# Technology as an Enabler for Addressing the COVID-19 Challenges in the East African Community

*Evious Kingswell Zgovu*

***Working Paper* - COVID-19_021**

AFRICAN ECONOMIC RESEARCH CONSORTIUM
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***Bringing Rigour and Evidence to Economic Policy Making in Africa***

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By

Evious Kingswell Zgovu

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# List of abbreviatons and acronyms

| | |
|---|---|
| 5G | Fifth-Generation |
| AERC | Africa Economic Research Consortium |
| AfDB | African Development Bank |
| AI | Artificial Intelligence |
| AUC | African Union Commission |
| B2B | Business-to-Business |
| B2C | Business-to-Customer |
| CDC | Centre for Disease Control and Prevention |
| CHWs | Community Health Workers |
| CMI | Capital Market Infrastructure |
| CMS | Customs Management Systems |
| COMESA | Common Market for Eastern and Southern Africa |
| COVID-19 | Coronavirus Disease 2019 |
| DMIS | Directorate of Management of Information Systems |
| EAC | East Africa Community |
| EAHRC | East Africa Health Research Commission |
| EAIDSNet | East African Integrated Disease Surveillance Network |
| EAPS | East Africa Payment System |
| ECOWAS | Economic Community of West African States |
| EEP | E-commerce Engagement Platform |
| EOC | Emergency Operations Centre |
| FSDRP | Financial Sector Development and Regionalization Project |
| GB | Gigabyte |
| GIZ | Germany Development Agency |
| GNI | Gross National Income |
| GSMA | Global System for Mobile Communications Association |
| HITs | Health Technologies and Informatics |
| ICT | Information and Communications Technology |
| IGAD | Intergovernmental Authority on Development |
| ITC | International Trade Centre |
| IXPs | Internet Exchange Points |
| KCCA | Kampala Capital City Authority |
| KNBS | Kenya National Bureau of Statistics |

| | |
|---|---|
| LDCs | Least Developed Countries |
| LMS | Learning Management System |
| Mbps | Megabits Per Second |
| MRH | Medicines Regulatory Harmonization |
| NICI | National Information Communication Infrastructure |
| NTBs | Non-Tariff Barriers |
| OECD | Organisation for Economic Co-operation and Development |
| RADDEx | Revenue Authority Digital Data Exchange |
| REB | Rwanda Education Board |
| RECDTS | Regional Electronic Cargo and Driver Tracking System |
| RECs | Regional Economic Communities |
| RKC | Revised Kyoto Convention |
| SADC | Southern African Development Community |
| SARS-CoV-2 | Severe Acute Respiratory Syndrome Coronavirus 2 |
| SASSA | South African Social Security Agency |
| SMS | Short Message Service |
| SolarSPELL | Solar-Powered Educational Learning Library |
| TF | Trade Facilitation |
| TFA | Trade Facilitation Agreement |
| TMEA | TradeMark East Africa |
| TORs | Terms of Reference |
| UNCTAD | United Nations Conference on Trade and Development |
| UNICEF | United Nations International Children's Emergency Fund |
| WCO | World Customs Organization |
| WHO | World Health Organization |
| WTO | World Trade Organization |

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# Disclaimer

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# Executive summary

COVID-19 is a highly contagious and deadly disease caused by the SARS-CoV-2 virus which is transmitted through respiratory droplets containing the virus. Governments around the world, including the East African Community (EAC), put in place public health emergency measures such as restriction or ban of non-essential face-to-face interactions in confined spaces, curfews, and lockdowns to contain and control the spread of the virus. These measures severely disrupted normal human life activities leaving countries and communities with the huge challenges of going about normal life, including in production and consumption of goods and services in public health, education, international and domestic trade, social interactions and networking, among others. Where human physical presence and face-to-face interactions can be minimized or avoided through, for example, the application of technology, economic and social activities has been restored and a semblance of normality regained. Thus, the pandemic has brought technology into greater prominence as a vehicle for attaining near-normality in social, economic and other life activities, and through that, support resilience and recovery from the challenges caused by the pandemic.

The objective of this study was to examine the role played by technology in addressing the challenges to normal life caused by the pandemic in the EAC, and contribute to policy on increasing the role of technology application for sustainable economic growth and development in the region. The specific objectives include examining, in the context of the EAC, the state of play of factors that determine technology inclusion and adoption, examples of technology solutions availed to address the challenges caused by the pandemic, and policy implications for promoting technology adoption and application to support recovery and greater economic prosperity in the EAC. The primary focus of the work here is on the innovative ways in which technology has been used in the EAC to try to get on with life as normal during the pandemic, rather than try to delve into the broad spectrum of roles and application of technology, and/or all the myriad of issues surrounding technology development in the region.

Due to international travel restrictions, the study was conducted offsite, primarily during November2020-December 2020 which coincided with the peak of a raging second wave of the pandemic in some of the EAC Partner States. Updates to data and information collected beyond December 2020 have been made where feasible but the main thrust of the information and data remain the primary period mentioned.

The study applied qualitative and descriptive quantitative analyses to secondary data collected from the EAC, the WHO, the African Union Commission, UNCTAD, OECD, the World Bank, *Hootsuite & We-Are-Social*, published e-articles, e-bulletins and news-articles published by some of the leading EAC and non-EAC news-houses and publishers.

The main findings of the study are:

a) **State of underlying factors for technology adoption and application in the EAC:**

i. **Low income and high costs of technology:** The fundamentals for technology adoption are rather weak in the EAC – low average of US$783 annual disposable income per capita (lower than LDCs' average of US$1,028) with large segments (37%-73%) of the population living on less than US$1.90 a day. This suggests that majority population cannot afford technologies – smartphones cost on average US$86 and only 34% of EAC residents can afford 1GB of mobile data per month.

ii. **There is an apparent low level of digital literacy:** literacy for adults is 63.5% among females and 74% among males, implying that a sizeable proportion of adults would have little or no basic understanding of digital technology. Low digital literacy would also explain a large part of the EAC low internet usage (average 23% of smartphone owners). This means the majority do not have direct access to digital information and data on COVID-19 control and response measures, inter alia. They receive such information through other medium.

iii. **Low financial inclusion:** EAC has low financial inclusion with fewer females than males participating in e-commerce; only 27% of EAC residents are banked, with limited use of more secure means (credit and debit cards) on online transactions, though ownership of mobile money accounts (39% in 2019 before COVID-19) is growing.

iv. **Low production of relevant content and services:** EAC has low availability of local and relevant content and services, in local languages, due to shortage of skilled local developers of bespoke solutions for mass communication of pandemic control information and alternative ways of carrying on with life as normal.

v. **Underdeveloped and limited telecommunication infrastructure supply:** EAC Partner States have spatially limited and slow telecommunication network, with connectivity speeds ranging from 9.1Mbps to 20.6Mbps, the average of 14.6Mbps being less than half of South Africa's 31.4Mbps.

vi. **Entities with wherewithal use some of the sophisticated technologies:** Some businesses and public institutions, e.g., in health, education, border control agencies, and public and private sector workplaces, inter alia, have

access to and use more sophisticated technology applications, standard and supercomputing, scanning and imaging devices, radios, drones, big-data, *AI*-operated, cloud-computing, audio and video-conferencing, inter alia.

b) **Despite the weak fundamentals, technology has been a useful enabler for addressing challenges caused by the COVID-19 crisis, and support near-normalcy.**

The COVID-19 control measures led to disruptions, restrictions, and suspension of human face-to-face or physical socializing which resulted in challenges in the provision of healthcare, education, exchange of goods and services, trade facilitation, public and private business meetings/conferences, and public services, inter alia, that hitherto relied on such human physical presence/socializing and face-to-face interactions.

