

Connect2Recover Research Competition

Winning Projects Booklet



Connect2Recover



Acknowledgements

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Foreword by ITU BDT Director

It is my pleasure to present to you the 15 winners of the Connect2Recover Research Competition, and their promising research proposals.

During the COVID-19 pandemic, broadband infrastructure has proven vital in helping countries and consumers adapt, to continue to work and learn remotely, and to access the latest health information, updates and directives from local and national authorities. The pandemic has also accentuated the disparity between those who are digitally connected and those who are not, with an estimated 37 percent of the world's population – or 2.9 billion people – still offline. Of the 2.9 billion still never connected to the internet, an estimated 96 per cent live in developing countries. Significant gaps remain between urban and rural areas, and between the Least Developed Countries and the rest of the world.

In line with the United Nations Secretary-General's Roadmap for Digital Cooperation and "Our Common Agenda", in particular on the global goal of universal connectivity, ITU along with the Government of Japan and Government of Saudi Arabia launched the Connect2Recover initiative. The Initiative helps countries transition from COVID-19 and other natural hazards' response phases to "building back better with broadband". A resilient broadband infrastructure and digital ecosystem are essential for robust, resilient and well-functioning societies.

In July 2021, the Connect2Recover Initiative launched an international competition to identify the most promising research proposals to accelerate digital inclusion during COVID-19 recovery. With 307 proposals submitted from 80 countries representing all six ITU regions, the competition reflects the importance and relevance of digital inclusion and digital resilience amongst the global research and academic community.

The evaluation and selection of the winning research proposals was carried out through an international five-member jury led by Professor Ahmad Reza Sharafat, Professor of Electrical and Computer Engineering at Tarbiat Modares University, I. R Iran. Other members of the jury

include Professor Ellen Helsper, Professor of Digital Inequalities at Department of Media and Communications at the London School of Economics and Political Science, United Kingdom; Ms. Ida Nganga, Regional Head Anglophone Countries of UNESCO Emerging Technologies for Development Steering Committee, Africa; and from ITU, Mr. Cosmas Zavazava, Chief of Partnerships for Digital Development Department and Ms. Nur Sulyna Abdullah, Chief of Digital Knowledge Hub. I am grateful for the contribution of the members of the Jury for sharing their expertise and devoting their time.

I am confident that the 15 winning proposals will contribute towards knowledge sharing, support the building of resilient digital infrastructure, and impact key areas such as education, healthcare and job creation for beneficiary countries. I look forward to the development of the research papers, which will be published as Research Briefs in the ITU publication series, *Build Back Better with Broadband: Research Stories from the Frontline*. A summary presentation is also planned at the World Telecommunication Development Conference (WTDC) in June 2022.

Congratulations to all 15 winners who demonstrated their dedication and commitment to making a difference in the world through this platform. Special thanks to ITU-D Sector Member Huawei for their contribution and support in making this competition a success.



Doreen Bogdan-Martin, Director
Telecommunication Development Bureau (BDT)
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Foreword by HUAWEI

More than ever before, we are living in a world in which digitalization is essential to virtually every aspect of our lives. Remote access to education, health and jobs goes a long way to securing our health individually and collectively. However, a persistent lack of meaningful connectivity still prevents billions of people from accessing the benefits of digitalization.

According to the International Telecommunication Union (ITU), 37 percent of the world's population is not connected to the Internet. In the Least Developed Countries (LDCs), more than 70 percent of the population are offline. With this lack of digital inclusion, we run the risk of further widening the gap of economic and social development when we should do everything we can to close it.

Huawei seeks to leave no one behind in its mission to build a fully connected, intelligent world. When I heard of Connect2Recover, I knew Huawei had to contribute to this ITU initiative in order to foster digital inclusion. Today's technology enables us to connect even the most remote areas. However, if technology is not the bottleneck, what is keeping us from connecting the unconnected?

In my experience, successful digital inclusion often depends on solving local issues. It can be as simple as a lack of reliable infrastructure mapping or insufficient capacity for building the necessary network backhaul. These challenges can be alleviated with further investments and international support. However, some other issues like reluctance to take-up digital solutions or lack of skills to use them can be much more difficult to solve.

In light of the great variety of local challenges to meaningful connectivity for everyone, Huawei decided to sponsor a total of 15 research projects to shed light on specific digital inclusion challenges globally and develop tailored, actionable recommendations to overcome them.

Indeed, the 15 winning proposals cover a wide range of solutions providing meaningful connectivity. Between them, the 44 institutions and individual researchers address the local circumstances in 32 countries of which 14 are among the poorest in the world. Their projects will create insights such as providing telemedicine for underserved rural communities, standardizing mapping tools, and developing a common data space to promote the development of the data economy in developing countries.

I am confident that the results of these projects will make a significant contribution to digital inclusion. Each of them seeks to make tailored and actionable recommendations to policymakers in the countries and contexts they address. However, the overall aim of the Connect2Recover research competition is to extrapolate from these findings to provide insights on how to provide meaningful connectivity globally.

Finally, I would like to express my gratitude to the jury members Professor Ahmad Reza Sharafat, Professor of Electrical and Computer Engineering at Tarbiat Modares University, I. R Iran; Professor Ellen Helsper, Professor of Digital Inequalities at Department of Media and Communications at the London School of Economics and Political Science, United Kingdom; Ms. Ida Nganga, Regional Head Anglophone Countries of UNESCO Emerging Technologies for Development Steering Committee, which is based in Bordeaux, France; Mr. Cosmas Zavazava, Chief of Partnerships for Digital Development Department at ITU; and Ms. Nur Sulyna Abdullah, Chief of Digital Knowledge Hub at ITU for their efforts in evaluating and selecting the winning proposals from among a total of 307 submissions. My thanks also go to the Connect2Recover team at ITU as well as Doreen Bogdan-Martin personally, who tirelessly fight to connect the unconnected.

