PhD |
| Position/Title Vice President | | Department   Higher Studies and Research |
| Male/Female Male | | Citizenship  Pakistani |
| Tel. #  +92333-5136508, | | Email   anaveed@iiu.edu.pk |
| Disciplinary expertise    Digital Signal Processing (DSP) applied in Digital Communications. Statistical Signal Processing. | | |

## Table: Sectoral Collaborators

All confirmed Sectoral Collaborators should be identified in this Table.  All sectoral collaborators must have been contacted prior to submission of the proposal and Letter of Commitment from the sectoral partners will be required.

| Company/Organization Name  Lady Reading Hospital | |
|---|---|
| Location  Peshawar | |
| Name of Collaborator Dr. Atif Ihsan | Position/Title  PG MTI |
| Tel. # +923331744469 | Email |
| Anticipated Contribution to Project Goals  Medical, Technical and Expert Opinion | |
| Anticipated Annual Financial Contribution  Nil | |
| Company/Organization Name  Benazir Bhutto Hospital | |
| Location  Rawalpindi | |
| Name of Collaborator | Position/Title |
| Tel. # | Email |
| Anticipated Contribution to Project Goals | |
| Anticipated Annual Financial Contribution | |
| Company/Organization Name  Shifa International Hospital | |
| Location  Islamabad | |
| Name of Collaborator | Position/Title |
| Tel. # | Email |
| Anticipated Contribution to Project Goals | |
| Anticipated Annual Financial Contribution | |
| Company/Organization Name  NESCOM Hospital | |
| Location Islamabad | |
| Name of Collaborator | Position/Title |
| Tel. # | Email |
| Anticipated Contribution to Project Goals | |
| Anticipated Financial Contribution | |
| Company/Organization Name  Pakistan Institute of Medical Sciences (PIMS) | |
| Location  Islamabad | |

| Name of Collaborator | Position/Title |
|---|---|
| Tel. # | Email |
| Anticipated Contribution to Project Goals | |
| Anticipated Annual Financial Contribution | |

# III. THE PUBLIC HEALTH AND SOCIETAL IMPACT OF THE PROPOSED RESEARCH IN ADDRESSING COVID-19

**The Public Health and Immediate Societal Impact on Priority Thematic Area (Max 250 words)**

Justify how the proposed RRG project research activities would make significant contribution in better understanding of epidemic, patterns of spread, develop diagnostics and improve patient care and the public health response in national context. Also focus on why the proposal is timely and requires rapid activation to address the identified research priorities

According to current serious scenarios related to Pandemic COVID-19, there is a need of establishment of epidemic modelling system of mandatory and voluntary reporting COVID-19 induced diseases by doctors and laboratories to governmental agencies, innovations in social media and so-called user-generated information could lead to faster recognition of cases of infectious disease .Moreover the direct access to such data could enable surveillance epidemiologists to detect potential public health threats such as rare, new diseases or early-level warnings for epidemics. (12,13)

The challenges of using these emerging surveillance systems for infectious disease epidemiology, including the specific resources needed, technical requirements, and acceptability to public health practitioners and policymakers, have wide-reaching implications for public health surveillance in the 21st century. It is anticipated in the coming future that AI enhanced methods will also play a vital role in disease preparedness. Additionally, the prediction outcomes from these methods could be helpful to investigate the prevalence of COVID-19. The advancement of AI methods for COVID-19, big data analytics could improve our ability to observe public reactions on disease outbreaks dynamically and predict disease spread accurately, which can help authorities to take timely response measures to contagious diseases.

# IV. PROJECT DESCRIPTION

| **Problem Statement** | **(Max 250 words)** |
|---|---|

In order to investigate the COVID -19 in Pakistan by integration of AI artificial intelligence and epidemic modelling methods for public health surveillance system, there is a need of National Electronic Disease Surveillance System (NEDSS) to facilitate the transfer of health data, laboratory test information, and clinical data to state and local health departments efficiently and securely using data standard with the integration of epidemiological model which is currently serving as mainstay of prevailing surveillance systems. So far there is a big gap to get complete data related to morbidity and mortality rate of COVID-19 patients in Pakistan. These systems could support well-timed assessment of ID data, permit access to health surveillance services and will be helpful in efficient planning/management of disease control activities against pandemic Corona virus. (9,10,13)

In order to cope with the current burden of Pandemic COVID-19, there is a dire need to develop a real-time COVID-19 surveillance system for Pakistan using cutting-edge epidemiological spread patterns/models, visualization modalities, inference capabilities, early warning routines, and disease forecasting algorithms. Epidemiological studies related to corona virus under diverse conditions and for different regions. The primary motivation for this project is to set-up a baseline for COVID -19 surveillance and recognize the key components of health surveillance to ease reproducibility of such systems in the future. (8,9)

| **Methodology & Deliverables (Max 250 words)** |
|---|

Main modules of this framework will include;
- Real-time data acquisition with Python integration
- Multisource data integration
- Statistical data analysis
- Visual analytics environment
- Data acquisition module will capture the input data for surveillance system and statistical data analysis. This toolset will be responsible for dynamic syndromic classification, spatiotemporal alerts generation for early outbreak detection and forecasting ID spread patterns of COVID-19 etc.
- Epidemic outbreak detection module Will focuses on techniques aimed at early outbreak detection for space-time stamped syndromic surveillance data.
- The surveillance framework will incorporates both temporal and spatio-temporal outbreak detection methods.
- We Will use space-time statistics to locate large clusters which would be helpful for epidemiological aspects. It will estimates the statistical significance of disease cluster/alarms with respect to time, i.e. spatial variation in temporal trends. It will allow performing frequent time-periodic measures for early outbreak detection, thus providing information about prevailing epidemic clusters/trends at a finer level of granularity.

**Required Resources & Facilities Available in the Host Institution and through Collaboration (Max 250 words)**

Describe briefly required resources (staff, materials, data facilities etc) for the proposed project and mention whether these are readily available and if not how they will be accessible to accomplish the project work plan.

Resources required for the project includes:
   i.     Data analyst
   ii.    Advanced software to integrate the data
   iii.   IT technical support
   iv.    Qualified expert personals to collect the data
   v.     Health care providers
   vi.    Advanced Computer systems

**Plans for Dissemination (Max 100 words)**

Describe how data will be collected, curated, maintained and shared.  Beyond publication in international, academic, peer-reviewed journals, what reports or other formal mechanisms will be employed to share research results with Public Health sector officials, policymakers and other stakeholders

- First identification of study objectives, followed by questionnaire development; to collect the data, analysis, and interpretation; and implementation of control measures.
- Other than publication the data will collected by only survey-based tools.
- Integration of data linked web page to the system

All the data and the information will be disseminated with the help of website, as all the primary, secondary and tertiary health system is automatically integrated with our web page.

Data from outpatient will be collected by our online domain from all the registered pharmacies of Pakistan.

And the other ways also include through social media and the apps application to the designed webpage.

**Ethical & Regulatory Considerations (If any) (Max 150 words)**

In particular, describe how the proposed research takes into consideration the World Health Organization guidelines on COVID-19.

The proposal should have a description of ethical considerations relating to the study. Document the issues that are likely to raise ethical concerns. It should also describe how the Principal Investigator is planning to address it and how he/she plans to obtain informed consent from the research participants.

In 2010, World Health Organization (WHO) recommend to improve global health governance and development of state-of-the-art health surveillance architectures by developing ID surveillance system in order to cope with imminent epidemic, to determine the lack of standards defined for disease reporting, importance and need for automated mechanisms of ID threats management .(8,9) They emphasized the need for model-based surveillance framework for public health policy making and in turn judge their effectiveness and preparedness for prevention of IDs and efficacy of control activities. (11,12) Therefore according to current situation of Pandemic COVID-19, with the help of

epidemiological modelling by health surveillance system of artificial intelligence will play a integral role towards policy making for the betterment of public health.

Security breaches threaten patient privacy when confidential health information is made available to others without the individual's consent or authorization.

Being a principal investigator a useful electronic health record (HER) system will require with the help of expertise of physicians, technology professionals, ethicists, administrative personnel, and patients. Leadership, teamwork, flexibility, and adaptability are keys to finding solutions. EMRs capacities will be maximized in order to enhance improve the quality, safety, efficiency, and effectiveness of health care and health care delivery systems.

| Potential Risks Imperil to the Project Progress & related risk strategy (Max 150 words) |
|---|
| Consider the potential risks (e.g. travel restriction due to Coronavirus epidemics, procurement delays, student or faculty strikes; non-adherence to the university calendar; significant change to institutional finances; procurement delays) that could imperil the progress and success of the proposed project and briefly describe the strategy that will be used to minimize and address these risks.<br><br>The above risk factors will be minimized by risk matrices. Similarly heat maps related to epidemic COVID-19 can be deployed that will also help to visualize risks and promote communication and collaborative decision-making.<br>Having an established plan with the help of electronic based data collection in place promotes calm and measured response and transparency by staff and ensures that corrective actions can be implemented and evaluated. |

# V. IMPLEMENTATION TIMELINE

All projects selected for RRG Funding will be evaluated annually on the achievement of outcome targets as part of project oversight. Develop a Gannt Chart and Identify major tasks and deliverables planned for each quarter of the proposed project. In all aspects, disparate activities should link together to result in a coherent work plan that achieves the objectives of the proposed project.