i. **Healthcare:** EAC healthcare professionals and researchers, policy makers, COVID-19 task forces, information broadcasters, community leaders, law enforcers, and a few common people have used individual or combinations of technology solutions to generate data, information and messages to control the spread of COVID-19. Technology has been used to facilitate data-intensive COVID-19 surveillance, control and management of the pandemic through generation, distribution and sharing information and data on testing and analysis of infection cases and rates, monitoring transmission and hot spots, devising and effecting methods for contact tracing and enforcement of appropriate measures (e.g., quarantine, self-isolation, advice, and support), inter alia, which would have been time-consuming and costly including in terms of loss of lives. Technology was also used in drone deliveries of medicaments, telehealth and telemedicine—though limited use—as in audio/video consultations and counselling, fact-checking and dispelling misinformation and myths (common on social media), amongst other things.

ii. **Education:** EAC-domiciled and access to overseas/international e-learning platforms for schools and organizations have multiplied in number and content offering modules, class notes, external learning resources, self-test exercises and assessments, online learning activities, assignment submissions and group project collaborations to the benefit of the learning community that have their schools closed due to the COVID-19 pandemic. However, e-learning is yet to be accessed by the majority of the population due to constraining technology inclusion factors.

iii. **Commerce:** EAC Partner States have witnessed increased e-commerce and related online traffic for mobile money transfers, banking and online purchases of goods and services to circumvent the challenge of closed business premises and markets, where possible and subject to residents having online access. But e-commerce is still in infancy with gaps in institutional frameworks and low participation rates among the region's residents, particularly females.

iv. **Trade facilitation:** To overcome the challenge of restricted physical contact, EAC Partner States have stepped up usage of paperless and contact-free trade clearance procedures and processes involving customs and other trade regulatory agencies responsible for border security and implementing trade taxes, sanitary and phytosanitary, technical standards and other requirements using national customs management systems incorporating national electronic single window systems; application of bespoke solutions for issuance and mutual recognition of COVID-19 test certificates at border points in the EAC, reporting and resolution of non-tariff barriers against regional trade, inter alia. Issues of outstanding implementation of harmonized trade regulatory requirements and need to deepen application of technology have been brought into more light by the pandemic, reactive technology solutions have helped somewhat but more work remains.

v. **Digital communication technologies used:** Apps/digital platforms/information dashboards/ chatbots that use *AI,* social media (*WhatsApp, Facebook, Instagram,* others); professional meeting platforms on *Zoom, Microsoft Teams, Meet Now, Skype,* inter alia.

## Policy implications

The paper found that, despite increased technology application, there is room for technology to play an even greater role supporting social, economic and other aspects of life in general and addressing the challenges caused by the crisis at hand. To achieve this, the EAC should improve access to technology for the majority, especially among women and rural communities; support creation of an enabling environment for technology development; and expand and develop telecommunication network infrastructure, inter alia. Specifically, the EAC should:

(a) Intensify technology adoption through pursuing open, pro-growth and poverty reduction policies to support increased digital technology knowledge and skills. In particular, the plight of women should be highlighted and given top priority (e.g., tech-buy incentives and training using existing community 'women's groups') to address societal biases on women in technology adoption and application yet they remain the fulcrum of household socioeconomic life in many parts of the region. The African Union Commission (2021) has similar sentiments and recommendation on the question of increasing participation in technology adoption and application, thus, urging African countries to "ensure universal access to the digital solutions best suited to local contexts. In addition to communication and energy infrastructure, a full range of public policies are needed to achieve positive digitalization for all. This will involve reducing inequalities, especially between women and men, and between megacities and rural areas, as well as the cost of accessing data, which is often higher than in other regions of the world."

(b) Introduce ICT syllabuses, with supporting ICT equipment and infrastructure, at the earliest levels of learning through tertiary education, adult and community digital literacy education via mobile and/or resident clinics. The call for policies and initiatives to expand digital literacy and digital skills are in line with the Digital Transformation Strategy for Africa (2020-2030) objective of offering "a massive online e-skills development programme to provide basic knowledge and skills in security and privacy in digital environment to 100 million Africans per year by 2021 and 300 million per year by 2025."

(c) Introduce new and harmonized regional legal and regulatory frameworks on technology to spur research and development, market entry and competition for developers and device producing value chains, data privacy and data security to entrench consumer protection and confidence transacting using technologies (for online transactions: eliminate fraud and product quality assurance, a buyer-seller arbitration, refunds, amongst others), and intellectual property rights, inter alia. These improvements will allow optimization of innovation, scaling and wide uptake of digital solutions and ultimately catalyse increased digital-driven social-economic development. Harmonization of regional policies on technology is also echoed in the AUC's Development Dynamics 2021: Digital Transformation for Quality Jobs (African Union Commission [AUC], 2021).

(d) The EAC should invest more in telecommunication infrastructure accessible to all communities. In the short term, and specially to support COVID-19 responses (information generation and dissemination), existing and new initiatives in this regard should be implemented fully and expeditiously. Invest in installing broadband connectivity to public institutions, including secondary schools, for greater internet speeds, improved online learning experience and research and stimulate creativity and innovation.

(e) Invest more in technologically advanced healthcare IT systems to increase the use of health informatics technology in pandemic responses, general healthcare systems and capacities (e.g., 5G, big data) that share digital images and reports. This will also permit greater access for patients to more healthcare specialists including from other countries (imported health services) especially for areas where there are acute skill shortages. Similar investments should be made in e-government for more cost-effective public service delivery and performance, and trade facilitation to support trade as the engine of growth.

(f) Review and upgrade public online telehealth, telemedicine and e-learning, e-commerce and other useful platforms for standardization, enhanced resource and data sharing for easier application of 'big data' and research and effective oversight, inter alia.

(g) To develop e-commerce, the EAC should fully implement the recommendations made by its recent E-Commerce Comprehensive Assessment which cover a wide range of important issues including on the regulatory environment, e.g., data

security and consumer protection, intellectual property rights, and developing and harmonizing national address systems for door-to-door service, among other things.

(h) The EAC should explore improving existing mechanisms (e.g., https://www.eac.int/covid-19 and others funded by the AfDB and other donors) for gathering, harmonizing and timely disseminating COVID-19 information to inform monitoring and response in the region. All EAC Partner States should be encouraged to supply real-time data and information on the true picture of COVID-19 situation on the ground to help fight and eradicate the pandemic in the region.

# 1. Introduction

The COVID-19 pandemic has caused a huge loss of human lives and devastating impacts on human normal activities affecting all countries around the world. COVID-19 is a deadly disease caused by the SARS-CoV-2 virus and transmitted through respiratory droplets containing the virus, hence is highly contagious. COVID-19 broke out in Wuhan Province, China, in November 2019, and was spread around the world by unsuspecting infected (symptomatic and asymptomatic) vector persons who travelled from the region and those who came into contact with them. As the number of cases spread rapidly around the world, the World Health Organization (WHO) declared COVID-19 a "Public Health Emergency of International Concern" on 30 January 2020. The number of infection cases and fatalities skyrocketed from March 2020 onwards. Unlike any pandemic in the past 100 years, the number of global daily infection cases rose dramatically from 3,300 cases on 3 March 2020 to 75,668 on 31 March 2020. After stabilizing above 70,000 daily cases, the numbers picked up again from May 2020 (96,134 on May 26) to 295,511 cases (31 July 2020) and 674,671 cases as at 20 November 2020.[1] Meanwhile, daily fatalities closely tracked daily number of cases. As of 2 April 2021, a total of 130,328,536 persons were infected and 2,842,782 lost lives due to COVID-19 since the pandemic begun.[2]

When the global number of infection cases had reached 100,000, the WHO "reminded all countries and communities that the spread of this virus can be significantly slowed or even reversed through the implementation of robust containment and control activities".[3] Following the WHO declaration and guidance on controlling the pandemic, governments around the world, including the East African Community (EAC), put in place public health emergency measures to contain and control the spread of the virus. The measures included suspending international travel and closure of borders to all but essential personnel and cargo, instituting stringent social distancing measures including local and national lockdowns, and issuing public health safety advices like face-masking, sanitization, and hand washing, inter alia. Public health measures restricting human physical contact included social distancing (minimum gap of two metres), reduced number of persons in social gatherings, restricted meeting with people from different households, curfews and eventually local and national lockdowns.[4] These measures severely disrupted normal human life activities, and at the same time there was an urgent need to understand how quickly the pandemic was spreading, where it was spreading, the spatial distribution and movement of the

vectors of the spread, to devise palliative medical treatments, oxygen supplements and ventilators to support acute hospitalized cases, and equipment to protect frontline workers and the general public. In addition, countries and communities were faced with the challenges of going about life including in working, education, commerce and international trade, distribution, inter alia, while observing restricted mobility and face-to-face human contact.