A handwritten signature in black ink, reading "Catherine Chen". The signature is fluid and cursive, with the first name "Catherine" and the last name "Chen" clearly distinguishable.

Chen Lifang
Corporate Senior Vice President and Director of the Board, Huawei Technologies Co., Ltd.



Introduction of Connect2Recover and Connect2Recover Research Competition

Connect2Recover is an ITU global initiative that aims to reinforce digital infrastructure and ecosystems of beneficiary countries. Connect2Recover seeks to galvanize action for affordable and reliable connectivity as part of COVID-19 recovery strategies. It also assesses risks due to natural hazards in strengthening resilience of digital infrastructure.

To assist in this effort, the ITU has organized, for the first time ever, an international competition under Connect2Recover to identify research proposals that have potential in fostering digital inclusion and digital resilience during the global recovery, specifically in the key areas of education, jobs and healthcare.

Fifteen research grants, each of a value of USD 42,000, were awarded to the winning research teams and as part of the winning package, winners also receive initial support from ITU to engage with policymakers in collecting data and information necessary for their research. The initiative will enable this exchange of information and knowledge through collaborative virtual events, where the winning teams will have opportunities to present and discuss their research directly with key government stakeholders and regulators.

The Connect2Recover Research Competition aimed to:

- Improve research focus on digital resiliency and digital inclusion to build back better with broadband for pandemic recovery;
- Build a global research community of think tanks and academic institutions around digital inclusion, and

- Promote knowledge sharing that informs targeted practices to build back better with broadband.

The research competition was open to members of academia, think tanks and individual experts affiliated with academic institutions from 30 July 2021 to 17 September 2021. The competition was promoted through Connect2Recover's websites, Africa regional office and Commonwealth of Independent States regional office websites as well as through social media channels, such as LinkedIn and Twitter.

Consequently, at the close of the competition, there was a total of 307 applications received from 80 countries, among which 16 research proposals featured collaborations between developed and developing countries. In addition, the research proposals were received from 6 ITU regions as follows:

Africa (130), Americas (47), Arab States (14), Asia Pacific (73), Commonwealth of Independent States (4), and Europe (51).

An assessment of the research proposals was carried out to ensure that the published eligibility criteria and evaluation criteria were met. The evaluation criteria were as follows:

- **Collaboration:** Participants are encouraged to apply in teams featuring institutions from both developed and developing countries. Effort will be made to balance the winners between regions.
- **Relevance:** The research must provide essential insights to foster digital inclusion. Research pertaining to the broad area of connecting the unconnected will receive a special focus. The submission should also offer recommendations on how good practices and (the proposed) additional research could improve the current situation and enable stakeholders to achieve their desired future state.
- **Impact:** The proposal should demonstrate a new, innovative recommendation and outline its potential and impact on vulnerable (currently digitally excluded) groups.
- **Viability:** The recommendations should demonstrate the research adaptability and replicability.
- **Sustainability:** The submission should be financially sustainable and consistent to the COVID-19 crisis for short- and mid-term impact while engaging with local partners.
- **Novelty:** The proposal should be original research and should be related to new knowledge discovery in the field of digital inclusion.
- **Implementation Plan:** Submit concrete, actionable recommendations along with an implementation plan for a Pilot Project in a beneficiary country.

The evaluation and selection of the fifteen winning research proposals was carried out by a global five-member jury led by Professor Ahmad Reza Sharafat, Professor of Electrical and Computer Engineering at Tarbiat Modares University, I. R Iran. Other members of the jury include Professor Ellen Helsper, Professor of Digital Inequalities at Department of Media and Communications at the London School of Economics and Political Science, United Kingdom; Ms. Ida Nganga, Regional Head Anglophone Countries of UNESCO Emerging Technologies for Development Steering Committee, which is based in Bordeaux, France; and from the ITU, Mr. Cosmas Zavazava, Chief of Partnerships for Digital Development Department and Ms. Nur Sulyna Abdullah, Chief of Digital Knowledge Hub.

In the next section, the five-member jury will be introduced, which will be followed by an introduction to the fifteen winning teams and their research proposals.



Jury members



Prof. Ahmad Reza Sharafat

Prof. Ahmad Reza Sharafat is Professor of Electrical and Computer Engineering at Tarbiat Modares University in Tehran, Iran; Senior Advisor to the Minister of Communications and Information Technology in Iran on international affairs, Member of Iranian Academy of Sciences; Chairman of ITU-D Study Group 2 in the International Telecommunication Union (ITU) in Geneva, Switzerland; Chairman of the Management Committee of Asia Pacific Telecommunity (APT), Past Chairman of IEEE Iran Section; Editor of the International Journal of Wireless Information Networks; and Editor of Scientia Iranica.

Prior to his present responsibilities, he has held numerous senior technical and managerial positions in various ICT-related entities, focusing on policies and directions for developing telecommunications networks and infrastructure, and also provisioning of new ICT-centric services and platforms in Iran. He has 12 patents, co-authored 4 books and more than 160 papers in refereed scholarly journals and professional conferences. He received his B.Sc. degree from Sharif University of Technology, Tehran, Iran, and his M.Sc. and his Ph.D. degrees both from Stanford University, Stanford, California, all in Electrical Engineering in 1975, 1976, and 1981, respectively. He is a Life Senior Member of IEEE and Sigma Xi.