| Quarter One | | | |
|---|---|---|---|
| Timelines, Major Tasks and Deliverables | | | |
| Task Name | Start | End | Duration (months) |
| Review Prior Epidemiologic Investigations of Similar Illnesses | 5/1/2020 | 5/31/2020 | 30 |
| Questionnaire Tool Development & Team Making | 5/15/2020 | 6/30/2020 | 46 |

| Arrangement of Resources | 7/1/2020 | 7/31/2020 | 30 |
|---|---|---|---|

**Gantt Chart** 5/1/2020 5/31/2020 6/30/2020 7/30/2020

Review Prior Epidemiologic Investigations of Similar Illnesses

Questionare Tool Development & Team Making

Arrangement of Resources

| Quarter Two | | | |
|---|---|---|---|
| **Timelines, Major Tasks and Deliverables** | | | |
| **Task Name** | **Start** | **End** | **Duration (months)** |
| Field Investigations | 8/1/2020 | 8/31/2020 | 30 |
| Questionnaire Tool Development & Team Making | 9/1/2020 | 10/15/2020 | 44 |
| Integration with policy makers | 10/1/2020 | 11/15/2020 | 45 |

**Gantt Chart** 8/1/2020 8/28/2020 9/24/2020 10/21/2020 11/17/2020

Field Investigations

Questionare Tool Development & Team Making

Integration with policy makers

| Quarter Three | | | |
|---|---|---|---|
| **Timelines, Major Tasks and Deliverables** | | | |
| **Task Name** | **Start** | **End** | **Duration (months)** |
| Scrutinizing of Data | 11/15/2020 | 12/15/2020 | 30 |

| | | | |
|---|---|---|---|
| Statistical Analysis | 12/1/2020 | 12/31/2020 | 30 |
| Implementations , and Follow-ups | 12/1/2020 | 12/31/2020 | 30 |

**Gantt Chart**   11/15/2020        12/8/2020        12/31/2020

Scruitining of Data

Statistical Anaylsis

Implementations , and Followups

| Quarter Four |
|---|
| **Timelines, Major Tasks and Deliverables** |

| Task Name | Start | End | Duration (months) |
|---|---|---|---|
| Published the Data | 1/1/2021 | 2/28/2021 | 58 |
| Launching the Tool  for Public Service | 3/1/2021 | 4/30/2021 | 60 |

**Gantt Chart**   1/1/2021    1/28/2021    2/24/2021    3/23/2021    4/19/2021

Published the Data

Launching the tool  for public service

# VI. PROPOSED PROJECT BUDGET

| Budget Justification | (Max 250 words) |
|---|---|
| Complete the budget template. . Please refer to Budget Guidelines available on HEC Website for details of each budget head. Justify the proposed budget under each head/category: | |
| **Institution Name** | Capital University of Science and Technology |
| **Project Title** | Investigation of COVID -19 in Pakistan by Integration of Artificial Intelligence and Epidemic Modelling Methods for Public Health Surveillance System |

| A. RAPID Research Grant | | |
|---|---|---|
| **Budget Element** | **% time spent** | **Total Budget** |
| **Personnel Costs** | | PKR |
| **Faculty** | | |
| Prof. Dr. Sahar Fazal | 30 | 500000 |
| Dr. Hina Ahsan | 30 | 400000 |
| Prof. Dr. Aamer Iqbal Bhatti | 30 | 400000 |
| Prof. Dr. Shaukat Iqbal | 15 | 200000 |
| Prof. Dr. Iqdus Naveed | 15 | 200000 |
| Total Faculty Costs | | 1700000 |
| **Postdoctoral Fellow** | | |
| Postdoctoral fellow 1 | 100 | |
| Postdoctoral fellow 2 | 100 | |
| Total Postdoc Costs | | 0 |
| **Students** | | |
| PhD Student | 100 | 600000 |
| M.Phil Student | 100 | 240000 |
| M.Phil Student | 100 | 240000 |
| Total Student Costs | | 1080000 |
| **Other Personnel** | | |
| Research Associate | 100 | 600000 |
| Data Analyst | 100 | 300000 |
| Data Analyst | 100 | 300000 |
| IT Technition | 100 | 180000 |
| Total Other Costs | | 1380000 |
| **Total Personnel Costs** | | 4160000 |
| **Equipment and Supplies** | | |
| Lenovo Idea Pad L340  (05) | | 1500000 |
| Data Integration Software | | 1000000 |
| Server PC with backup system | | 1000000 |
| Equipment 3 (misc.) | | 500000 |
| Web Development Charges | | 500000 |
| Communication Network Accessories | | 500000 |

| | | |
|---|---|---|
| **Total Equipment/Supplies** | | 5000000 |
| **Foreign Researchers** | | |
| Travel | | |
| Living | | |
| Limited salary costs | | |
| **Total Foreign Researcher Costs** | | 0 |
| **Other Costs** | | **#REF!** |
| Publications | | 300000 |
| Patent filing | | 20000 |
| Work Shop/ Conference | | 500000 |
| Travel Grants | | 600000 |
| Research Support Cost | | 400000 |
| Administration cost | | 800000 |
| Documentation, literature, information, online search, contingencies | | 100000 |
| Producing licensing agreements | | 200000 |
| Legal and financial investment advice | | 400000 |
| **Total Other Costs** | | 3320000 |
| **Overhead** | | **1248000** |
| | | |
| **Total Budget Requested** | | 13728000 |

# VII.      LIST OF REFERENCES

References should be reported in a standard form, and include:   the names of all authors; the article and journal title; book title; volume and page numbers; and year of publication.  If available, a Digital Object Identifier (DOI) may be provided.

[1] Ali MA, Ahsan Z, Amin M, Latif S, Ayyaz A, Ayyaz MN. ID-Viewer: a visual analytics architecture for infectious diseases surveillance and response management in Pakistan. Public health. 2016 May 1;134:72-85.
[2] Schneeweiss S. Learning from big health care data. N Engl J Med 2014;370(23):2161e3.
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[9] Radosavljevic V, Jakovljevic B. Bioterrorismdtypes of epidemics, new epidemiological paradigm and levels of prevention. 2007;121(7):549e557.

[10] Lee MB, Greig JD. A review of nosocomial Salmonella outbreaks: infection control interventions found effective. Public Health 2013;127(3).

[11] Edmond M, Wong C, Chuang S. Evaluation of sentinel surveillance system for monitoring hand, foot and mouth disease in Hong Kong. Public Health 2011;125(11).

[12]. Choi S, Lam P. Enhancing legal preparedness for the prevention and control of infectious diseases: experience from severe acute respiratory syndrome in Hong Kong. Public Health 2009;123:242e6.

[13]. Wilkins K, Nsubuga P, Mendlein J, Mercer D, Pappaioanou M. The data for decision making project: assessment of surveillance systems in developing countries to improve access to public health information. Public Health 2008;122:914e22.

[14]. James L, Shindo N, Cutter J, Ma S, Chew S. Public health measures implemented during the SARS outbreak in Singapore, 2003. Public Health 2006;120(1):20e6.

[15]. Griffiths S, Jewell T, Donnelly P. Public health in practice: the three domains of public health. Public Health 2005;119(10):907e13.

## VIII.      REQUIRED ATTACHMENTS

1. Curriculum Vitae of the following individuals:

   - Principal Investigators
   - The lead collaborator from the primary industry/sectoral partner
   - Up to three additional collaborators who will contribute to the proposed Project.
   - The CVs should be of a standard form (maximum two pages) and include the following information:

     - Full Name
     - Position/Title
     - Institution
     - Professional Training/Education

- Chronological List of Positions
- List of up to five publications related to the proposed project, in standard citation format
- List of up to five activities related to the proposed project. These activities may include: technology transfer activities; patents; current or previous grants; teaching; collaborations; leading workshops/conferences; community outreach or engagement; consulting; etc.

**Additional Documents Required Later on:**  The following documents also required to be attached. However due to time limitation and COVID-19 restrictions the same may be submitted at the time of award of the project:

2. Letter of Support (maximum two pages) from the University Vice-Chancellor.  The letter should: confirm the institutional commitment to the proposed project

3. Letters of Commitment (máximum two pages each)

- From Academic Collaborators (maximum 3 letters)
- From sectoral collaborators (maximum 3 letters)
- The letters should describe the how the collaborator will contribute to the proposed project goals.  The letter must also describe how, and at what level, the collaborator will finance their participation in the proposed RRG project

4. Declaration Certificate duly singed and stamp by PI of research proposal, Director ORIC and Head of institute

5. Endorsement Form duly singed and stamp by PI and Co-PI of research proposal, Director ORIC and Head of institute

6. Ethical Certificate duly signed by Ethical Research Committee of Institute

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No.15/CUST/ORIC/2020
March 13, 2020

**12$^{th}$ ORIC Research Committee Meeting**

**Minutes of the Meeting held on 5$^{th}$ March, 2020**

The 12$^{th}$ ORIC Research Committee Meeting was held on Thursday, March 05, 2020 in the Conference Room, F-Block at 03:30 PM.

Prof. Aamer Iqbal Bhatti, Dean Research & Innovation chaired the meeting.