Early estimates of impacts showed cliff-edge drops in economic activities, and although mild rebounds were recorded during June-October 2020 after initial successes in containing the virus spread, mutation of the virus unleashed further waves of the pandemic with more devastating effects on economies and human lives. As of late-November 2020, two promising anti-COVID-19 vaccines were undergoing emergency use authorization in the United States of America. This brought respite and hope of turning the corner, and light at the end of a long tunnel. Despite the roll out of the vaccines, which has met uptake hesitancy in many parts of the world, there have been further episodes, including in the EAC.

## Context and issues

Covid-19 control and containment measures severely restrict (in some cases preclude) economic activities that require or involve human physical presence and face-to-face interactions. This in turn hampers the related production and exchange, distribution, and consumption of goods and services. However, where human physical presence and face-to-face interactions can be minimized or avoided through, for example, the application of technology, a semblance of normality is restored and economic activities have flourished. In this regard, the pandemic has increased the importance of technology as a means for attaining near-normality in social, economic and other life activities, and through them, support resilience and recovery from the challenges caused by the pandemic.

The onset of the pandemic has elevated the profile and usage of some pre-existing technology solutions, and led to repurposing and creation of multitudes of other bespoke solutions, devices, networking and data storage and security technologies. Specifically, there has been an increased use of technology as in application of 'big data', Artificial Intelligence (AI), cloud-computing, and Internet of Things (IoT) , inter alia. Globally, technology has been instrumental in the surveillance, control and management of the pandemic through generation, distribution and sharing information on testing and analysis of test results, data collection on infection cases and rates, devising and effecting methods for contact tracing and enforcement of appropriate measures (e.g., quarantine, self-isolation, advice, and support) to control the spread of the pandemic. Furthermore, technology has been useful in the continuation of provision of services largely conducted via face-to-face interaction including in health services (e.g., by Telemedicine, Telehealth), in education (e.g. e-learning or Tele-education), in

commerce (e.g., buying and selling products, money banking and transfers), in allowing public and private meetings for business, conferences, training, learning, worship, social and family gatherings, inter alia, to continue through virtual meetings on online platforms such as *Zoom, Microsoft Team, YouTube, Meet Now, Skype, Telegram and Google Classroom,* via social media platforms such as *WhatsApp, Facebook, Instagram, Twitter,* amongst others; in trade facilitation and logistics, e.g., e-customs, e-logistics and cargo-tracking and reporting non-tariff barriers via mobile SMS; and for entertainment and gaming, inter alia.

Not all countries have the same level of ICT development, adoption, or capacities to develop, utilize and optimize technology in ways including those enumerated above. Thus, the pandemic has been a boon for countries and communities that were e-ready and in business, but a loud wake-up call for those on the wrong side of the digital divide, usually typified by having low inclusion factors, high unit technology production and user costs, low connectivity speeds, limited telecommunication network coverage especially among non-urban communities, low per capita technologies ownership and consumption underpinned by a weak or non-existent coherent enabling legal and institutional frameworks, and restrictive market entry and participation for suppliers, inter alia. Of interest in this paper is to understand the extent to which technology has acted as an enabler for addressing challenges caused by the COVID-19 crisis in the East African Community (EAC).

## Aims of the study

The COVID-19 pandemic and the measures applied by governments to contain and control its spread in the communities, nationally and across borders, with a purpose to save lives, put severe restrictions and challenges on the way people conduct their normal life activities involving close physical contact without personal protective paraphernalia. In this way, the COVID-19 pandemic has brought challenges on the production and exchange, distribution, and consumption of goods and services, inter alia, as well as being a threat to human lives. The application of various forms and aspects of technology can minimize or avoid the need for human physical presence and face-to-face interactions, and thus act as an enabler for addressing some of the challenges caused by the pandemic to bring about near-normality of life activities in times of national/local lockdowns and other restrictions on human-to-human contact instigated by the COVID-19 pandemic.

The main aims of this study are to examine how technology helped in addressing the challenges caused by the pandemic in the EAC, and contribute to policy options for increasing the role of technology application for sustainable economic growth and development in the region. The specific objectives include examining, in the context of the EAC, the state of play of factors that determine technology inclusion and adoption, technology solutions availed to address the challenges caused by the pandemic, and the scope/results in addressing the challenges.

The rest of this study is structured as follows. The state of play of factors determining technology inclusion in the EAC is presented in Section 2. Section 3 presents methodological issues, followed by presentation of the main findings and their discussion in Section 4. The findings and discussions are divided into two parts, namely, state of play—factors underpinning technology inclusion, and the role of technology in addressing COVID-19 challenges in the EAC. Section 5 presents the summary of the main findings and conclusions, and policy implications for the EAC.

# 2. State of play of factors determining technology inclusion in the EAC

To understand the role of digital technology as an enabler for addressing the challenges presented by the COVID-19 pandemic in the EAC, it is useful to consider some of the key prevailing conditions in the region that underpin adoption and application of digital technology. The state of play reviewed here is largely as at mid-December 2020 when data collection and analysis were undertaken. An overview of the number of COVID-19 cases and fatalities is given first. As at 2 April 2021, the EAC reported a total of 211,397 cases, of which 164,493 recovered, another 43,955 still active and 2,949 fatalities (see Table 1). There have been concerns by the WHO that the true number of cases from the region is unknown due to problems with under-reporting. Available data shows Kenya with the highest number of cases (135,042) and fatalities (2,167) in both absolute terms and relative to population (2,471 cases and 40 deaths per one million persons). Uganda reported second highest number of cases but registered lower incidence of cases and fatalities relative to population than Kenya and Rwanda. At the global scale, the numbers of infections and fatalities in the EAC are significantly smaller than the world totals and also compared to the United States of America and Brazil with the highest and second-highest numbers of cases and fatalities in the world. Cases and fatalities in Africa are also smaller on the larger global scale.

In terms of evolution of the pandemic over time, almost all countries have experienced more than one episode/wave in the severity of the pandemic. Rwanda and Kenya (some of the countries with most data reported) have undergone two and three waves, respectively, of heightened daily number of COVID-19 infections since the pandemic begun (see Figure 1). Although the numbers of daily cases from Kenya and Rwanda are smaller on the global scale, the disruptive impacts and loss of human lives caused by the pandemic are nonetheless significant in the two countries and neighbouring EAC Partner States, amongst others.

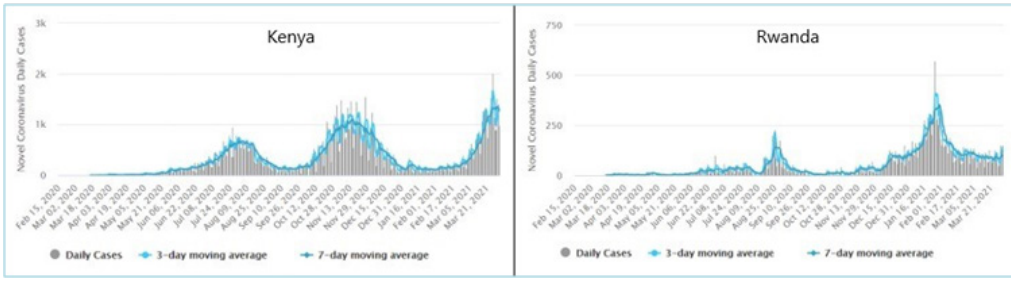
Continued presence and recurring episodes of the pandemic both point to continued hardships and challenges to normal life among the EAC residents as governments respond with pandemic control measures and normal life get disrupted by the public disengaging from normal life activities.