Jury members (continued)



Prof. Ellen Helsper

Prof. Ellen Helsper is Professor of Digital Inequalities in the Department of Media and Communications at London School of Economics, where she also serves as Programme Director for the MSc Media and Communications (Research). Her current research interests include the links between social and digital inequalities; mediated interpersonal communication; participatory immersive digital spaces (VR, ER); and quantitative and qualitative methodological developments in media and communications research.

Ellen holds positions as a Visiting Scholar at the USC Annenberg School for Communication and Journalism, the Pontificia Universidad Catolica de Chile, and the Centro Regional de Estudos para o Desenvolvimento da Sociedade da Informação Latino America (Cetic.br). She has held similar positions at Microsoft research in Boston, NYU Steinhardt's department of Media, Culture and Communications, the University of Twente and the University of Oxford. In addition, she has worked in Chile, Mexico and the US in commercial market and audience research.



Ms. Ida Nganga

Ms. Ida Nganga is the Regional Head, Africa, Anglophone Countries for UNESCO Emerging Technologies for Development Steering Committee which is based in Bordeaux, France; the Global President of Startup Innovation at the Global Council for the Promotion of International Trade; and on the Board of the International Centre for Enterprise Development (ICED DigitizingTrade Taskforce).

She is also the founder of the award-winning Regional Consortium of Experts for Development who use technology and engineering as an enabler for achieving the SDGs (RCD Africa).

She is committed to putting a spotlight on startup development, technology transfer, gender inclusion, stakeholder engagement and intercontinental collaboration. She is on the advisory committees for the International Telecommunication Union (ITU)'s Digital Innovation Framework, Afrinic's Government Cluster, ICANN's Africa Strategy 2020, Communications Authority's Online Safety, and the Global Peace Foundation's Leap Innovation HUBS. She also Co-Chairs the Internet for Development Global Community and its Internet for Education Lead. She is a Tech for Good global partner on online safety and security, computer science education, and cloud solutions, as well as an Ambassador for Africa Code Week by SAP and UNESCO.

She is also a certified leadership and management trainer by Dale Carnegie International, which uses the behavioral science approach, and is a much sought-after global speaker known for her oratory prowess.

Jury members (continued)



Dr. Cosmas Zavazava

Dr. Cosmas Zavazava, a national of Zimbabwe, joined ITU in 2001 with a special focus on integrating the least developed countries, landlocked developing states, and small island developing states in the digital economy. He held various other positions and was appointed Chief of Department for Projects and Initiatives in 2010 and then Chief of the Projects and Knowledge Management Department in 2012. He currently works in ITU as Chief of Department responsible for Partnerships for Digital Development.

Dr. Zavazava has designed and implemented global ICT projects mainly in the areas of bridging the digital divide, disaster risk reduction and management, climate change mitigation and adaptation, and pandemic mitigation. He has written on the role of ICT in addressing the unique needs of least developed countries, landlocked developing countries, and small island developing states, and legal aspects of e-commerce in developing countries with a focus in Africa.

Dr. Zavazava has a track record in leading high-level negotiations, resource mobilization, and publishing. He organized and ran more than 20 Partnership Round Tables aimed at promoting telecommunication/ICT projects to development partners such as development banks, private sector, and foundations in favour of the least developed countries and countries emerging out of war and major natural disaster situations.

He holds a PhD in Multilateral Trade. He has Master's degrees in Telecommunications and Information Technology Law (LLM), International Relations (MA, *summa cum laude*), and Business Administration (MBA). He also holds diplomas in Telecommunications and Systems Engineering, and a Bachelor's degree in Business Administration.



Ms. Nur Sulyna Abdullah

Ms. Nur Sulyna Abdullah is Chief of the Digital Knowledge Hub Department in ITU. She was previously Chief Officer for Strategy and then Transformation at the Malaysian Communications and Multimedia Commission and has held various positions on the international front representing Malaysia. On the APEC front, she was the Chair of the APEC Ad Hoc Steering Group on the Internet Economy from 2015 - 2017, chairing the APEC TEL Working Group immediately before that. She also chaired the APT Preparatory Group for the ITU Plenipotentiary 2018 (PP-18) and went on to chair the Working Group of the Plenary at the ITU PP-18 itself. In ASEAN, she was the founding Director of the ASEAN ICT Centre. Before ITU, she had a short stint with Netflix as Director of Public Policy for Southeast Asia.

Ms. Abdullah holds an LLB (Hons.) from the University of London and is an Advocate and Solicitor of the Malaysian Bar.

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Connect2Recover

Winning projects



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Research Paper 1: Making Higher Education Truly Inclusive

The 'Inclusive higher education post- COVID-19' research project focuses on new, mainly digital, modes of higher education delivery that emerged during the COVID-19 pandemic and that promise a more inclusive environment and meaningful opportunities for marginalized university students. The emergency shift to remote education may well hold significant potential for improved inclusion of marginalized students. The project draws on case studies from three countries - Australia, the Philippines and South Africa - to synthesize a set of relevant in-depth observations about the current opportunities and barriers for marginalized groups to access higher education post-COVID. Thus, the project will provide new knowledge related to digital inclusion in higher education paying particular attention to the role of ICT infrastructure in fostering sustainable digital inclusion, especially in the context of higher education.

Project impact:

Higher education plays an important role in national development by providing high-level skills and new knowledge for innovation. As higher education increased in importance after the 1950s as society shifted towards the post-industrial age, a growing number of commercial actors sought to thrive in the expanding market of students. Just as massification transformed the higher education landscape in significant ways, the current COVID-19 pandemic has substantively disrupted higher education as lockdowns and other restrictions were imposed across the globe. Most higher education institutions turned to emergency online teaching and learning to keep delivering education to students.