The following members attended the meeting.

| | | |
|---|---|---|
| Dr. Sahar Fazal | HoD/Associate Professor (BS Dept) | Member |
| Dr. M. Tanvir Afzal | Professor (SE Dept) | Member |
| Dr. Majid Ali | Professor (CE Dept) | Member |
| Dr. Khawar Naveed | Assistant Professor (ME Dept) | Member |
| Dr. Umer Amir Khan | Assistant Professor (EE Dept) | Member |
| Dr. Mahboob Alam | Assistant Professor (Pharmacy Dept) | Member |

Dr. Abdul Rahman Kashif (Associate Professor, Mathematics Department) didnot attend the meeting due to certain departmental commitments. Dean Research and Innovation, Prof. Aamer Iqbal Bhatti welcomed the committee members. Subsequently, the meeting progressed as per agenda items listed below.

| Item 01 | **Confirmation of Previous Minutes of Meeting** | **Action By** |
|---|---|---|
| | 1.1  It was notified that no observations were received on the decisions taken in the 11$^{th}$ ORIC Research Committee meeting held on December 24, 2019. Therefore, the minutes of meeting were confirmed. | |

| Item 02 | **ORIC Activities Calendar Spring-2020** | **Action By** |
|---|---|---|
| | 2.1  Dean Research & Innovation presented the ORIC Activities Calendar Spring-2020 before Research Committee members. He briefly explained the events and tasks intended by ORIC in current semester. The inaugural lecture of Prof. Majid Ali was initially planned in the 4$^{th}$ week of March but he requested to reschedule the event in second week of April due to upcoming PEC visit and other departmental commitments which Dean Research & Innovation graciously accepted. | ORIC/Dr. Majid Ali |

|  |  |  |
|---|---|---|
| 2.2 | Dean Research & Innovation apprised the members about the research publications update mechanism recommended by VC office. The Vice Chancellor obliged ORIC to design Research Database Form and email it to all academic department heads by the end of every month and receive the requisite data. Dean Research & Innovation asked Research Committee members to play their prospective role in collection of research data from their respective departments. | ORIC/Research Committee |

**Item 03      NRPU Proposals**

|  |  |
|---|---|
| 3.1 | Dean Research & Innovation briefly discussed the list of research proposals submitted by CUST faculty members of almost all departments in HEC NRPU Programme. He acknowledged the efforts of faculty members and added that proposals submission itself is a big challenge and is worth to be appreciated. |
| 3.2 | The Committee members also praised the efforts of ORIC in NRPU proposals advertisement,support and associated documentary procedures. |

**Item 04      ORIC Policy**

|  |  |  |
|---|---|---|
| 4.1 | Dean Research & Innovation updated the members about proposed ORIC policy draft to be presented in subsequent Executive committee Meeting. This was followed by a detailed discussion on various aspects of the policy. | ORIC |
| 4.2 | The Research Committee members proposed the Seed Money to be included in CUST Annual Research Grant. Dean Research & Innovation asked Assistant Director ORIC to add the Seed Money as agenda item for the next meeting to have a comprehensive discussion on it. | ORIC |
| 4.3 | A brief discussion was carried on proposed CUST Travel Grant Policy. Dr. Khawar Naveed made attention to the clause 5.7.10.3 of the policy relevant to documentary evidences to be submitted for travel grant. He proposed to submit the documents listed from (a) to (d) in the clause after the conference and remaining listed from points (e) to (k) before the conference to university administration. Dr. Majid Ali proposed to allocate a departmental quota for various departments. Dean Research & Innovation affirmed to present and discuss the implementable amendments before the Executive Committee. |  |

4.4 The Faculty Research Load Criteria was also con-
versed in detail. Dean Research & Innovation ex-
plained that the proposed faculty load sharing mech-
anism is being followed by Sydney University, Aus-
tralia. Dr. Majid Ali said that the Faculty Research
Load table should be simplified in to three major do-
mains teaching, research and administration. Dean
Research & Innovation explained that various crite-
rion discussed in the table actually come under the
said three major domains as sub headings to con-
cisely explain the workload. The committee mem-
bers presented various suggestions with regard to the
Faculty Load Criteria. Dean Research & Innovation
said that the proposed plan is yet to be presented in
Executive body of university and modifications can
be made as per university requirements in the light
of recommendations of higher authorities.

ORIC

4.5 The Financial Model for workshops and training was
conversed in brief. Dean Research & Innovation ap-
prised the members about the proposed CUST busi-
ness Incubation Center. He asked respective mem-
bers to play their role in making this happen.

**Item 05**          **CUST Commercialization Matrix**

5.1 Dean Research & Innovation presented the CUST
Commercialization Matrix before Research Com-
mittee members that was formulated after Ideas
Hunting Sessions held with various departments. He
shared the details of potential commercializeable
ideas and recent progress report of ORIC and rele-
vant departments.

5.2 Dean Research & Innovation updated the members
about the visits of Assistant Director ORIC to poten-
tial clients and various nurseries of Rawalpindi and
Islamabad for "Tissue Culture" venture. He apprised
that ORIC has also visited Animal House of National
Institute of Health, Islamabad along with concerned
faculty to know about the various requirements of
Animal House. The visit of executives from Pharma-
ceutical Industries to CUST is also a proof of ORIC
efforts for commercialization.

5.3 Dean Research & Innovation also apprised the mem-
bers about the working on Cold Storage System pro-
posed by ME department. He asked Dr. Khawar
Naveed to stimulate his department in this matter.
He further added that clients for CS based projects
are available but need to be approached which can-
not be possible without departmental support.

Dr. Khawar
Naveed/Dr.
Tanveer
Afzal

3

**Item 06          Certificate Courses**

      6.1 Dean Research & Innovation updated the members about the Certificate Courses initiated by ORIC in current semester. The response of organizations like NESCOM was praiseworthy. He asked Research Committee members to play their prospective role in continuing these courses in future and motivating professionals for the mentioned courses using their peculiar contacts.

Being no further item for discussion the meeting was adjourned with a vote of thanks the chair and participants.

**Prepared by**

Muhammad Raheel Anjum
Assistant Director ORIC

**Approved by:**

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

**Distribution.**

      – Vice Chancellor
      – Registrar
      – ORIC Committee Members
      – File

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# CUST Faculty Research Report

## Journal Publications

Capital University of Science and Technology (CUST), Islamabad has always been proactive in the field of practical research. It has been through the hard work and extreme dedication of CUST faculty and students that they have been successful in publishing their research work in renowned Impact Factor (IF) National and International Journals. The continual growth in quality research publications in recent years showcases the persistence of faculty, researchers and students.

## Department wise Publications Trend

The following graph depicts the trend of department wise Journal Publications ranging till 30th September 2020 as per the data provided by departments. A total of 91 research articles are published by CUST faculty in various Journals.

**CUST Department-wise Journal Publications 2020**

| | BS & BI | CE | CS & SE | EE | Maths | ME | MS | Pharm |
|---|---|---|---|---|---|---|---|---|
| Publications | 9 | 9 | 8 | 14 | 10 | 3 | 19 | 19 |

## Year wise Publications Trend

The following graphs highlight the year wise publications trend in accordance with the data provided by departments. The overall Journal and Conference publications are 804 and 460

respectively till 30th September 2020. The total CUST publications amounts 1264 including Impact Factor, Non-Impact Factor and Conference Publications.

**CUST Year-wise Journal Publications Trend**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Publications | 334 | 422 | 536 | 713 | 804 |

**CUST Year-wise Total Publications Trend**

| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Journal | 334 | 422 | 536 | 713 | 804 |
| Conference | 338 | 364 | 400 | 440 | 460 |

## CUST Total Publications Trend (Journal and Conference)



## Research Group 5Ps Data

The following graphs depict the overall progress of CUST Research Groups in terms of Publications, Projects, Prototypes/Product Development, PhDs Produced and Patents Filled/Approved.



**Research Group of Microelectronics & RF Engineering**
Group Head: Prof. Muhammad Mansoor Ahmed

## ACME Center for Research in Wireless Communications (ARWiC)
### Group Head: Prof. Noor Muhammad Khan



Legend:
- Publications
- Projects
- Prototypes
- PhDs
- Patents

Values: 7, 37

## Control and Signal Processing Research Group (CASPR)
### Group Head: Prof. Aamer Iqbal Bhatti



Legend:
- Publications
- Projects
- Prototypes
- PhDs
- Patents

Values: 22, 6, 8, 68

## Center of Research in Network & Telecom (CoReNet)
### Group Head: Prof. Amir Qayyum



Legend:
- Publications
- Projects
- Prototypes
- PhDs
- Patents

Values: 5, 3, 9, 23

## Vision and Pattern Recognition Group
### Group Head: Prof. Imtiaz Ahmed Taj



- Publications
- Projects
- Prototypes
- PhDs
- Patents

## Research Group of Design and Machines
### Group Head: Dr. Waqas Akbar Lughmani



- Publications
- Projects
- Prototypes
- PhDs
- Patents

## Thermofluids Research Group
### Group Head: Dr. Muhammad Mahabat Khan



- Publications
- Projects
- Prototypes
- PhDs
- Patents

## Manufacturing Industrial & Systems Engineering Research Group
### Group Head: Dr. Tayyaba Zahid



- Publications
- Projects
- Prototypes
- PhDs
- Patents

## Structural Materials Research Group
### Group Head: Prof. Majid Ali



- Publications
- Projects
- Prototypes
- PhDs
- Patents

## Water and Environment Research Group (WE R)
### Group Head: Dr. Ishtiaq Hassan



- Publications
- Projects
- Prototypes
- PhDs
- Patents

## Research Group of Construction Management
### Group Head: Dr. Syed Shuja Safdar Gardezi

Legend: Publications, Projects, Prototypes, PhDs, Patents

6

## Center for Research in Data Science, Semantics & Scientometrics
### Group Head: Prof. Muhammad Abdul Qadir

Legend: Publications, Projects, Prototypes, PhDs, Patents

1
2
2
7
63

## Data Management and Analytics (DMA)
### Group Head: Prof. Nayyer Masood

Legend: Publications, Projects, Prototypes, PhDs, Patents

1
8

# Center for Software Dependability (CSD)
## Group Head: Prof. Aamer Nadeem



- Publications
- Projects
- Prototypes
- PhDs
- Patents

# Genetic and Molecular Epidemiology Research Group (GMER)
## Group Head: Dr. Maryam Bakhtiar



- Publications
- Projects
- Prototypes
- PhDs
- Patents

# Cancer Cytogenetics Research Group
## Group Head: Prof. Shaukat Iqbal Malik



- Publications
- Projects
- Prototypes
- PhDs
- Patents

## Research Group of Green Biotechnology
### Group Head: Dr. Erum Dilshad



- Publications
- Projects
- Prototypes
- PhDs
- Patents

25

## Integerative BioSciences Research Group
### Group Head: Dr. Sahar Fazal



- Publications
- Projects
- Prototypes
- PhDs
- Patents

2

30

## Industrial & Environmental Bio Technology Research Group
### Group Head: Dr. Arshia Amin



- Publications
- Projects
- Prototypes
- PhDs
- Patents

14

# List of Publications (2020 till 30$^{th}$ Sep 2020)
# Capital University of Science and Technology

[1] U. Ahmed, M. Ahmed, and Q. Memon, "A modified analytical model for algan/gan finfets i–v characteristics," *Semiconductor Science and Technology*, vol. 35, no. 3, p. 035002, 2020.