**Table 1: COVID-19 reported cases and fatalities in the EAC**

| | Cases | Recovered | Active cases | Deaths | Cases /1M pop. | Fatalities /1M pop | Total Tests | Population |
|---|---|---|---|---|---|---|---|---|
| Burundi | 2,842 | 773 | 2,063 | 6 | 234 | 0.5 | 90,019 | 12,153,504 |
| Kenya | 135,042 | 93,067 | 39,808 | 2,167 | 2,471 | 40 | 1,494,777 | 54,653,147 |
| Rwanda | 21,918 | 20,308 | 1,302 | 308 | 1,662 | 23 | 1,156,698 | 13,190,960 |
| South Sudan | 10,197 | 9,710 | 375 | 112 | 903 | 10 | 132,246 | 11,291,885 |
| Tanzania | 509 | 183 | 305 | 21 | 8 | 0.3 | | 60,997,199 |
| Uganda | 40,889 | 40,452 | 102 | 335 | 873 | 7 | 942,737 | 46,811,736 |
| **EAC** | **211,397** | **164,493** | **43,955** | **2,949** | **6,151** | **81** | **3,816,477** | **199,098,431** |
| | | | | | | | | |
| Africa | 4,273,739 | 3,837,187 | 323,109 | 113,443 | | | | |
| USA* | 31,244,639 | 23,754,391 | 6,923,637 | 566,611 | 93,981 | 1,704 | 405,032,316 | 332,457,943 |
| Brazil* | 12,842,717 | 11,239,099 | 1,278,059 | 325,559 | 60,099 | 1,523 | 28,600,000 | 213,691,728 |
| Europe | 39,859,204 | 28,126,818 | 10,815,248 | 917,138 | | | | |
| **World** | **130,164,886** | **104,890,342** | **22,434,759** | **2,839,785** | **16,699** | **364.3** | | |

* Top two most affected countries.
Source: Author using data from https://www.worldometers.info/coronavirus/

**Figure 1: Daily cases of COVID-19 infections in Kenya and Rwanda**




Source: https://www.worldometers.info/coronavirus/country/

The next subsections examine some of the technology inclusion factors that determine technology adoption, hence, the extent to which it can play a role in addressing the challenges caused by the COVID-19 pandemic to restore semblance of normality, amongst other things.

## Population and socioeconomic factors

With a young population (median age 18), rising disposable income (proxied by gross national income, GNI[6]) in four of the six large economies (Rwanda's GNI grew by 4.4%, Tanzania 3.2%, Kenya 3%, and Uganda 1.4%) and relatively high literacy rates (female at 64%, male at 74%), the EAC has strengths in some of the essential factors for accelerated adoption of digital technology and contribute to improved economic welfare (see Table 2). However, the EAC's low average GNI per capita of US$783 (excluding Kenya's US$1,482 GNI per capita) sitting below the least developed countries (LDC)'s average GNI per capita of US$1,028 (2015-2019 average), coupled with comparatively high percentages (about 37% to 73%) of residents living below the

poverty line of US$1.90 a day (versus regional comparator South Africa's low of 19%), suggest the majority of the residents cannot afford and thus do not have access to digital technology products and services. In fact, the EAC, like other African regions, faces noteworthy structural challenges, e.g., limited telecommunication infrastructure, slow telecommunication network connectivity, high cost of logistics, costly internet data plans relative to incomes (only 34% of East Africans can afford 1GB of mobile data per month according to AUC (2021)), data privacy and security and low digital literacy rates (proxied by literacy rates, inter alia) that undermine effective access to and application of economic growth-enhancing digital technology (UNCTAD, 2020; African Union Commission, 2020[7]). Socio-political challenges and instability in Burundi and South Sudan over the past decade suppress the regional outlook and performance.

## Mobile connections and internet usage

As indicated in Table 2, the EAC witnessed moderate growth in the number of mobile connections (average of 7%) and internet usage (region average of 8.9%, highest in Burundi by 21% and lowest in South Sudan by 1%). However, the comparatively low numbers of mobile connections (low of 20% in South Sudan, highest 98% in Kenya (compared to South Africa's 176%, meaning more than one mobile connection per person) and, crucially, the low number of residents using the internet (for all purposes) (EAC average 23%) indicate that the EAC has some ground to cover to have the majority of its residents have access to internet connection.

Almost all mobile connections in the EAC are on prepayment basis (EAC average 98%) driven by data plan prices and limited payment options, inter alia. When it comes to the quality of connection, a small number of connections (EAC average 43.8%, range from 32% in Burundi to 52% in Tanzania) use the more versatile and larger bandwidth-enabled Broadband with high-speed and always-on internet connection in terms of transmission capacity. Meanwhile, 70% of South Africa's mobile connections are on broadband which is ahead of the best EAC performer by 18 percentage points, and Netherlands the world's highest-rated country has 91% broadband connection rate.

From around 2019 until early 2021, Google's 'Loon' technology partnered with Telkom Kenya (third largest mobile telecommunication network provider in Kenya) and launched 35 balloons into lower space to provide constant internet connection to people in difficult-to-reach parts of the country, initially covering 50,000 square kilometres. The balloons were essentially 'floating cell-towers' delivering internet speeds between 4.74 megabits per second (Mbps) uplink and 18.9Mbps downlink with latency of 19 milliseconds, which compare favourably to speeds in the established/urban areas in the region.