Drawing on case studies in three countries, the project seeks to understand how the higher education system has responded to the pandemic. It sheds light on the requirements for ICT systems to enable a continuation of remote higher education offers. Within that, the project will investigate the role of interventions to foster digital inclusion for higher education in the three countries targeting marginalized students. Finally, the project team will assess if the disruption to higher education as a result of the COVID-19 pandemic, particularly the uptake of new modes of instruction, learning and assessment, can result in greater inclusion in the future provision of education.

The results will provide actionable insights into both the supply and demand side of the higher education system as well as specific recommendations as to how framework conditions have to adapt in order to foster digital inclusion especially for marginalized students.

The project team:



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Research Paper 2: Market Resilience in Emerging Digital Economies: Case Study of Kenya During COVID-19 Pandemic

This study seeks to assess market resilience in emerging digital economies with a case study of Kenya during the COVID-19 pandemic. The resilience elements include the capacity of the market to self-regulate, maintain diversity and competition, the private and public actors' collaboration, and existing regulatory frameworks and their soundness. Thematic areas that will be explored for market resilience include: emergency communications, affordability, availability, spectrum policy, and content distribution for a National Emergency Telecommunications Plan (NETP) to guide the implementation efforts. The plan will be hinged upon for increasing availability of mobile and other broadband connectivity solutions; opening up more licensed, license-exempt, and shared spectrum, enabling mobile, fixed, satellite, and HAPs connectivity; and implementation of clear and enforceable competition policies that spur the market.

The objectives will be to determine its maturity status, market changes, intervening responses, and the effects of the responses on market resilience.

The study will conduct literature reviews on different market resilience models with consideration of systems theory and theory of change, which is followed with quantitative and qualitative data using mixed method exploratory design with primary and/or secondary data. Data collected will be analysed using qualitative and quantitative methods into descriptive and inferential statistics. Findings will be used to make recommendations for policies and practices to achieve inclusiveness, boost market resilience and competitiveness.

Project impact:

The project will explore market resilience in the case of Kenya during the COVID-19 pandemic - the maturity status, the market changes experienced, the intervention responses taken for market resilience and the effects of the market resilience responses undertaken.

The findings will be used to make recommendations on policy and practice to achieve inclusivity and competitiveness for growth of education, health-care, and job creation through market resilience.

The project team:



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Research Paper 3: Digital Transformation of Micro-Enterprises in Ghana

Micro-enterprises—such as street vendors, small-holder farmers and retailers—often build their businesses around direct interaction with their customers. Thus, their businesses were hit particularly hard by the COVID-19 pandemic. Access to digital payment services and social commerce channels go a long way to helping these entrepreneurs survive. Focusing on Africa, and using Ghana as a case study, this project will provide actionable recommendations on how micro-enterprises can adopt Fintech to be more resilient to the impact of COVID-19, or future contingencies, by changing how they traditionally work. Combining insights gathered in interviews with micro-enterprise owners and suppliers of digital payment solutions as well as secondary data on available and emerging Fintech solutions, the project will also understand unanticipated benefits and the support required from government and the Fintech sector to help micro-enterprises.

Project impact:

The project will demonstrate how Fintech, in conjunction with other digital technologies such as social network and messaging applications can support micro-enterprises to be more resilient in the face of pandemics and related shocks. The project will also demonstrate how this digital transformation can better include micro-enterprises in the formal economy and open-up opportunities for growth.

Specifically, the project's results will inform policymakers about the benefits and risks associated with the use of digital solutions for micro-enterprises. Based on the data collected, the project will develop actionable recommendations as regards the support required from government and the Fintech sector to help micro-enterprises adopt such digital solutions.

The take-up of such solutions can help to sustain micro-enterprises even in dire times. More importantly, the access to digital tools can equally be a stepping stone away from informal business practices and into structures that provide security, health support and tax revenue in the long term. As such digital inclusion also means social inclusion for many micro-enterprise owners.

The project team:



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Research Paper 4: Rebuilding Digital Inclusion for the Rural Counties of Kenya

This research will focus on the assessment of the broadband challenges faced by the rural counties of Kenya as a result of the COVID-19's "forced state" of physical distancing, particularly for healthcare and education sectors. The project team endeavors to contextually explore and present broadband opportunities elucidated by the concept of dynamic spectrum access (DSA) - under the TV white spaces and community networks regulatory frameworks enacted by Kenya for digital inclusivity. While most rural communities across the globe appear to face similar challenges of infrastructure together with high Internet costs, the study will dwell on two rural counties of Kenya - Kakamega and Turkana. Kakamega is the most populous rural county of Kenya while Turkana is the largest rural county (also largest county in Kenya) by land area. Turkana is considered among the ones with poor broadband access. The project team envisions the study to contribute to the ITU's goal of having a systemic platform of universal data set of connectivity gaps in broadband needs versus infrastructure coverage. The two variables for consideration of this study are - geography and population size. More importantly, the project team envisages that the findings and publication of this research will demonstrate to the regulator, the government and other stakeholders the potential models (regulatory, business and technical) that can be adopted to reinforce Kenya's digital infrastructure and deliver on the "pandemic recovery".

Project impact:

The background of the state of connectivity in Kenya (and by extension Africa) and the painful bite of the COVID-19 form the basis of this research. The steps taken by Kenya to enact new spectrum sharing-based regulations amidst the pandemic gives this research the rationale to consider strengthening points for regulation, technology and business. This is part of assessing the resilience of digital infrastructures and the opportunity of digital inclusivity through meaningful connectivity that can support the rural institutions of education and healthcare.