[2] S. Shafique, K. S. Karimov, M. Abid, M. M. Ahmed, and K. M. Akhmedov, "Carbon nanotubes, orange dye, and graphene powder based multifunctional temperature, pressure, and displacement sensors," *Journal of Materials Science: Materials in Electronics*, pp. 1–7, 2020.

[3] R. Saadia and N. M. Khan, "Single carrier-frequency division multiple access radar: Waveform design and analysis," *IEEE Access*, vol. 8, pp. 35 742–35 751, 2020.

[4] M. Kamal Mazhar, M. J. Khan, A. I. Bhatti, and N. Naseer, "A novel roll and pitch estimation approach for a ground vehicle stability improvement using a low cost imu," *Sensors*, vol. 20, no. 2, p. 340, 2020.

[5] A. Hanif, Q. Ahmed, A. I. Bhatti, and G. Rizzoni, "A unified control framework for traction machine drive using linear parameters varying-based field-oriented control," *Journal of Dynamic Systems, Measurement, and Control*, vol. 142, no. 10, 2020.

[6] S. Ullah, Q. Khan, A. Mehmood, and A. I. Bhatti, "Robust backstepping sliding mode control design for a class of underactuated electro–mechanical nonlinear systems," *JOURNAL OF ELECTRICAL ENGINEERING & TECHNOLOGY*, 2020.

[7] R. Ara, U. A. Khan, A. I. Bhatti, and B. W. Lee, "A reliable protection scheme for fast dc fault clearance in a vsc-based meshed mtdc grid," *IEEE Access*, vol. 8, pp. 88 188–88 199, 2020.

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[9] Z. Masood, R. Samar, and M. A. Z. Raja, "Design of fractional order epidemic model for future generation tiny hardware implants," *Future Generation Computer Systems*, vol. 106, pp. 43–54, 2020.

[10] M. Shafiq, I. A. Taj, M. Ghafoor, S. A. Tariq, A. Abbas, and A. Y. Zomaya, "Accelerating fingerprint identification using fpga for large-scale applications," *Journal of Parallel and Distributed Computing*, 2020.

[11] M. Ghafoor, S. A. Tariq, I. Taj, N. Jafri, and T. Zia, "Robust palmprint identification using efficient enhancement and two-stage matching technique," *IET Image Processing*, 2020.

[12] U. RAFIQUE, M. A. WAHLA, S. U. DIN, and H. KHALIL, "Compact cpw-fed super wideband planar elliptical antenna."

[13] N. Zahid, J. Jiang, U. Rafique, and D. Eric, "A modified planar square-loop antenna for electronic article surveillance rfid applications," *Journal of Communications Technology and Electronics*, 2020.

[14] M. Tahir, I. A. Taj, P. A. Assuncao, and M. Asif, "Low complexity high efficiency coding of light fields using ensemble classifiers," *Journal of Visual Communication and Image Representation*, vol. 66, p. 102742, 2020.

[15] M. Hassan and I. Hassan, "Improving ann-based streamflow estimation models for the upper indus basin using satellite-derived snow cover area," *Acta Geophysica*, pp. 1–11, 2020.

[16] S. Janjua, I. Hassan, M. Zarghami, and S. Islam, "Addressing supply-demand gap in shared rivers using water diplomacy framework: utility of game theory in the indus river within pakistan," *Water Policy*, 2020.

[17] S. Janjua, I. Hassan, and S. Islam, "Role and relevance of three enabling conditions to resolve inter-provincial water conflicts in the indus basin within pakistan," *Water Policy*, 2020.

[18] S. Janjua and I. Hassan, "Fuzzy ahp-topsis multi-criteria decision analysis applied to the indus reservoir system in pakistan," *Water Supply*, 2020.

[19] S. Janjua and I. Hassan, "Transboundary water allocation in critical scarcity conditions: a stochastic bankruptcy approach," *Journal of Water Supply: Research and Technology—AQUA*, vol. 69, no. 3, pp. 224–237, 2020.

[20] S. Janjua and I. Hassan, "Use of bankruptcy methods for resolving interprovincial water conflicts over transboundary river: Case study of indus river in pakistan," *River Research and Applications*, 2020.

[21] M. Khan and M. Ali, "Optimization of concrete stiffeners for confined brick masonry structures," *Journal of Building Engineering*, p. 101689, 2020.

[22] S. Ahmed and M. Ali, "Use of agriculture waste as short discrete fibers and glass-fiber-reinforced-polymer rebars in concrete walls for enhancing impact resistance," *Journal of Cleaner Production*, p. 122211, 2020.

[23] M. Khan, M. Cao, and M. Ali, "Cracking behaviour and constitutive modelling of hybrid fibre reinforced concrete," *Journal of Building Engineering*, vol. 30, p. 101272, 2020.

[24] M. Khan, A. Rehman, and M. Ali, "Efficiency of silica-fume content in plain and natural fiber reinforced concrete for concrete road," *Construction and Building Materials*, vol. 244, p. 118382, 2020.

[25] R. Sabir, M. M. Khan, N. A. Sheikh, I. U. Ahad, and D. Brabazon, "Assessment of thermo-hydraulic performance of inward dimpled tubes with variation in angular orientations," *Applied Thermal Engineering*, vol. 170, p. 115040, 2020.

[26] L. A. Khan and M. M. Khan, "Role of orientation of fins in performance enhancement of a latent thermal energy storage unit," *Applied Thermal Engineering*, p. 115408, 2020.

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# CUST PhD Repository -2020

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|---|---|---|---|---|---|---|---|
| Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 | Column8 |
| **BS Deptt** | **ME Deptt** | **EE Deptt** | **CS Deptt** | **Pharm Deptt** | **MS Deptt** | **CE Deptt** | **Math Deptt** |
| Optimization and Establishment of In Vitro Cultures of Potato, Banana and Ornamental Plants for Commercialization | Design and Development of Energy Efficient Electric Vehicle with On-Board BMS and Motor Control | Indigenous Development of Drone Detection Radar | Mualim-Entertainment Based Learning Tool (EBLT) | Pharmacological Screening of Selected Synthetic Benzimidazole Derivatives against Painful Diabetic Neuropathy in Animal Models | Preparation of Indigenous Manual Based Intervention for Lowering anxiety and Depression Levels among Pakistani Youth | Impact of Urbanization and Flood Risk Assessment in Islamabad and Rawalpindi | |
| Molecular and bioinformatics analysis of drug resistance strains of Mycobacterium tuberculosis | Capacity Building of an Accomplished Engine Research Group for the Development High Power Diesel Engine. | Robust Model Predictive Control of Super Maneuverable Fighter Aircraft | Citation Recommendation System: A Novel Approach to Identify Meaningful Citations | | Addressing missing links between real estate suppliers, consumers and policy makers: a comparative state of housing in Islamabad and Lahore | | |
| Investigation of COVID -19 in Pakistan by Integration of Artificial Intelligence and Epidemic Modelling Methods for Public Health Surveillance System | Integrated modelling and Simulation of High –Power Diesel Engine for the verification of engine design enhancement | Establishment of Center of Excellence for Training, Advisory and Facilitation in Electric Vehicles (2-3-wheeler and heavy commercial wheeler) Technology | Anticipation of abnormal activities in complex urban environments using multi-camera information fusion | | **Towards the Application of Artificial Intelligence for Sustainable Livestock Management - A Pilot Project to uplift Socio-economic Conditions of Rural Women** | | |
| Investigation of Drug Resistant Strains of Mycobacterium Tuberculosis | Investigation of Fracture Properties of Human and Animal Bones and Establishing National Center of Excellence for 3-D Printability Fabrication of Prosthetic and Orthotics | | **Current and Future Impact of Public Sector Secondary Education in Pakistan** | | **Behavioral Intervention for Sustainable Agricultural Practices: A Field Experiment for Water Conservation** | | |
| Molecular Epidemiology and Prevalence of Antibiotic Resistance Genes in Smog Particulate Matter: Implications for Human Exposure in Pakistan | Computational Model for Combustion in the wake Region of flame Holder | | Capacity Building for Digital Health Monitoring and Care Systems in Asia - DigiHealth-Asia | | | | |
| A Hybrid Approach for Investigation of Morphology and Pharmacology of Iron and Zinc Oxide Nanoparticles utilizing Mentha asiatica added with External Modifiers | CFD Analysis of Atomization of Liquid Fuel | | Strategic Support for Accreditation of Programs and Internationalization at South Asian Higher Education Institutes (HEIs) / SSAPI | | | | |
| **Bioremediation and Toxicity Reduction of Effluents by Indigenous Microbial Strains as well as Optimization of Bioreactor for Sustainable Production of Third Generation Bioethanol** | | | Optimization framework for future 5G and beyond green wireless networks | | | | |
| | | | Smart Ambulance Care and Readiness in Emergency Disaster - SACRED | | | | |

# Structural Material Research Group (SMaRG)

SMaRG
Structural Materials Research Group
Department of Civil Engineering
Capital University of Science and Technology
Islamabad, Pakistan

## GROUP INTRODUCTION

The main objective of Structural Material Research Group (SMaRG) is to have an advanced research with focus on bridging gap between material properties and structure performance. This will help practicing engineers to recommend modern materials in construction industry. The scope of research ranges from properties of fibers as construction materials to structure performance including their economical aspects. The group is actively working on predicting the structure behavior keeping in mind the material properties of composites.