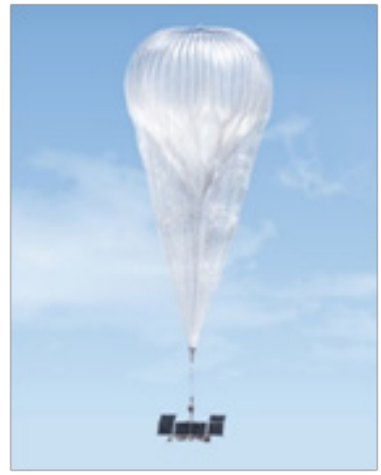


**Table 2: Internet and mobile connections, usage, inclusion and connectivity in the East African Community (2019)**

| | Indicator | Burundi | Kenya | Rwanda | South Sudan | Tanzania | Uganda | EAC Average | South Africa |
|---|---|---|---|---|---|---|---|---|---|
| **1** | **Population and Disposable** | | | | | | | | |
| (a) | Total population (million) | 11.70 | 53.17 | 12.79 | 11.13 | 58.87 | 45.01 | **192.67** | 58.93 |
| (b) | Urban population (% of total population) | 13 | 27 | 17 | 20 | 34 | 24 | **22.5** | 66 |
| (c) | Female (% of total population) | 50 | 50 | 51 | 50 | 50 | 51 | **50.3** | 51 |
| (d) | Median age (years) | 17.3 | 20.1 | 20 | 19 | 18 | 16.7 | **18.5** | 27.6 |
| (e) | Female literacy among adults aged 15+ (%) | 61 | 78 | 69 | 29 | 73 | 71 | **63.5** | 86 |
| (f) | Male literacy among adults aged 15+ (%) | 76 | 85 | 78 | 40 | 83 | 83 | **74.2** | 88 |
| (g) | GNI per capita, Atlas method (current US$, 2015-2019 average)* | 274 | 1,482 | 768 | 1,090 | 1,004 | 778 | **899** | 5,744 |
| (h) | GNI per capita growth (2015-2019 average) (%)* | -3.1 | 3.0 | 4.4 | -7.4 | 3.2 | 1.4 | **0.3** | -0.7 |
| (i) | Poverty headcount ratio at $1.90 a day (% of population)* [a,b,c] | 72.8 | 37.1 | 56.5 | 44.7 | 49.4 | 41.5 | **50.3** | 18.7 |
| **2** | **Mobile Connections** | | | | | | | | |
| (a) | Share of population with mobile connections (%) | 59 | 98 | 73 | 20 | 75 | 60 | **64.2** | 176 |
| (b) | Annual growth in the number of Mobile connections (%) | 9.9 | 8.7 | -1.6 | 16 | 1.6 | 7.7 | **7.1** | 3.1 |
| **3** | **Internet Usage** | | | | | | | | |
| (a) | Share of population using Internet (%) | 9.9 | 43 | 26 | 8 | 25 | 24 | **22.7** | 62 |
| (b) | Annual growth in the number of internet users (%) | 21 | 16 | 8.8 | 1 | 3 | 3.5 | **8.9** | 3.1 |
| **4** | **Mobile Connections by Payment Type and Bandwidth** | | | | | | | | |
| (a) | Share of prepaid mobile connections (%) | 99 | 97 | 99 | 99 | 96 | 97 | **97.8** | 83 |
| (b) | Share of post-paid mobile connections (%) | 0.6 | 3.1 | 0.8 | 0.7 | 3.7 | 3.4 | **2.1** | 17 |
| (c) | Share of connections that are Broadband (3G-5G) (%) | 32 | 51 | 36 | 43 | 52 | 49 | **43.8** | 70 |
| **5** | **Internet Connection Speeds (megabits per second, m.b.p.s.)** | | | | | | | | |
| (a) | Average speed of mobile internet connections | .. | 20.6 | 9.1 | .. | 12.7 | 15.9 | **14.6** | 31.4 |
| (b) | Average speed of fixed internet connections | .. | 18.7 | 17.3 | .. | 14.3 | 15.2 | **16.4** | 26.9 |
| **6** | **Web Traffic by Device (Dec 2019):** | | | | | | | | |
| (a) | Share using Mobile phones (%) | .. | 68.8 | 52.9 | 86.4 | 67.8 | 68.9 | **69.0** | 84.9 |
| (b) | Annual growth (%) | .. | 2.7 | -3.5 | 3.1 | 7.9 | 22 | **6.4** | 4.9 |
| (c) | Share using Laptops and desktops (%) | .. | 29.9 | 45.8 | .. | 31.1 | 30 | **34.2** | 13.8 |

| | Indicator | Burundi | Kenya | Rwanda | South Sudan | Tanzania | Uganda | EAC Average | South Africa |
|---|---|---|---|---|---|---|---|---|---|
| 7 | **Social Media Usage** | | | | | | | | |
| (a) | Share of population using social media (%) | 4.5 | 17 | 4.8 | 2.5 | 7.6 | 5.6 | 7 | 37 |
| (b) | Annual growth in the number of Active social media users (%) | 22 | 13 | 20 | 26 | 13 | 27 | **20** | 19 |
| (c) | Share of social media users accessing via mobile phones (%) | 97 | 98 | 97 | 98 | 99 | 97 | **97.7** | 98 |
| | ***Potential Number of People Marketers can reach using Facebook*** | | | | | | | | |
| (e) | Share of population that Facebook Reports can be reached with adverts (%) | 4.4 | 15.0 | 3.9 | 2.4 | 5.8 | 5.1 | **6.1** | 33.9 |
| (f) | Facebook's advertising reach compared to total population aged 13+ (%) | 7.5 | 23 | 6 | 3.8 | 9.4 | 8.7 | **9.7** | 45 |
| (g) | Quarter-on-Quarter change in advertising reach (%)<br>*(Thousands of people in Quarter-on-Quarter change)* | 8.3<br>*(+40)* | 6.7<br>*(+500)* | 14<br>*(+60)* | 13<br>*(+30)* | 6.3<br>*(+200)* | 4.5<br>*(+100)* | **8.8** | 11.2<br>*(+2,000)* |
| 8 | **Financial inclusion factors (persons aged 15+), share of:** | | | | | | | | |
| (a) | Owning an account with a financial institution (%) | 6.9 | 56 | 37 | 8.6 | 21 | 33 | **27.1** | 67 |
| (b) | Women with a credit card (%) | 0.3 | 3.5 | 0.2 | 1 | 0.6 | 1.8 | **1.2** | 8.1 |
| (c) | Men with a credit card (%) | 0.3 | 8.1 | 1.3 | 1.9 | 0.5 | 2.8 | **2.5** | 9.7 |
| (d) | With a Mobile Money Account (%) | 0.7 | 73 | 31 | .. | 39 | 51 | **38.9** | 19 |
| (e) | Women making Online purchases, bills payment (%) | 0.2 | 20 | 3.4 | 2.4 | 8.4 | 5.8 | **6.7** | 12 |
| (f) | Men making Online purchases, bills payment (%) | 0.3 | 33 | 5.9 | 4.8 | 15 | 13 | **12** | 17 |
| 9 | **Mobile Connectivity Index (out of 100) - enablers & drivers**[d] | | | | | | | | |
| (a) | Overall country index score | 26 | 51 | 43 | 57 | 41 | 40 | **43** | 59 |
| (b) | Mobile network infrastructure | 23 | 53 | 63 | 43 | 37 | 40 | **43** | 62 |
| (c) | Affordability of devices and services | 32 | 45 | 34 | 52 | 34 | 34 | **39** | 53 |
| (d) | Consumer readiness | 46 | 59 | 48 | 76 | 56 | 49 | **56** | 67 |
| (e) | Availability of relevant content and services | 13 | 47 | 33 | 63 | 40 | 38 | **39** | 57 |
| | **Average** | **28** | **51** | **44** | **58** | **42** | **40** | **44** | **60** |

Notes: a: Data for 2015-2019 for Kenya, Rwanda, Tanzania, Uganda, Nigeria, Ghana, and Egypt. b: Data for 2011-2014 for Burundi, South Africa, and Morocco. c: Data for 2007-2010 for South Sudan. d: The respective 'Overall', 'Mobile infrastructure', 'Affordability', 'Readiness', and 'Availability' indexes for the Netherlands are: 82, 83, 73, 88, and 85; average 82.
Source: Hootsuite & We Are Social (2020). * Data from World Bank (2020).

The Google Loon project improved capacity to inform remote populations about the COVID-19 pandemic and how to respond to it with control measures, sources of healthcare support, inter alia, as well as the spread of digital technology for e-commerce and other activities. Data on the exact numbers of institutions and persons that benefited from this service is unavailable at the time of the study, but what is in no doubt is that this was an opportunity for providing mobile telecommunication connections in difficult-to-reach areas which were otherwise unserved by the existing supply of telecommunication infrastructure.

## Internet connection speeds and Fifth-Generation (5G) mobile technology

Average internet connection speeds in the EAC at 14.6-16.4 megabits per second (Mbps) are almost half the speeds in South Africa (26.9Mbps to 31.4Mbps) and 4 to 7 times slower than the Netherland's 67.1Mbps to 107.4Mbps for mobile and fixed internet connections, respectively.[8] High bandwidths and internet speed add significant value to business and that is why huge investments are made in rolling out broadband and latest generation of mobile telecommunication technology. The higher the bandwidth and internet/mobile connection speed, the faster the application (app) performance, the higher the interactivity (between user and app), the higher is data transfer capability, the faster the streaming of image and video content, the fewer the crashes, the more customers can be supported concurrently, the higher the user satisfaction, and hence more business and growth, inter alia.

The fifth-generation (5G) mobile telecommunication technology is highly regarded as a step-change in mobile networking technology over the 4G as it delivers exponentially faster download speeds, and has much larger bandwidth which supports most efficient data acquisition, real-time positioning and high-quality transmission of 3D images.

| | 3G | 4G | 5G |
|---|---|---|---|
| Deployment | 2004-05 | 2006-10 | 2020 |
| Bandwidth | 2mbps | 200mbps | >1gbps |
| Latency | 100-500 milliseconds | 20-30 milliseconds | <10 milliseconds |
| Average Speed | 144 kbps | 25 mbps | 200-400 mbps |

Vodafone notes that 5G allows for device speeds around 10 times faster than 4G, the generation commonly used worldwide. 5G delivers the capture and transmission of high-quality, ultra-high resolution 4K video calls. 5G is expected to revolutionize mobile networking and create new opportunities in many spheres of life.