Specifically, the project will contribute to the universal data set of connectivity gaps in broadband needs versus the infrastructure coverage, particularly on variables of geography and population size based on these two counties.

More importantly, the findings and publication of the project will demonstrate to the regulator, the government and other stakeholders the potential models (regulatory, business and technical) that can be adopted to reinforce Kenya's digital infrastructure and deliver on the "pandemic recovery". Further, the intention of this work is to also awaken a "ripple effect" of broadband-driven innovation across all counties of Kenya through the emerging technologies for a more economically resilient country in the future.

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Research Paper 5: CoLRN: A Community-based Vision for Local Resilient Networks

The COVID-19 pandemic has widened the gap between the rich and the poor. People at the edge of the Internet still experience unequal access, in terms of relevant local content, costs, and device constraints.

To solve this challenge, the research proposes to rethink the approaches to network infrastructure. The project team plans to look beyond community networks as a means of access to the Internet - and towards a community of local infrastructures that effectively leverage digital technology to bring community members together.

To "build back better", the project team will actively work with communities to co-design and co-deploy the networks: empowering easy deployment of engaging and relevant digital content and services, and to make network management tools that lower the barrier to sustainable maintenance and operation of community networks.

With the idea, the project team proposes a series of design workshops in India and Africa to develop a community-based vision for resilient local networks, simultaneously leveraging existing projects around intuitive network management and local content creation to evaluate the design strategies to foster resilience and effectiveness in empowering community networks.

Project impact:

The project seeks to recognize the crucial role of community members, not just as users and managers of the Community Networks but as experts in local socio-cultural context and content. The project will work closely with partner communities to understand community-based visions and requirements for resilience and sustainability of community wireless networks, as well as co-production of local content and services. With the vision, the project team plans to co-design and co-deploy locally relevant services, empower communities to leverage wireless communications on their own terms, understanding that greater empowerment at the local level will lead to more vibrant participation in the global Internet, with communities actively contributing to a rich and diverse discourse in a way cognisant of the importance of their voices.

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Research Paper 6: A Policy Framework for Education Resilience

This project aims to develop a policy framework to address digital divide in education in African cities and regions. The COVID-19 pandemic has made obvious the impact of the apparent digital divide that is particularly pronounced on the African continent. As schools and universities were forced to switch to online learning during the pandemic, the lack of digital inclusion has a tangible impact on the future of a whole generation of students who will inevitably shape the future prospect of any country for further economic and societal development. In fact, in sub-Saharan Africa, the vast majority of students did not have access to computers and the Internet to continue receiving lessons. This research intends then to propose actions to address the digital divide in African cities for better access to education for all. It aims to propose a framework of actions for better digital inclusion in the education sector in African cities. The project seeks to cover three cities - Bengerir in Morocco, Nairobi in Kenya, and Cotonou in Benin - to identify the current gaps, specific locations, and root causes for the apparent digital divide. This research will help city councils, local and regional governments, and policymakers understand the occurrence of the digital divide in the education sector in African cities, and guide them in the short-, medium-, and long-term measures to enable greater digital inclusion in education for more resilient post-COVID cities and regions that leave no one behind.

Project impact:

The project follows a unique approach as it combines geospatial and socio-logical analyses. It seeks to uncover the status and causes of the digital divide and associate these findings with specific neighborhoods in the three target cities. As a second step, the project seeks to draw on an extensive literature review to identify key examples that provide best practices in fostering digital inclusion. These best practices will be benchmarked against the finding of the first phase in order to identify an actionable policy framework.

This framework will feature a set of recommendations including measures and actions that should be put in place in order to address the digital divide in the education system in the pilot cities. These measures will help to build a digital inclusion action plan for better access to education. They will build on the strengths identified, while filling the gaps and exploiting the opportunities identified to ensure digital inclusion in education. Although focused on the pilot cities, the recommendations will also serve as a guide for similar cities in Africa.

This digital inclusion action plan will define the activities or actions to be implemented in the short, medium and long term, identify the actors and their responsibilities, and possible means of funding the components of gaps, locations and roots on the continent. This will be supported by expert interviews who have a rich experience in digital inclusion in Africa's education.

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Research Paper 7: Network in a Box to Provide Health Services in Remote Areas

An insufficient cost to revenue ratio commonly prevents the market-driven connection of low-density areas to the Internet. The network in a box (NIB) is a promising technology that provides a solution to foster digital inclusion in such areas. Concretely, the NIB can provide on-demand connectivity in remote areas as well as temporary sites since it is light to carry, easy to deploy, and cost-effective. The efficient operation of NIB however relies on careful coverage planning to determine the NIB positions. This project seeks to contribute an optimized approach to deploying NIB broadly. Specifically, the project will address the need to set up on-demand and low latency online access in temporary sites for the provision of medical services during the pandemic and other emergencies such as natural hazards. Its results will define the requirements in terms of infrastructure and transportation for governments and other stakeholders to optimize their planning.

Project impact:

The project's results will provide actionable recommendations for network planning in rural and remote areas whose populations often suffer disproportionately during the pandemic and in other hazard situations. A lack of access to online (remote) medical diagnosis and treatment or even the inability to quickly and reliably register vaccinations conducted in remote areas into a central database aggravate the current crisis for the digitally excluded.

For these remote regions, and specifically establishing medical treatment in these areas, the project will make a substantial difference. Once the planning can be done in a fairly standardized way, the deployment of the NIB technology will become much easier and cheaper. Hence, the technology can be used to provide digital inclusion in remote areas featuring on-demand access with low latency and high reliability.