## GROUP HEAD

### Engr. Prof. Dr. Majid Ali

Engr. Prof. Dr. Majid Ali received his PhD in Seismic-Resistant Housing (Natural Fibre Concrete) from University of Auckland, New Zealand in 2013. He did his bachelors with Gold Medal and Masters with first position in structures specialization from UET Taxila, Pakistan. He has over 16 years of vast teaching, research and professional experience. He is an active international level researcher in structural materials. Prof. Majid is a regular publisher in national and international journals and conferences of highest repute. He has around 100 publications including 25 ISI IF papers with Cumulative ISI Impact Factor over 100. He is an HEC Approved PhD Supervisor. Before joining academia, he had remained on keynote positions in industry, notably NESPAK (one of the leading consultants of Pakistan). He is recipient of numerous awards and distinctions. Prof. Majid is an active member of various professional bodies which includes his lifetime membership of PEC as Professional Engineer. He is among the founding members of Civil Engineering Department at Capital University of Science and Technology, (CUST), Islamabad and currently serving as Professor and as Convener University Health, Safety & Security Committee at CUST.

## RESEARCH AREAS

- Properties of Fibres for Civil Engineering Applications
- Material Properties of Fibre Reinforced Composites
- Multiple Fibre Reinforced Composites for Structural Elements
- Performance of Composites in Structures
- Economic Aspects of Composites to be used in Structures Novel Materials

## CURRENT MS/PhD STUDENTS

1. Engr. Aaron Josha Das (PhD)
2. Engr. Ali Rehman (PhD)
3. Engr. Safeer Ullah (PhD)
4. Engr. Mehran Khan (PhD DUT China, Co-Supervision)
5. Engr. Sohail Afzal (MS)
6. Engr. Junaid Farooq (MS)
7. Engr. Hammad Bashir (MS)
8. Engr. Khurram Shahzad (MS)
9. Engr. M Sajid Aslam (MS)
10. Engr. M Sardar Junaid (MS)
11. Engr. M Izhar (MS)
12. Engr. M Awais (MS)

## NOTABLE MS/PhD ALUMNI

### Engr. M. Usman Farooqi

PhD Thesis Title: Potential utilization of Wheat Straw in Concrete for Pavement Applications from Engineering Perspectives
Year: 2020

### Mr. Furqan Qamar

PhD Thesis Title: Utilisation of Natural Fibrous Plaster for out-of-plane Lateral Resistance of Masonry Walling
Year: 2020

### Mr. Shehryar Ahmad

MS Thesis Title: : Impact Resistance of Concrete Wall having Jute Fibers and GFRP Rebars
Year: 2020

### Mr. Fayaz Khan

MS Thesis Title: Dynamic Behavior of Prototype Interlocking Plastic-block Structure Using Locally Developed Low-cost Shake Table
Year: 2019

### Mr. Tasaddaq Hussain

MS Thesis Title: Reduction of Reinforcement Using Jute Fiber Reinforced Concrete in Slabs under Impact Loading
Year: 2018

### Mr. Asad Zia

MS Thesis Title: Experimental Properties Evaluation of Fiber Reinforced Concrete related to Canal-lining
Year: 2017

### Mr. Mehran Khan

MS Thesis Title: Seismic Performance of Unreinforced and Reinforced Brick Masonry Structures by Numerical Modeling for Design Optimization
Year: 2017

## GROUP MEMBERS

1. Engr. Prof. Dr. Majid Ali
2. Engr. Dr. M. Usman Farooqi
3. Engr. Faiza Khalid
4. Engr. Sana Gul
5. Engr. Aaron Josha Das
6. Engr. Ali Rehman
7. Engr. Safeer Ullah

## SELECTED PUBLICATIONS

### Journal Publications

- S. Ahmed, and M. Ali, "Use of agriculture waste as short discrete fibers and glass-fiber-reinforced-polymer rebars in concrete walls for enhancing impact resistance," Journal of Cleaner Production, vol. May, p. 122211, 2020, (I.F: 7.246).
- M. Khan, M. Cao, and M. Ali, "Cracking behaviour and constitutive modelling of hybrid fibre reinforced concrete," Journal of Building Engineering, vol. 30, p. 101272, 2020, (I.F: 3.379).
- M. Khan, A. Rehman, and M. Ali, "Efficiency of silica-fume content in plain and natural fiber reinforced concrete for concrete road," Construction and Building Materials, vol. 244, p. 118382, 2020, (I.F: 4.419).
- F. Qamar, T. Thomas, and M. Ali, "Improvement in lateral resistance of mortar-free interlocking wall with plaster having natural fibres," Construction and Building Materials, vol. 234, p. 117387, 2019, (I.F: 4.419).
- M. U. Farooqi and M. Ali, "Effect of pre-treatment and content of wheat straw on energy absorption capability of concrete," Construction and Building Materials, vol. 224, pp. 572–583, 2019, (4.419).
- F. Qamar, T. Thomas, and M. Ali, "Assessment of mechanical properties of fibrous mortar and interlocking soil stabilised block ISSB) for low-cost masonry housing," Materiales de Construction, vol. 69, no. 336, p. 201, 2019, (I.F: 1.456).
- T. Hussain and M. Ali, "Improving the impact resistance and dynamic properties of jute fiber reinforced concrete for rebars design by considering tension zone of FRC," Construction and Building Materials, vol. 213, pp. 592–607, 2019, (I.F: 4.419).
- M. U. Farooqi and M. Ali, "Contribution of plant fibers in improving the behavior and capacity of reinforced concrete for structural applications," Construction and Building Materials, vol. 182, pp. 94–107, 2018, (I.F: 4.419).

### Conference Publications

- M. Sudheer and M. Ali, "Behavior of interlocking plastic-block wall with opening under harmonic loading using locally developed shake tables," in 11th International Civil Engineering Conference (ICEC2020) Integrating Innovation and Sustainability in Civil Engineering, NED-UET / IEP Karachi, Pakistan, vol. 11, 2020.
- M. U. Farooqi and M. Ali, "Construction practices for first ever wheat straw reinforced concrete pavement for light traffic," 5th International Conference on Sustainable Construction Materials and Technology, Kingston University, London, UK, July 14-17, Paper ID SCMT5169, 2019.
- M. Ali, "Awareness of preparedness in institutional buildings of developing countries for a disaster," Annual Australian Earthquake Engineering Society Conference, Perth, Australia, November 16-18, Paper 14, 2018.
- M. Ali, "Evacuation of institutional buildings during a disaster in developing countries: from planning to implementation," Annual New Zealand Society for Earthquake Engineering Conference, New Zealand, April 27-29, Paper 0220, 2017.

# Online Seminar on Managing and Implementing Change with respect to COVID-19

Office of Research, Innovation and Commercialization (ORIC) is conducting a series of Online Training Sessions/Seminars for Knowledge Building/Enlightenment of faculty members, research scholars and students about the most recent subject matters.

The recent seminar entitled "SARS COVID-19" was held on Thursday 09th July 2020 at 2PM. The session was held on Microsoft Teams under "ORIC Seminars Team". The objective of the particular session was to educate CUST faculty members, research scholars and students with the updated research and comprehension about Change Management in COVID-19 pandemic.



The resource person for the particular session was Dr. Muzaffar Asad, Assistant Professor, Department of Management and Marketing, University of Bahrain. Dr Asad is an internationally acclaimed trainer and has conducted several trainings in the domains of Communication Skills, Leadership, Entrepreneurship, SPSS, Smart PLS etc. at various academic and professional institutes.

The speaker educated the addressees about the current practices and methodologies adopted worldwide to effectively implement and adapt to the changes transpired as a result of COVID-19 pandemic. The participants included the faculty members and students across various departments. The seminar lasted till 3:30PM including the Q/A session. The talk ended on a high note and proved to be a great source of knowledge and acquaintance to the participants. The session concluded with the vote of thanks to Resource Person by Assistant director ORIC.

**Prepared by:**

Muhammad Raheel Anjum
Assistant Director ORIC

**Approved by:**

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

No.23/CUST/ORIC/2020

June 18th, 2020

# Online Seminar on SARS COVID-19

Office of Research, Innovation and Commercialization (ORIC) organized an interactive Online Seminar entitled "SARS COVID-19" on Wednesday 17th June 2020 at 2PM. The session was held on Microsoft Teams under "ORIC Seminars Team". The objective of the particular session was to educate CUST faculty members, research scholars and students with the most updated research and comprehension about COVID-19 pandemic.



The resource person for the particular session was Prof. Dr. Shaukat Iqbal Malik, Professor, FHLS and Director VIS, CUST. The speaker discussed the various types of Corona Viruses with their brief history. He educated the addressees about the symptoms, testing methods with their effectiveness, precautionary measures and treatment procedures. The presentation also covered the societal impact of COVID-19.

A total of 45 participants including the senior faculty members, research scholars and students from various departments attended the seminar. The seminar lasted till 3:30PM including the Q/A session. The faculty members and students took keen interest in the session that was also evident from Q/A session. The talk ended on a high note and proved to be a great source of knowledge and acquaintance to the participants. The Resource Person and faculty members were graciously thanked by Assistant director ORIC at the end of with the commitment to continue such type of sessions on consistent basis.

**Prepared by:**

Muhammad Raheel Anjum
Assistant Director ORIC

**Approved by:**

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

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No.23/CUST/ORIC/2020

June 11th, 2020

# Training Session on Recent Approaches in Literature Review

Office of Research, Innovation and Commercialization (ORIC) organized an Online Training Session entitled "Recent Approaches in Literature Review" on 09th June 2020 at 5PM. The session was held on Microsoft Teams under "ORIC Seminars Team". The objective of the particular session was to enlighten CUST faculty members, research scholars and students with the updated knowledge about the most recent practices in Literature Review.