A handful of African countries have tested 5G[9], and only one had gone live at the time of the study in November 2020.

The Prime Minister of Uganda at MTN Uganda's Public demonstration of 5G

Kenya (Safaricom with access to licensed 2.5GHz and 3.5GHz bands ideal for 5G) completed testing and trials, and MTN Uganda in collaboration with ZTE demonstrated 5G in January 2020. Nigeria tested 5G in November 2019, pending the necessary spectrum allocation. Africa's first 5G network went live in South Africa in May 2020.[10] Kenya followed South Africa with a trial that rolled out on 26 March 2021 four months after the initial data collection and writing of this paper. The Kenya 5G trial is rolled out in four cities, Nairobi, Kisumu, Kisii and Kakamega.[11] The EAC is well served by the older 3G and 4G network; the AUC (2021) estimates that 52% of the EAC population had 4G coverage in 2020.

Web traffic in the EAC is mostly conducted via mobile phones (EAC average 69.9%) compared to laptops and desktops (34.2%), with the former growing at 6.4% and the latter fading out rapidly at 10.4% annually. The growth in mobile phone ownership and usage is driven by the falling mobile phones unit prices.

## Financial inclusion and spending on smart home technologies

The state of financial inclusion in e-ecommerce reveals the state of e-readiness of economies, amongst other factors. E-commerce is more efficient using financial accounts with financial institutions, and/or at least a mobile money account. Otherwise, 'cash on delivery' is used in the EAC in the absence of bank accounts. Available evidence shows that a small percentage of 27.1% EAC residents own an account with a financial institution—highest being in Kenya at 56% and lowest in Burundi at 6.9%; South Africa recorded 67% on this metric. A larger percentage (38.9%) of EAC residents own a mobile money account, thanks to improving smartphones affordability and the innovative e-commerce-supporting solutions such as M-PESA developed and offered by some of the mobile telecommunication network operators (e.g., Safaricom of Kenya) in the EAC.

Jumia, Kenya's leading e-commerce platform, reports a continuous decrease in the average price of smartphones over the last few years. The average amount spent decreased from US$186 in 2014 to US$97 in 2016, and further down to US$86 in 2018. The rise of affordable entry-level devices from brands continues to remain a key driver of smartphone adoption.

*Text adapted from "KENYA Mobile Report 2019" in Jumia (2020)*

Credit card ownership and online purchases is generally very low among both sexes in the EAC vis-a-vis South Africa, except for Kenya (concerning online purchases). The relatively lower financial inclusion factors in the EAC compared to other economies with higher financial inclusion rates signals that the EAC needs to pick up speed in its digitalization endeavours to join the pack of some of the leading economies in this respect to reap the full benefits from digitalization and e-commerce.

Data on spending (average annual revenue per smart home) on EAC smart home devices is unavailable on all EAC but Kenya. According to *Hootsuite & We Are Social* (2020), Kenya spent an average of US$256 on all smart home devices the bulk of which

(US$243) was on smart home appliances in 2019. The comparative average spending in South Africa and the Netherlands were US$586 and US$374, and US$713 and US$334, respectively. The differences in spending on all smart home devices vis-a-vis all smart home appliances in the three countries reveal differing levels of sophistication in consumption of digital technologies, with the more developed countries tending to spend more on non-smart home appliances than Kenya.

## Overall mobile connectivity index

The measures of enablers and drivers of mobile internet connectivity show that the EAC has strength in 'consumer readiness' (average index of 56 out 100) buoyed by sizeable mobile connections (64.2% of the population). All other metrics are below midpoint (50 out of 100), with affordability of devices and services (39 out of 100) and availability of relevant content and services (index 39.2) being weakest areas needing concerted support to drive up mobile connectivity and e-commerce participation. At country level, South Sudan is ahead with a better average mobile connectivity index (58) followed by Kenya (51). Rwanda (index 64) is ahead on mobile network infrastructure. Relative to regional comparator South Africa (average index 60) and world top-rated the Netherlands (average index 82), the EAC is underperforming, suggesting the need for redoubling efforts and investment in developing mobile connectivity.

## Initiatives in technology development in the EAC

The EAC has a regional Model ICT policy framework designed to make it become a prosperous and world-class knowledge-driven economic region through the adoption and application of ICT. The regional framework harmonizes Partner States' visions in the ICT sector to facilitate the implementation of common projects and programmes reported in Table 3.

**Table 3: List of ICT development initiatives in the EAC**

| | |
|---|---|
| • Legal and Regulatory Frameworks in ICTs | • ICT and Social Development |
| • ICT Infrastructure Development | • Rural Connectivity and Universal Access/ Universal Access Fund |
| • Cross border infrastructure Connectivity | • Research and Development in ICT |
| • Complimentary Services | • Norms and Standards |
| • Human Resources Development | • Ecommerce/ e-Transaction |
| • ICT Industry Development | • E-Content Development |
| • E- Government, e-governance | • Health, Safety and the Environment |
| • ICT and Economic Development | • Cyber Security |

Source: EAC (2020a).

Different Partner States are at different stages in the development and implementation of the initiatives above, with South Sudan and Burundi being behind the rest. EAC Partner States are also implementing backbone networks that have played a key role in making technology available and support efforts to address challenges caused by the COVID-19 pandemic. For example, Partner States are implementing broadband connectivity projects (in final states in all Partner States except South Sudan). Mobile access network is also being expanded with 3G and 4G reaching 90% coverage (EAC, 2020a). Uganda and Kenya have made progress in testing and started rolling out 5G network. The EAC has a 'One Area Voice Network' operating in the Northern Corridor countries (Uganda, Kenya, Rwanda, and South Sudan), with Burundi and Tanzania planned for on-boarding by the end of 2020 (EAC, 2020a). 'One Area Data Network' is yet to be implemented in the region. When implemented, it will facilitate interoperability and affordability of data roaming in the EAC which will benefit e-commerce growth, inter alia. Other relevant initiatives include:

a) East Africa Payment System (EAPS) project, and the Financial Sector Development and Regionalization Project (FSDRP)[12] — inter-bank connection for reduced bank transactions time and cost.

b) Capital market infrastructure (CMI) project [13] — with an Automated Trading System (important for Rwanda and Burundi) to simplify cross-border capital market trading.

c) 50 Million Women Speak Project (50MWSP) [14] — to create and deploy a social media platform for African women for addressing specific problems faced by women entrepreneurs (compounded by low education and entrepreneurial skills, and limited access to finance, financial services and information). Also implemented in COMESA, SADC and ECOWAS.

d) EAC Medicines Regulatory Harmonization (MRH)[15] project — to harmonize medicines registration in the region based on common documentation, processes and shared information. This supports the Integrated Pharmaceutical System that facilitates exchange of information on medicines in the region.

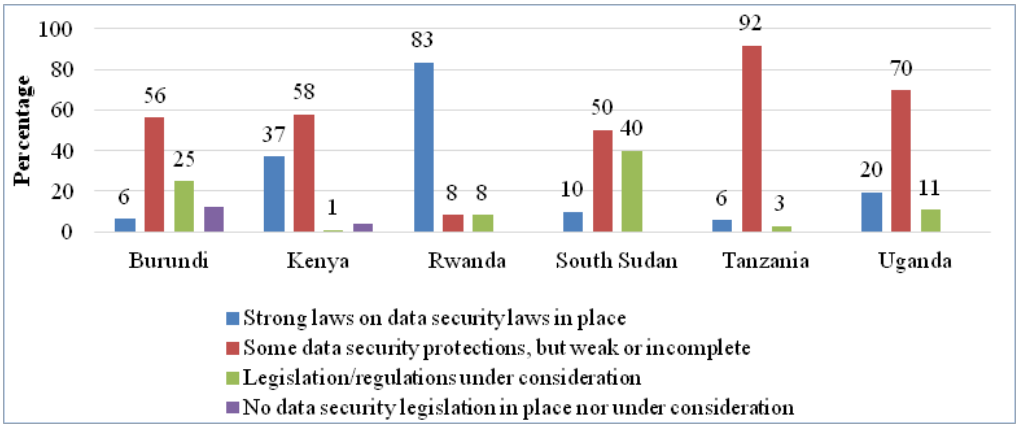
e) East African Internet exchange points (IXPs) — being implemented with the support of the East Africa internet governance forum.