The NIB with limited and user-friendly hardware and software capability significantly saves capital and operational expenditure in a mobile network. Thus, it perfectly supports the use cases discussed above owing to ease of deployment, mobility, network flexibility and reconfigurability on varying environments. Thus, the project will provide policymakers, national health systems, and other stakeholders with a new tool to enable digital inclusion and the provision of state-of-the-art health services even in remote areas.

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Research Paper 8: Creating a Blueprint for Africa's Transition Towards an Inclusive and Competitive Digital Economy: Identifying Potential Industries, Stakeholders, and Use Cases for the Development of a Federated Digital Platform and Advanced Services with a Focus on Botswana

The research team proposes to conduct a six-month-long multi-stakeholder study to identify industries, actors, and use cases best suited to leverage Botswana as Africa's digital testbed for federated digital platforms featured with shared and open data spaces, which can foster new and innovative digital services and business models by lowering market entry barriers and attracting smaller digital players.

The identification and definition of use and business cases for this project will be guided by Botswana's digital transformation strategy: Towards Digital Transformation for Botswana. The research team will work directly with a local government collaboration partner (SmartBots) under the joint goal of adapting a digital federation platform framework to the context of Botswana and its level of digitalization maturity. The team will identify a suitable pilot project and outline ways to scale the concept of federation-driven data spaces for Africa.

This project will involve an implementation-oriented approach based on an implementation plan, which will translate research findings and recommendations into a proposal for concrete actions and collaboration methods.

Project impact:

The project is guided by the overarching goal of adapting the Federated Digital Platform Framework (FDPF) to the context of Botswana and its stage of digitalization, identifying a pilot project, and outlining ways to scale the concept of federated shared data spaces to Africa and beyond Botswana's borders. The researchers seek to explore how the concept of a federated digital platform contributes to Botswana's SmartBots digitalization strategy and how it will help Botswana to build an internal digital market, co-create data-driven products and services, compete in global digital markets, and build a knowledge-based economy and workforce. The research will also identify the key stakeholders in the digital ecosystem, the priority use cases, and existing digital services suitable for a pilot in Botswana and design a pilot implementation plan. The research will also explore the cross-border scalability of the shared data spaces.

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Research Paper 9: An Assessment of Digital Inclusion among the Vulnerable Persons in Developing Economies: A Comparative Study between Uganda and South Africa Economies

The project aims to identify the factors and their interdependencies that influence digital inclusion among the vulnerable groups living in Uganda and South Africa. Drawing on the findings, the project team intends to develop a suitable digital inclusion framework for developing economies that can provide in-depth insights into the drivers of digital inclusion as well as recommendations on how to bridge the digital divide. Within this, the project will not only address obvious shortcomings of infrastructure availability, but also include social, political, institutional and cultural aspects that indicate the people's lack of access to ICTs. In particular for vulnerable groups of people (people with special needs, elderly, women, and people in remote places) such 'soft' factors may play a disproportionately significant role in keeping them from making full use of digital opportunities. Therefore, the results of the project will go a long way to alert policymakers to these issues as well as ways to address them. To arrive at these insights, the project team will conduct a survey which will be underpinned with qualitative interviews and focus group discussions to dive deeper into the reasons and rationales behind the numbers.

The project seeks to address the following research questions: a) what are the factors and their interdependencies that influence digital inclusion among the vulnerable persons in developing economies? b) What are basic requirements for digital inclusion in developing economies? c) How can the identified factors be used to develop a suitable digital inclusion framework for developing countries? d) What are the recommendations to narrow the digital inclusion gaps among people in developing economies?

The project focuses on emerging economies taking a comparative study of Uganda and South Africa. A mixed research methodology involving both qualitative and quantitative study design will be used to obtain rich and deep data to guide the phenomena of study. Both primary and secondary data will be collected involving detailed literature review, survey, semi-structured interviews and focus group discussions. Centered on the findings, the project team will identify the specific factors and their interdependencies that influence digital inclusion among the vulnerable people to arrive at the requirements for digital inclusion. Ultimately, the resulting digital framework can be applied beyond the two countries featured in the project.

Project impact:

The digital divide often runs along social disparities as it does along infrastructure deployment. The project sets out to approach the issue of how such underlying issues shape digital inclusion. The results of the project will provide clear recommendations on how to address and mitigate such hidden factors that disproportionately affect vulnerable groups.

Based on the framework, policymakers can develop more targeted approaches to foster digital inclusion with vulnerable and otherwise often overlooked groups. With the many positive impacts of digital inclusion, this could go a long way in helping these groups find better opportunities for gainful employment, increase their productivity, enhance their wellbeing, access to e-health services, instant access to reliable information and financial credit, participation in the digital economy, and remain competitive and networked to their families and friends.

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Research Paper 10: Digital Health Inclusion to Enhance Nigeria's Health Service Delivery

Nigeria's health service struggles with a brain drain, insufficient infrastructure and inadequate specialist skills on one hand, and affluent patients choosing to be treated abroad on the other hand; medical tourism is costing the Nigerian economy in the region of \$1.3 billion annually. Hence, the health service for dependent Nigerians, in particular those living in rural and remote areas, is often poor and inadequate. One way to mitigate these shortcomings is to make use of digital solutions enabling shared specialist resources that reside in Nigerian central health facilities. The project and case study will examine the application and resilience of communications satellite technology to provide telemedicine services. Such services can critically improve access to high quality healthcare advice and services. Utilizing this technology, early diagnosis and prompt treatment are a realizable goal. To gather insights, the project draws on a mixed-methods approach comprising: case studies, a survey and action research to determine the potential for implementing a satellite communication network for telemedicine in rural areas. Such an implementation will enhance the persistence and resilience of broadband availability beyond the pandemic and will as well explore creating a mobile emergency response facility that can be quickly deployed to a disaster location or internally displaced persons (IDP) camps to extend emergency healthcare service delivery in an attempt to enhance the nation's disaster response preparedness and effectiveness utilizing communications satellite technology and software applications.