A literature review is a survey of scholarly sources on a specific topic. It provides an overview of current knowledge allowing you to identify relevant theories, methods and gaps in the existing research. Conducting a literature review involves collecting, evaluating and analyzing publications, such as books and journal articles that relate to your research question.

A total of 22 participants including faculty members and research scholars from various departments attended the seminar. The resource person for the particular session was Dr. Lakhi Muhammad, Assistant Professor, Management Sciences Department, CUST. The session ended on a high note and proved to be a great source of knowledge and acquaintance to the participants, and research scholars in particular. The Resource Person and participants were thanked by Assistant director ORIC at the end of the session.

**Prepared by:**

Muhammad Raheel Anjum
Assistant Director ORIC

**Approved by:**

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

No.23/CUST/ORIC/2020
July 28th, 2020

# Online Training Session about "How to Avoid Depression During University's Academic Tenure"

Office of Research, Innovation and Commercialization (ORIC) is conducting a series of Online Training Sessions/Seminars for Knowledge Building/Enlightenment of faculty members, research scholars and students about the most recent subject matters.

The recent session entitled "How to Avoid Depression During University's Academic Tenure" was held on Tuesday, 21st July 2020 at 12PM. The session was held on Microsoft Teams under "ORIC Seminars Team" which is specifically created by ORIC for its Online workshops, seminars and similar activities. The objective of the particular session was to educate students about how to cope with the depression and uneasiness during their academic period.



The resource person for the particular session was Engr. Qazi Abdul Moqueet, Lecturer, Electrical Engineering Department, CUST. The speaker educated the addressees about the effective practices and routines to effectually avoid rigorousness and associated depression during University education.

The participants included the undergraduate students of various departments. The seminar lasted till 1:30PM including Q/A session. The talk ended on a high note and proved to be a great source of knowledge and acquaintance to the participants. The session concluded with the vote of thanks to resource person by Assistant Director ORIC.

**Prepared by:**

Muhammad Raheel Anjum
Assistant Director ORIC

**Approved by:**

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

No.23/CUST/ORIC/2020
March 03, 2020

# FYPs Funding Certificate Distribution Ceremony

The FYPs Funding Certificate Distribution Ceremony was held on Thursday, 27th Feb 2020 in Workshop Room, B-Block at 02 PM. The event was organized by Office of Research, Innovation and commercialization to instigate the students for their innovative project ideas and explicit business plans. Prof. Arshad Hassan, Dean FMSS was chief guest at the occasion. The following faculty members/project supervisors were present at the event.

1. Prof. Aamer Iqbal Bhatti, Dean Research & Innovation
2. Prof. Mueen Aizaz Zafar, HoD MS Department
3. Dr. Muhammad Mahabat Khan, HoD ME Department
4. Prof. Muhammad Ashraf, Professor EE Department
5. Dr. Salman Sagheer Warsi, Assistant Professor ME Department
6. Dr. Muhammad Shahid Iqbal, Assistant Professor CS Department

The event started with the recitation of few Verses from Holy Quran. The chief guest and faculty members were briefed about the particular competition and the evaluation procedure adopted. Subsequently Dean FMSS was invited for certificate distribution among the students as per following merit standing.

| Sr. No. | Project Title | Supervisor | Students |
|---------|---------------|------------|----------|
| 1 | Design and Fabrication of Shoe Testing Rig | Dr. Salman Sagheer Warsi | 1. Muhammad Usman<br>2. Ayaz Saleem Qureshi<br>3. M. Yamin Jan |
| 2 | Home Automation using Rasbery pi | Dr. Muhammad Shahid Iqbal | 1. Muhammad Hamza<br>2. Haris Khan<br>3. M. Hamza Bhatti |
| 3 | Thermal Heat Storage Unit | Dr. Muhammad Mahabat Khan | 1. Mamoon-ur-Rasheed<br>2. Muhammad Sheryar<br>3. Shahid Ali |
| 4 | Solar PID Reversal Unit | Prof. Muhammad Ashraf | 1. Shahbaz Tariq<br>2. Faizan Butt<br>3. Abdul Wasay |
| 5 | Cafe 97 | Dr. Ansir Ali Rajput | Warda Imtiaz |
| 6 | Smart Living Solar Solutions | Prof. Sajid Bashir | 1. Aiman Arshad<br>2. Alina Sajjad<br>3. Hamza Toor |

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After the certificate distribution, Dean FMSS delivered a brief talk. He inspired the students about their endurance and highlighted the importance of business plans in present age of commercialization. He appreciated the efforts of students and highlighted the significance of entrepreneurship and marketing the product in the present age of commercialization.



Following the ceremonial, an interactive session of ORIC was held with Dean FMSS and award winning supervisors. The following points were deliberated in detail:

1. Customer Outreach Strategies for selling Products
2. Business Plan Competition
3. Business Case/Innovative Products Showcase
4. Presentations of award winning students in Business/Management Oriented Courses Classes

The faculty members wished that such type of awards and funding should be conducted on continual basis. They also agreed on interdepartmental collaborations and joint projects for better progression of students and faculty.

**Prepared by:**

Muhammad Raheel Anjum
Assistant Director ORIC

**Approved by:**

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

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# Optimization and Establishment of In Vitro Cultures of Potato, Banana and Ornamental Plants for Commercialization

## 1. Preamble

In recent years, tissue culture techniques have become very famous and substitute tool for vegetative propagation of plants. As an emergent technology, the micropropagation of plants has influenced greatly both agriculture and industry by making sure the provision of plants to encounter the ever-growing world demand. It is contributing significantly to the progression of agricultural sciences in current eras and today they establish an essential tool in contemporary agriculture. It is due to that we can generate a huge number of clones from a solitary seed or explants, select required traits, reduce the amount of space needed for field trials and eradicate plant diseases through the vigilant assortment and sterile techniques. This biotechnological tool offers various valuable prospects for crop yield improvement under sterile environments [1].

The system is specified by the very tensile rapid multiplication of plants giving a high proliferation rate in a very small period of time [2]. It is a potential biotechnological tool that has become a commercially viable method of in vitro clonal propagation of a wide range of herbaceous and woody plants [3]. Morel in 1960 first time used this technique for orchid's multiplication and is currently applicable to various plants and it has been proven to be a very effective tool to speed up the creation of superior class pathogen-free plantlets, in terms of genetic and physiological consistencies [4].

The commercial feasibility of these techniques has been demonstrated in many diverse plant species including fruit and vegetable plants. Potato is the world's most imperative non-cereal food crop, and therefore, it is considered one of the major food sources for humankind. Its conventional propagation is asexual, by using the tuber, which allows the accumulation and dissemination of pathogens to new cultivation areas. This fact not only impairs the yield of this solanaceous plant but also threatens the maintenance of genotypes for commercial or breeding purposes. Due to the impossibility of using botanical seed, conservation and exchange of germplasm of this species by means of conventional methods are not feasible. In all potato-producing regions, the demand for high-quality tubers has been paramount to ensure crops production. Thus, biotechnological techniques based on tissue culture are very important [5].

For large scale production of uniform, identical seed material of potato, micro-propagation can be the better alternative over conventional propagation of potato. By using the technique, which involves low-cost components, largescale clonal material can be produced in a short time duration. Use of micro-propagation for commercial seed production has moved potato from test tubes to field. Potato production is being seriously hampered due to certain viruses, fungus and bacterial diseases. Researchers showed that some viruses can decrease the yield by 40% singly and in combination with other viruses, the loss is 90% [6].

Similarly, banana and plantain (Musa spp.) are the most important fruit crops of India; the largest banana cultivator on the globe. The most important difficulty though confronted in the banana rising zones is the scarcity of identical and disease-free planting materials, which is due to the vegetative mode of propagation of the plant (through side-suckers) at a slow pace in conventional cultivation. This difficulty can be addressed by employing the commercial tissue

culture technology for mass-production of the popular banana varieties. The said tissue culture technology can also be utilized for conservation & multiplication (as per the requirement) of other locally important, elite, endangered and ornamental banana varieties.

Banana is usually cultivated vegetatively; therefore micropropagation technique offers vigorous means to formulate disease-free implanting resources that can offer the resistance against pathogens in evolving an integrated disease-management program for banana. Nevertheless, commercial tissue-cultured banana seedlings are not always accessible available. Larger-scale banana agriculturalists may desire to create a banana tissue-culture aptitude in-farm to guarantee handiness of disease-free seedlings for cultivation in combination with a practice of abolishing contaminated plants.

Among the top ten ornamental flowers sold worldwide, the tulip takes the third place. Similarly Araucaria heterophylla is a very popular ornamental tree in gardens,Commercially, the propagation of of these ornamental plants is based on the vegetative production of daughter bulbs by the buds located in the axils of the mother bulb scales. Such a type of propagation can cause an accumulation of viruses and their subsequent spreading within daughter bulbs. Viral diseases can drastically affect the yield and quality of plants. When propagating or cultivating ornamental plants, it is essential to start with healthy virus-free bulbs. Micropropagation of selected virus-free plants and elimination of viruses during in vitro culture are the best methods to ensure that the breeding and planting stocks are healthy.

## 2. Problem Statement

On a commercial scale, potato, banana, tulip and araucaria have vegetative propagation. However, this type of multiplication can accumulate several systemic fungi, bacteria and virus infections that provoke degeneration in the plants, culminating with yield and vigour losses. Thus, the use of virus-free propagative material, with high phytosanitary, physiological and genetic quality is of great importance to ensure that the plant expresses its maximum yield potential.