The EAC (2020a) also identifies a new need area, the E-commerce Engagement Platform (EEP), for addressing cross-cutting barriers to cross-border e-ecommerce in the region. Such barriers include: (a) infrastructural inefficiencies related to logistics and connectivity, (b) inefficiencies within supply chains, (c) regulatory, legal and policy barriers, (d) inadequate payment mechanisms, (e) general cultural challenges related to doing business online, low awareness levels and digital skills, trust and security of online transactions. Further details (objectives, strategies, terms of reference, inter alia) on the proposed EEP are available in EAC (2020a).

## E-commerce regulatory frameworks in the EAC

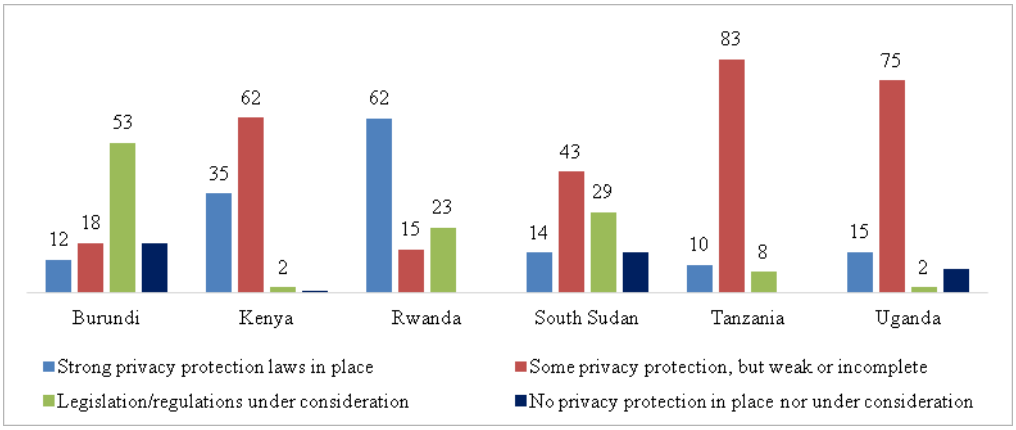
An enabling environment from the regulatory and policy framework viewpoints is an important factor for digital technology to be an effective enabler for addressing COVID-19 challenges and other areas of application, including e-commerce. EAC Partner States embarked to work on developing a regional e-commerce strategy based on best practice to achieve a harmonized institutional framework that will facilitate effective e-commerce development. According to a recent TMEA-funded comprehensive e-commerce survey reported in EAC (2020a), all EAC Partner States, except Burundi, have varying numbers and state of regulatory instruments and policy frameworks (e.g., data security, information protection and privacy, intellectual property rights, anti-money laundering, cybercrime, competition, payments, logistics and taxation) that guide e-commerce and digitalization. The EAC (2020a) survey identified the gaps in the relevant legislations and policies, and recommended the way forward to address the issues. Figure 2 and Figure 3 report on the state of data security laws and privacy laws and regulations in the EAC based on survey respondents in EAC (2020a).[16] The state of play of the other regulatory frameworks can be found in EAC (2020a). Data security and privacy laws engender confidence in online transactions by protecting actors and their transactions but punish offenders.

**Figure 2: Percentage of survey respondents rating the state of data security laws in the EAC**




Source: EAC (2020a).

**Figure 3: Percentage of survey respondents rating the state of privacy laws and regulations in the EAC**




Source: EAC (2020a).

It is clear from the foregoing that the e-commerce regulatory environment is still in the formative stages with all Partner States reported to have considerable respondents reporting 'some data protections, but weak or incomplete' data security and consumer protection laws. Rwanda is ahead in terms of both laws on data privacy and protection law. EAC (2020a) reports Kenya enacting data protection legislation in 2019, whereas Tanzania has data security laws "under review" otherwise currently guided by the Electronic Government Act 2019 and the Tanzanian ICT Policy of 2016 for privacy and data protection. Burundi embarked on drafting its first law on cyber security, electronic transactions and on consumer protection.

This paper was prepared at the same time that the EAC (2020a) study was reporting its findings to policy makers, and since then there has been no major changes in Partner States' legal frameworks on e-commerce or technology, thus there is no value addition to redo the analyses. Besides, this research does not have the budget and time to mount a comprehensive re-review of the relevant legislation and policy frameworks of six countries in 3-4 weeks in addition to addressing other questions of the TORs. To save space, readers are referred to EAC (2020a, see Table 5) for the full findings on the relevant legislation and policy frameworks of EAC Partner States. Suffice to note here, in addition to the review on data security and consumer protection regulatory in the foregoing, that EAC (2020a) reports finding a multitude of different and uncoordinated national legal and regulatory instruments on e-commerce. This paper notes that the different and uncoordinated policy and regulatory frameworks can have the unintended effects of creating artificial institutional barriers that potentially impede frictionless intra-EAC e-commerce to flourish. Accordingly, the way forward for the EAC is to harmonize these instruments, guided by international best practice, for greater efficiency, confidence in transacting online, and compliance.

There is no doubt that the EAC has taken technology development seriously going by the regulatory and policy developments and technology development initiatives

(preceding subsection) being implemented. These prior efforts will have been key in the extent to which technology has been instrumental in addressing the challenges caused by the COVID-19 pandemic. At the same time, it is also clear from the gaps in the regulatory and policy frameworks, including their harmonization at regional level and technology inclusion factors, that there is still a long way to go before technology is fully instituted and exploited to benefit the region. Technology's role in addressing the challenges caused by the COVID-19 pandemic is examined hereunder after a brief statement on data and methodology.

# 3. Data and methodology

## Data, sources and analysis

This study was mandated to focus on the EAC region and experiences in other African regional economic communities, subject to the budget constraint, data, and time availability. This was a rapid research study initiated in mid-October 2020 and was initially meant to be presented to EAC regional policy makers by end December 2020 or early in January 2021. For that reason, the bulk of data collection and analysis were conducted during November-December 2020. Updates have since been made to the data and information, where possible, otherwise the report is largely based on data and information as was available and true during the November-December 2020 period.

The paper uses secondary data collected from reputed public institutions' websites in the EAC, e.g., government ministries, departments and agencies, the EAC Secretariat; international data repositories (e.g., WHO, Johns Hopkins University, ESRI, Google Mobility Data, World Bank, Hootsuite & We-Are-Social, inter alia), e-articles, e-bulletins, e-newsletters published by some of the leading EAC news-houses and publishers, amongst others. Data and information gathered are on determinants of technology and financial inclusion, mobile connection, internet usage, internet connection speeds, web traffic, social media usage, financial inclusion, mobile connectivity index, reported and observed technologies (apps, digital platforms, social media, inter alia) used to overcome the challenges of restricted face-to-face interactions, technologies used in gathering and analysing data to inform public health decisions and advices, COVID-19 task force committee publications, COVID-19 statistics updates, policies from technical studies and policy documents, amongst others. A combination of both quantitative and qualitative textual analysis is used to analyse data and information. Tables of descriptive data (averages, growth rates, and shares), infographics and textual analyses, inter alia, are used to analyse data and information for interpretation and inference.