Project impact:

Telemedicine can only work with sufficient broadband coverage. As technology progresses, satellite networks can provide the required connection quality. Thus, they are a viable option to provide secure services in rural areas, underserved and unserved locations in developing countries. The project will determine the potential for deploying such a solution in Nigeria to address the apparent shortcomings of health-services in rural and semi-urban areas.

Specifically, the project will investigate the resiliency of communication satellite technologies to deliver broadband for telemedicine in rural areas of Nigeria. It will determine if and how such a network can help to leverage specialist hospitals to enhance and improve sustainable healthcare service delivery in rural areas. The aim is to validate the case for delivering rural and community healthcare services sustainably within a nationwide network with real-time video consultation using software applications. Furthermore, the project seeks to explore the creation of a mobile emergency response facility that can quickly be deployed to a disaster location to extend emergency healthcare service delivery. Thus, the project will also make a critical contribution to enhance the nation's disaster response preparedness and effectiveness utilizing communications satellite technology.

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Research Paper 11: Determinants of Digital Inclusion in Higher Education: Exploring the Ethiopian context

Despite the Ethiopian government's effort to integrate ICT in education and the steady expansion of Internet connectivity in the country, studies show a low level of ICT adoption in educational institutions. Poor ICT access, low digital literacy, the difficulty to integrate ICT use in the pedagogy and teachers' reluctance to use ICT in education are some of the problems discussed in past studies. This project plans to use concepts from universal or inclusive design and social theory to present a more comprehensive definition of digital inclusion. Moreover, the insights will examine how diversity in users' background, needs and preferences in the Ethiopian context could inform the digital inclusion efforts in education.

Project impact:

COVID-19 has clearly demonstrated that the use of ICT should be mandatory to create an alternative path to education when face-to-face interaction becomes inconvenient. For that, an inclusive ICT infrastructure that caters to the diversity of users' background, needs and preferences would be crucial. The other problem is the lack of a clear definition of digital inclusion.

This project incorporates ideas from inclusive or universal design and social policy to create a more comprehensive framework to test the inclusiveness of Ethiopia's ICT infrastructure in higher learning institutions. It will use exploratory sequential mixed methods on selected public universities to examine the state of connectivity and available ICT capabilities, and examine how those capabilities were used during the COVID-19 pandemic when students were forced to stay at home.

The results of the project will make a critical contribution towards improving the ICT infrastructure of Ethiopia, and creating a more comprehensive framework to test the inclusiveness in higher learning education. Moreover, the project will also explore the barriers faced by both teachers and students. Consequently, it will contribute to a better conception of digital inclusion that would inform ICT policies in universities and the education sector at large.

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Research Paper 12: How Contemporary Digital Inclusion Strategies can Reinvigorate the Quality of Life for the Elderly in Post-COVID Malaysia?

This project aims to invigorate the elderly population who are aged 60 and above from "burden population" status to "knowledge force" population through digital inclusion strategies.

The project first identified four key issues of aged population: society's erroneous thinking about ageism, seen as welfare receivers, limited feelings of political efficacy, and lack of participation in envisaged information society agenda. Recognizing the challenges mentioned above, the research proposes a Dragon Fly Model approach with two premises: elderly population are reckoned as knowledge force population; and digital inclusion strategy can drive the social, economic and governance dimensions as well as provide access to knowledge and connectivity irrespective of time, geography, cultures and traditions. The Dragon Fly Model also depicts social, economic and governance dimensions that can engage the elderly in social life, gainful employment, and decision making. Element of access, affordability, and usage skills are imperatives in public policy context.

The project aims to investigate the Dragon Fly Model by first conducting literature reviews to understand challenges of aged population. This is followed by a sample survey to cover at least 150 senior citizens, and focus group interviews of policy makers and development practitioners to investigate on the social, economic, and governance dimensions highlighted in the Dragon Fly Model.

Project impact:

The project explores the current statistical status of elderly population globally and in Malaysia, identifies the issues currently plaguing the aged population, especially issues in the wake of on-going global pandemic and recognizes the challenges elderly are facing with modern information and communications tools.

Then the project follows to explore national policy strategies regarding digital inclusion and digital resilience, exploring whether public policies regarding care and welfare for elderly population are adequate and how the gaps and shortfalls can be duly addressed.

The Dragon Fly Model proposed by this project could provide a way forward strategy in addressing the traditional and new emerging challenges plaguing the elderly population and invigorate the elderly population who are aged 60 and above from "burden population" status to "knowledge force" population through digital inclusion strategies.

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Research Paper 13: Telemedicine: An Approach in the Management of Chronic Diseases in Dominica

The overarching objective of the project is to improve Dominican health-care accessibility and affordability using telemedicine as a platform for equality and increased efficiencies in healthcare managing chronic diseases in Small Island Developing States (SIDS) without geographical barriers. Relying on a resilient Information, Communication and Technology (ICT) infrastructure, telemedicine allows long-distance patient, clinician contact, and networking among critical stakeholders, which helps bridge the gap between emerging healthcare demands and restricted access to quality resources. Such provision of health services can proportionately improve the level of service provision in rural areas, particularly during the time of the COVID-19 pandemic. Saving the aging population, reducing medical complications and even death of patients are benefits of this initiative. Considering the special geospatial and economic characteristics of Dominica, the project will implement pilot telemedicine consultative sessions over a six-month period. The insights gathered from assessing this pilot will critically guide and inform the implementation of similar services in Dominica and other island states. The project will place particular emphasis on studying the role of telemedicine in this pandemic and future health crisis in treating and effectively managing chronic diseases.