In this scope, plant tissue culture can be applied to potato, banana, tulip and araucaria production chain in order to efficiently propagate the material of interest, maintain germplasm banks, facilitate genetic exchange, provide the study of this species and of its interactions with biotic and abiotic factors, and to produce genetically modified plants and pathogen- free seed potatoes [11].

## 3. Objectives

The main objective of the study is the enhancement in the production capacity and commercialization of potato, banana, tulip and araucaria through tissue culture techniques. The objective can be achieved by the following steps:

1. Optimization of protocol for ex-plant sterilization and germination of potato, banana and tulip plants.
2. Optimization of cytokinin concentration for caulogenesis and best shooting response
3. Optimization of auxin concentration for a best rooting response.
4. To acclimatize the in-vitro grown plants and shifting to the greenhouse.

# 4. Project Team

The project will be conducted under the supervision of HoD Biosciences, Dr Sahar Fazal along with Dr Erum Dilshad, Assistant Professor Bioscineces Department and Dr Arshia Amin Butt, Assistant Professor Bioscineces Department. MS research students of respective faculty members will be carrying out their research work in this project under the proper guidance of their supervisors. At least 1 or 2 MS students of each faculty member (mentioned above) will be allocated the task of tissue culturing of particular plants mentioned in the project. Dr Sahar Fazal would be supervising the tissue culturing of ornamental plants like araucaria, while Dr Erum Dilshad and Dr Arshia Butt would be dealing with the micropropagation of edible crops like potato, banana and their various varieties.

# 5. Requirement

5. MS Media
6. Agar
7. Tissue Culture Jars
8. Forceps and Surgical Blades
9. Scissors
10. Blade Holders
11. Petri Plates
12. Growth Harmones
13. Bleaching agents
14. Invertible AC
15. Laminar Flow Hood
16. 01 Attendant

# 6. Methodology

## a. Sterilization

The greatest difficulty in establishing or optimizing the tissue-cultured protocol for potato and banana are mainly because of the fungal, bacterial and viral contaminations. Fungi and yeasts can be controlled by eliminating the contaminated material by previously sanitizing the explants. In this case, plant shoots are disinfested by immersion in 70% alcohol for 15 seconds, followed by immersion for 15 minutes in 1.5% sodium hypochlorite solution with 0.1% Tween-80, and rinsed three times with distilled and autoclaved water [7].

## b. Micropropagation

Shoot tips after sterilization will be inoculated in medium containing more cytokinin than auxin for differentiation into aerial parts. Subsequently, these multiplicated shoots will be transferred to the medium containing only cytokinin (or not). A shoot tip can generate from 500 to more than 1000 plants, depending on the cultivar or even on the shoot tip. Bandinelli et al. (2013) reported that the 50% reduction in the MS salts concentration during multiplication increases the ex vitro survival rate in Asterix, Macaca, and SMINIA793101-3 potato clones [8]. Similarly, micropropagation protocol for banana will be followed as reported earlier [9]. At the establishment and multiplication stages, plants are kept in a growth chamber, with light (14-16

h photoperiod) and temperature (25-27ºC) control. Seedlings can be transferred to a medium richer in sucrose for in vitro tuberization [5].

**c. Acclimatization/shifting to greenhouse**

In vitro grown plants will be acclimatized to the external environment and finally shifted to the greenhouse before commercialization.


## 7. Key Milestones and Deliverables

| S. No | Elapsed Time in Months | Milestone | Deliverables |
|---|---|---|---|
| 1 | 03 | Sterilization and Optimization of Media | • Explant Purchase<br>• Optimization of Sterilization<br>• Optimization of Media |
| 2 | 03 | Shooting | • Culturing for shoots<br>• Growth of Shoots<br>• Subculturing of Shoots |
| 3 | 03 | Rooting | • Optimization of Rooting Medium<br>• Transfer of Shoots for Rooting<br>• Growth of Roots |
| 4 | 02 | Aclimitization | • Optimization of Soil Composition, Temperature and Humidity<br>• Transfer of all Plants into Optimized Medium |
| 5 | 02 | Green House Transfer and Dispatch | • Growth of Aclimatized Plants<br>• Dispatch of 1ˢᵗ Lot of Plants |
| 6 | 01 | Reporting and Audit | Result Submission and Audit |


## 8. Project Approach

### i. Sterilization and Optimization of Media

The first objective is to get the sterilization of seeds and explant done which would be accomplished in a maximum of 2-3 months as optimization of conditions would be performed. At the end of this stage sterilized seeds/ex-plants would be ready for further propagation into the shooting stage.

### ii. Plants with Shoots

To get next stage of the plants with proper shoots, previously sterilized seeds/ex-plants will be grown on various combinations of plant growth hormones, this would be requiring 3-4 months at least to get a significant number of plants with shoots.

### iii. Plants with roots

After obtaining healthy shoots, rooting will be initiated with a proper hormonal combination. This may require further 2-3 months to get complete rooted plants in a significant number.

### iv. Complete Mature Plants

Once tremendous plants with proper shoots and roots are available, they will either be directly supplied to nurseries if demanded or waited for acclimatization. Plants will be shifted to pots containing soil and wrapped with polythene bags. When got hardened and matured, they will be gradually exposed to the external environment and after successful completion of this stage (2-3 months) plants would be ready for supply to the buyer.

## 9. Financial Demand

The financial demand for the project is Rs. 375,148/- as per the following requirements.

| S.N. | DESCRIPTION | MAKE | QTY | RATE | Unit | TOTAL |
|------|-------------|------|-----|------|------|-------|
| 1 | MS Media Powder Form | USA | 4x100L | 12500.0 | 100L | 50,000.0 |
| 2 | Agar | Sigma/Bio World | 500gm | 7000.0 | 500gm | 7000.0 |
| 3 | Tissue Culture Jar | Local | 100Pcs | 55.0 | Each | 5500.0 |
| 4 | Forceps small 4" | S.Steel | 2Pcs | 375.0 | Each | 750.0 |
| 5 | Forceps Large 6" | S.Steel | 2Pcs | 1100.0 | Each | 2200.0 |
| 6 | Petri Plates 20x100mm | Germany | 100pcs | 165.0 | Pair | 16500.0 |
| 7 | BAP 6-benzylamino purine | Sigma /Phyto | 25gm | 8500.0 | 25gm | 8500.0 |
| 8 | 1-Napthalene Acetic Acid | Sigma | 25gm | 5500.0 | 25gm | 5500.0 |
| 9 | Gibberelic Acid | Sigma | 5gm | 6500.0 | 5gm | 6500.0 |
| 10 | Chlorox Bleach | Imported | 5x1.75Lit | 850.0 | 8.75 Lit | 4250.0 |
| 11 | Ethanol 95% | Merck | 5x2.5L | 1800.0 | 12.5L | 9000.0 |
| 12 | Terbinafine | Sigma | 1gm | 18000.0 | 1 gm | 18000.0 |
| 13 | Cefotaxime Sodium salt | Imported | 5gm | 16000.0 | 5 gm | 16000.0 |
| 14 | Laminar Flow Hood | China | 01 | 170940.0 | Each | 170940.0 |
| **Total** | | | | | | **PKR 320,640/-** |
| **GST 17%** | | | | | | **PKR 54,508/-** |
| **G.Total** | | | | | | **PKR 375,148/-** |

# 10. Timeline

## 11. Commercialization and Stake Holders

Following end users were identified based on demand of ornamental plants and edible crops:

i. Distributers of Potato seeds in Northern areas of Pakistan
ii. Distributors of sterilized, invitro plants of Banana in Khairpur and other interior Sind areas initially.
iii. At later stages, after completely optimizing protocols and a lot of acclimatized plants in green house international collaboration will be seeked.

For ornamental plants initially nurseries and flower distributers will be approached. At later stages different industries (Perfumery distillation industries) will be approached for precious and rare plants local production.

## 12. Expected Outcome (Reseach & Commercial Output)

Plant tissue culture is one of the most rapidly growing areas of biotechnology because of its high potential to develop improved crops and ornamental plants. With the advances made in the tissue culture technology, it is now possible to regenerate species of any plant in the laboratory. Plant tissue cultures is associated with a wide range of applications, the most important being the production of pharmaceutical, medicinal and other industrially important compounds.

The project involves wide range of research including study of new varieties of plants and seeds. The outcome of paper will be documented in research journals and filing of National and International patents. The knowledge gained in the process will help to produce projects at MS and PhD level.

Commercialy the project will help to establish a tissue culture supply chain of ornamental, banana, potatoes plants to various nurseries and vendors.

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No.23/CUST/ORIC/2020
September 28, 2020

# **Report of Certification Courses Spring-2020**

Continuing Education and Certification Courses help an individual to showcase his competency, commitment for the profession, build expertise in his professional subject area, and helps with job advancement. These courses not only provide training on various aspects of subject but also deliver detailed knowledge and skills required to perform real-world job responsibilities.

Keeping in view the significance of these certifications, Office of Research, Innovation and Commercialization (ORIC) initiated specific one semester long Certificate Courses in Spring-2020 for professionals and practitioners, who intend to develop on job skills and professional growth. The eligibility criteria for the particular courses was having minimum 16 years of education in the relevant discipline. The classes for each course were held once in a week from 6 PM – 9 PM in the evening with postgraduate students.