Project impact:

Reports show that chronic diseases are impacting communities in Dominica. Youth, working class and the elderly suffer disproportionately from chronic diseases. Among its small island population, Dominica is facing challenges in the management of Non-Communicable Diseases (NCDs) in the Caribbean region for varying reasons. Within this, a particularly high number of patients suffering from diabetes and hypertension constitutes a challenge for the health system. Due to poor compliance and untimely follow-ups of these individuals with chronic diseases, many individuals die prematurely. Health is a critical aspect for the survival of the island community. Consequently, the use of telemedicine should become an increasingly common avenue for providing clinical care and consultation, performing research, and conducting public health interventions in Dominica.

This project aims to discuss how SIDS economies can better leverage ICTs to assist front-line health professionals and patients with advance technologies and its application to improve healthcare services during crisis. It will analyze the feasibility and benefit of telemedicine in developing countries like Dominica, and strengthen the integration of ICTs and healthcare. Against this background, the objective of this project is to improve health-care accessibility and affordability using telemedicine as a platform for equality and increased efficiencies in healthcare managing chronic diseases in SIDS without geographical barriers.

The results of the project will make a critical contribution to improve the access to health care for island communities, digitalize health care services, and increase the ability for immediate response to patients' needs. Ultimately the resulting data can contribute to a database for chronic diseases patterns which will facilitate appropriate strategies to counter chronic diseases in the future.

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Research Paper 14: The Digital Financial Inclusion of Micro, Small and Medium Enterprises (MSMEs) of the COMESA Region into Electronic Business During and PostCOVID 19 Pandemic

The micro, small and medium enterprises (MSMEs) of the Common Market for Eastern and Southern Africa (COMESA) region are the fulcrum of economic advancement, employment creation and invention. Focusing on the COMESA region, the emergence of COVID-19 pandemic came as a huge blow and generated a historical disturbance to COMESA's main agenda of advancing into a huge economic and trading entity. Therefore, digitalization of the business environment is something that must be done to ensure MSMEs in the COMESA region clutch to the digital world without fail. The Internet provides significant benefits as a new medium of interaction. This study is very necessary now as it calls for a relook into the way business is performed in the COMESA region. The study aims to augment digital financial inclusion through e-business usage among MSMEs in the COMESA region. The factors hindering effective financial inclusion and e-business will be empirically examined. A cross-comparison of the digital divide within COMESA members will also be analyzed and evaluated. The effect of this study is the substantiation of a digital financial inclusion model which borders on e-business and enhances job creation.

Specifically, the project will use a pragmatist paradigm; whilst a descriptive-explanatory design will be applied. MSMEs in the COMESA region will be targeted with a cluster sampling by using generic micro, small and medium clusters combined with country rankings of the gross domestic product (GDP). Pilot-testing of the research instruments will be done in three countries namely Burundi, Zambia, and Zimbabwe.

Project impact:

The project will demonstrate how digital inclusion will regenerate more than a million jobs that were lost due to COVID-19 pandemic by examining the dynamic trend of e-business adoption among MSMEs of the COMESA region, ascertaining the factors affecting their adoption of e-business, examining the factors hindering effective financial inclusion and e-business, and testing a framework which augments digital financial inclusion through e-business usage among MSMEs in the COMESA region

This project can assist in demonstrating that digitalization will help small and medium companies to survive and thereby lead to the creation of more jobs.

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Research Paper 15: Digital Health Provision through Telemedicine Ecosystem in Sub-Saharan Africa

Global health shocks have become rampant in the past few decades. The economic and social consequences of such events, even though non-trivial for many countries, are more dire for many developing countries. The project aims to investigate how telemedicine ecosystems can be leveraged to expand health service delivery particularly to the poor and the vulnerable (children, women and the elderly) in remote communities. Within the project, it will examine the state of the telemedicine ecosystem in Sub-Saharan Africa broadly, focusing on Ghana for a more in-depth investigation. Therefore, the project would reveal the issues to the policymaker as well as the solutions to address it. Findings and recommendations will help strengthen the health system to withstand any future covariate health shock. To achieve the insights, the project team will use an in-depth review of secondary data and exploratory approaches to explore the telemedicine ecosystem.

Telemedicine can be defined as the use of telecommunications technologies to provide medical information and services. The project aims to approach the issues of telemedicine ecosystem in Sub-Saharan Africa. The parties involved in the study are researchers from the UK, Sweden, Ghana, and some relevant stakeholders from Ghana. The project is highly interdisciplinary and ambitious, aiming to shed more light on complex issues of building a telemedicine ecosystem against the COVID-19 pandemic in Sub-Saharan Africa.

Project impact:

The focus of the project is to better understand the patterns and dynamics of users' challenges with the use of telemedicine against the COVID-19 pandemic by collecting and analyzing data with both vulnerable groups and relevant stakeholders.

Focusing on Ghana, this includes identifying challenges from various users of telemedicine within the whole telemedicine value chain, and suggesting some recommendations for building a telemedicine ecosystem. This will provide information to the policymakers to better understand the challenges with digital health provision during COVID-19 pandemic in Ghana and further suggest a telemedicine ecosystem to facilitate the provision of digital health in Sub-Saharan Africa.



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