The advertisement was posted to around 100 organizations through invitation letters and course brochures. The registration fee for each course was 27,000 PKR and the deadline for courses registration was February 17, 2020. A total of 15 professionals were registered in four different courses as per following detail.

| Sr. No. | Course Title | Participants' Names | Organization |
|---|---|---|---|
| 1 | Radar Signal Processing | Dr. Ijaz Hussain | NESCOM |
| | | Ms. Sabeeqa Batool | NESCOM |
| | | Mr. Syed Waqar Haider | NESCOM |
| | | Mr. Maqsood Ahmed | AQSA SDS |
| 2 | Machine Learning | Dr. Hussain Abbas | NESCOM |
| | | Dr. Ijaz Hussain | NESCOM |
| | | Mr. Syed Waqar Haider | NESCOM |
| | | Ms. Rahat Saadia | NESCOM |
| | | Ms. Sabeeqa Batool | NESCOM |
| | | Mr. Muhammad Ali Akhtar | NESCOM |
| 3 | Robust Control Systems | Ms. Amna Arshad | NESCOM |
| | | Mr. Muhammad Raza | NESCOM |
| | | Mr. M Shoaib Khan | NESCOM |
| | | Mr. Waleed Arshad | NESCOM |

| | | Mr. Fawad Farooq Ashraf | NESCOM |
|---|---|---|---|
| | | Mr. Muhammad Sadiq | Student |
| 4 | Product Design & Development | Mr. Ubaid Ali Bakar | NESCOM |
| | | Mr. Musharaf Abbas | NESCOM |

It is worth mentioning that an amount worth 451, 440 PKR has been earned by CUST through these courses. Keeping in mind the success of these courses and as per recommendation of departments, ORIC has again advertised and offered certification courses for Fall-2020 and found promising response from various organizations.

**Attachments-**
Payment Detail

**Prepared by:**

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**Approved by:**

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## 1$^{st}$ FYP Commercialization Meeting on CS Project entitled "Flex Tracker"

### Minutes of the Meeting held on 30$^{th}$ July, 2020

The 1$^{st}$ FYP Commercialization Meeting on CS Project entitled "Flex Tracker" was held on Thursday, July 30, 2020 in the Meeting Room, D-Block at 11:00 AM.

Prof. Aamer Iqbal Bhatti, Dean Research & Innovation chaired the meeting.

The following attended the meeting.

| | |
|---|---|
| Dr. Nayyer Masood | HoD/Professor, CS Department |
| Dr. Mueen Aizaz Zafar | HoD/Professor, MS Department |
| Dr. Ansir Ali Rajput | Associate Professor, MS Department |
| Dr. Ahsan Mahmood Ahmed | Assistant Professor, MS Department |
| Dr. Muhammad Ishfaq Khan | Assistant Professor, MS Department |
| Mr. Salman Ahmed | Lecturer, CS Department |

Dean Research & Innovation welcomed the members. Subsequently, the meeting progressed as per agenda items listed below.

| Item 01 | Demonstration of Flex Tracker | Action By |
|---|---|---|

1.1 The meeting started with the brief demonstration about "Flex Tracker" which is an application that can be employed by various companies/organizations to track their vehicles or goods. This application can manage multiple services in one platform. The system is capable of dynamic stop and route configurations, comparison of followed route by driver with actual defined route, live location of vehicles on map, and over speeding notification to admin. The potential clients for flex tracker can be universities, schools, and goods distributer. The presentation was delivered by Mr. Salman Ahmed. He updated the participants that Flex Tracker has been successfully tested in University.

1.2 Dean Research & Innovation asked about the possibility of Working Demonstration, in case if certain company/client takes interest in the application. Dr. Nayyer Masood, HoD CS informed that the said demonstration can be delivered to any client or organization which is interested in the system.

| Item 02 | Marketing and Commercialization Aspects of Project | Action By |
|---------|---------------------------------------------------|-----------|

2.1 Dr. Nayyer Masood requested MS faculty to play their productive role in marketing and commercialization of the project. Dr. Mueen Aizaz Zafar asked MS faculty members to present their marketing ideas/suggestions with regard to the given application. Dr. Ishfaq Khan asked about the possible initial price of the application. Dr. Nayyer informed him that we are not initially too interested in its price, rather we want to sell our product even free of cost for its pilot testing and evaluation. He added that we need some reasonable work from MS students in their summer projects to at least introduce the application in relevant companies and clients. Dr. Nayyer also requested HoD MS to update CS Department about their summer projects beforehand so that mutual collaborations can be done with regard to commercialization and marketing aspects of their projects.

**HoD MS**

2.2 Dr. Ishfaq Khan updated the participants about the possibility of similar applications in the market. He recommended the comparative analysis including the financial prospects of the project. Dr. Ahsan suggested that we can hide certain outstanding features from customers during their free subscription which can be availed through premium subscription. Dr. Ansir Rajput was of the opinion that initially we have to tailor our application as per market requirements as there is so much competition in outside world. He recommended to offer the project on a specific website "Flypa" which will help customizing and modifying the application as per market requirements.

**Item 03    Incubation of Company**

3.1 After a deliberate discussion over the suggestion floated by Dr. Ishaq Khan, the meeting participants agreed over the incubation of a company consisting of CUST faculty and students which would bring ownership among the team to sell their application. The proposed company team would consist of Mr. Salman Ahmed from CS Department and Dr. Ishaq Khan from MS Department with relevant students who would have privilege to be part of it. It was also decided that the initial deployment of the application would done in university buses after consent from concerned higher authorities.

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| 3.2 | The participants agreed to have a deliberate meeting with VC Office after some initial working over the idea. Dean Research & Innovation directed Dr. Ishaq and Mr. Salman to provide a small proposal about the list of initial requirements for the startup. | Dr. Ishaq/Mr. Salman |

**Item 04**  **Faculty Development Trainings on Entrepreneurship**

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| 4.1 | Dr. Ansir Rajput stressed on the significance of faculty trainings on Entrepreneurship. Dean Research & Innovation graciously accepted the suggestion and requested him to conduct faculty trainings on Entrepreneurship. He also promised the full support of ORIC in conductance of these sessions. | ORIC/Dr. Ansir Rajput |

Being no further item for discussion the meeting was adjourned with a vote of thanks the chair and participants.

**Prepared by**

Muhammad Raheel Anjum
Assistant Director ORIC

**Approved by:**

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

**Distribution.**

- Vice Chancellor
- HoD CS Department
- HoD MS Department
- Dr. Ansir Ali Rajput, MS Dept
- Dr. Muhammad Ishfaq Khan, MS Dept
- Dr. Ahsan Mahmood Ahmed, MS Dept
- Mr. Salman Ahmed, CS Dept
- File

No.37/CUST/ORIC/2020
**Dated:** September 2, 2020

### 2$^{nd}$ FYP Commercialization Meeting on CS Project titled "Flex Tracker"

### Minutes of the meeting held on August 25, 2020

The 2$^{nd}$ FYP Commercialization Meeting on CS Project titled "Flex Tracker" was held on Tuesday, August 25, 2020 in HoD Management Science office at 3:30 PM
Prof. Aamer Iqbal Bhatti, Dean Research & Innovation chaired the meeting
The following attended the meeting.

| | |
|---|---|
| Dr. Mueen Aizaz Zafar | HoD/Professor, MS Department |
| Dr. Muhammad Ishfaq Khan | Assistant Professor, MS Department |
| Mr. Salman Ahmed | Lecturer, CS Department |

Dean Research & Innovation welcomed the members. Subsequently, the meeting progressed as per agenda items listed below.

| | **Item 01** | **Developments in Flex Tracker** | **Action By** |
|---|---|---|---|
| | 1.1 | The application "Flex Tracker" was discussed in detail in the meeting. Dr. Ishfaq Khan put forward few observation, including that we can not call it as a vehicle tracker application as it does not track vehicle rather it tracks a smart phone of a driver. He suggested to upgrade the application by using GPS for vehicle tracking. The idea was backed by Dean Research & Innovation with a comment that it actually is a fleet management system. Dr. Ishfaq opined for changing the name of application as it highlights to be tracking specific application. All agreed to the suggestion and it was decided that a new name will be proposed by Mr. Salman Ahmed and Dr. ishfaq Khan. Dean Research & Innovation asked Dr. Ishfaq Khan to submit his suggestion to be incorporated in the application to the ORIC, based upon these suggestions application will be upgraded by the CS Department. | Dr. Ishfaq Khan, Mr. Salman Ahmed |
| | **Item 02** | **Marketing and Commercialization of the Project** | |
| | 2.1 | Dean Research & Innovation requested Dr. Ishfaq Khan to play his productive role in marketing and commercialization of the project. He further added that fleet management requirements in market, sectors to be targeted and how to target these sectors should be identified. | Dr. Ishfaq Khan, Mr. Salman Ahmed |

2.2  After detailed deliberation it was decided that Dr. Ishfaq Khan and Mr. Salman Ahmed will propose a timeline by mutual consent, highlighting the steps forward towards up gradation and commercialization of the application.

Dr. Ishfaq Khan, Mr. Salman Ahmed

**Item 03   Entrepreneurship & Incubation**

3.1  Dean Research & Innovation briefed the participants that two student from Department of Computer Science have initiated their own company by the name "TechFlickers". ORIC is providing them full assistance interms of company registration and working place. He asked HoD Management Sciences to start such ventures in his Department, ORIC will fully support and back such ventures.

Dr. Ishfaq Khan suggested for an integrated entrepreneurship course. The idea was appreciated by all the participant and it was agreed to propose an integrated course between Management Science and Engineering student with combined projects.

Being no further item for discussion the meeting was adjourned with a vote of thanks to the chair and participants.

**Prepared by**

Muhammad Farhan
Assistant Director ORIC

**Approved by:**

*HAlBhatti*

Prof. Aamer Iqbal Bhatti
Dean Research & Innovation

**Distribution.**

– VC Office
– HoD MS Department
– Participants
– File

# Tech Flickers

## Services We Offer

- Development (Web, Mobile)
- Graphic Designing
- Search Engine Optimization
- Web Security & Forensics

## Projects & Deals

- Restaurant/Cafe Online System (Rs. 100,000+ per annum)
- Zamkart - E-Commerce Website (Rs. 30,000)
- Mobile Walay - SEO (Rs. 70,000)



## Founding Members

- Mr. Arslan Akram
- Mr. Shoaib Ali



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