## Challenges encountered

The challenges faced when preparing this paper include limited data availability, particularly primary data and information. This paper uses mainly secondary data as there was no opportunity (resources and time) to mount institutional and household primary data collection surveys in six EAC Partner States over a period of about a

month. It would help to have institutional and household level data to gain a clear picture and understanding on the application of technology to address some of the challenges caused by the COVID-19 pandemic. This shortcoming was recognized by the Terms of Reference (TORs) which recommended use of secondary data. Data collection from secondary sources was conducted over a period when some of the EAC Partner States were at the peak of the second and most deadly wave of the pandemic. For example, Kenya (Uganda) recorded the highest monthly infections of 28,426 (14,757) persons and fatalities of 488 (94) in November-December 2020.[17] The pandemic made it difficult for some remote-working stakeholders (who were also attending to pressing meetings and other issues during this challenging time) to respond with data and information which is otherwise unavailable offsite. The other challenge has been trying to concentrate on the research work when one is surrounded by a raging pandemic in the neighbourhood and distressing news of sickness and even losses of lives in the communities near and far.

# 4. Findings and discussion

In response to the public measures restricting (in some cases precluding) close human physical contact and face-to-face interactions to contain and supress the spread of COVID-19, individuals and institutions have adapted the ways of going about life in their socio and economic endeavours. To this end, digital technology has seen a huge uptake and application to facilitate conduct of activities and transactions that would otherwise mostly entail face-to-face and/or physical contact/interaction between transacting parties. The COVID-19 crisis has bolstered and accelerated the trend, and brought digital technology into greater prominence as 'must-have' conduit for activity continuity, resilience and recovery. Over the past few years EAC Partner States and other African countries have become increasingly e-ready to varying degrees as seen in the preceding sections, and which has contributed to application of technology. This section presents and discusses the findings on application of technology as an enabler for addressing the COVID-19 challenges in the EAC in a few selected gamut of application in public health, especially for managing and controlling the pandemic, education, e-commerce, and trade facilitation.

Limited coverage is provided on technology application in e-government and workplaces relating to the conduct of meetings and conferences. Otherwise, technology has been and is applied in every sphere of life and sectors from aviation, defence, energy, engineering, entertainment, financial markets, manufacturing, mining, pharmaceutical and scientific research, production of personal protective equipment and ventilators, transportation, inter alia, all of which have had to adapt and employ technology to address specific challenges caused by restrictions placed on human face-to-face interactions. For lack of space and keeping focus, the paper selected those few areas where there has been an extraordinary increase in technology uptake, including by the common person, to address the challenges caused by the crisis.

Due to resource and data limitations (e.g., a short window of three weeks for secondary data collection and analysis in the middle of the pandemic in November 2020), the coverage of issues is not exhaustive as one would wish, rather the paper tries to capture and review some of the key issues in the selected areas at the time of data collection for the study. There have been new developments since that time, and some of the developments are reflected subject to resources permitting, otherwise it

is important that the content be viewed in the challenging contexts above. The next subsection considers the digital technologies used to address the challenges presented by the COVID-19 crisis in the EAC and other African regional economic community blocs where data is available. Where regional data are not available, comparisons are drawn with comparator countries ranked by UNCTAD as having good technology inclusion factors.

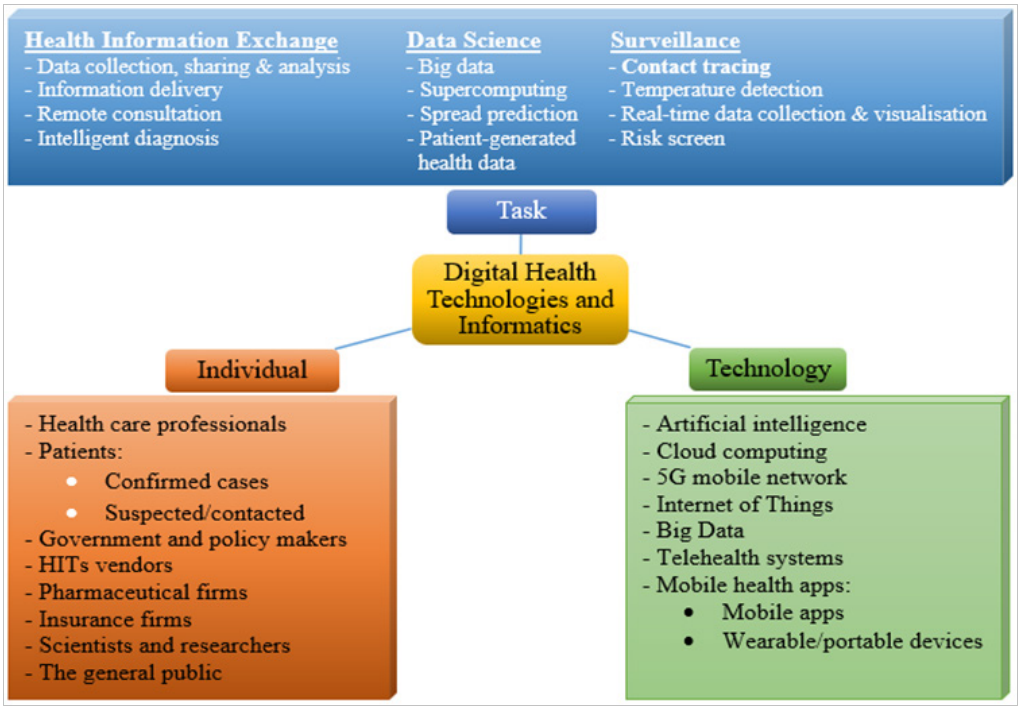
## Use of technology in addressing challenges in provision of health services in the EAC

The health sector is at the battlefront of the fight against the COVID-19 pandemic/challenge, and technology has been heavily relied upon in controlling its spread by facilitating data collection, analysis and formulation of responsive public health policies, strategies and measures, contact tracing of persons highly likely exposed to the novel coronavirus, search for vaccine and treatments, improving service delivery efficiency, reporting and monitoring transmission, debunking myths and misinformation, inter alia. The importance and role of technology cannot be overemphasized as most of these actions would have been difficult to near-impossible, time-consuming and expensive to achieve without technology. The next sections report and analyse how technology has been useful in addressing the challenge of controlling the spread and management of the COVID-19 pandemic from the healthcare perspective.

### *Digital health technologies and informatics for controlling pandemics*

Figure 4 portrays an ideal (conceptual) arrangement on how technology can be used for developing public health safety responses to control the spread of a pandemic such as COVID-19. Technology in healthcare systems can be in the contexts of devices and apps used in detection (temperature detection), real-time data collection (testing of the general public, scientific research), generation and processing of *big data*[18] in telehealth systems, use of Internet of Things, deployment of latest superfast mobile network generations such as 5G, supercomputing, cloud computing and storage, application of artificial intelligence (*AI*)[19] to inform prediction and forecasting, contact tracing, telemedicine telehealth services and support by healthcare professionals (including remote consultation and intelligent diagnosis), government and policy makers, pharmaceutical companies, insurance firms, logistics, inter alia.

**Figure 4: Interrelationships - individuals, task and digital health technologies and informatics**




EAC governments' task forces on the control of the COVID-19 pandemic have used elements of the Health Technologies and Informatics (HITs) depicted in Figure 4 in varying ways to be able to inform their public health policy and guidance, and control the spread of the pandemic which is the challenge number one.[20] It is expected that the 5G that has started being trialled in the region (Kenya) will permit remote surgery, real-time transmission of medical images like computed tomography scan and high-definition images and other functions best performed with large bandwidth, high transmission speed, stability and low latency. Given the advantages of 5G, not only for the health sector, but other sectors, it is imperative that all EAC Partner States join the growing large number of other countries introducing 5G including for health, commercial and other purposes and reap the rewards from the telecommunication networking efficiency it brings.

## *Technology used for data collection and analysis for pandemic control in the EAC*

Healthcare systems in the EAC and other regions are relying on real-time data (and near-real-time data due to capacity constraints) for tracking, screening and predicting the immediate and future progress and paths of the pandemic. To this end, EAC healthcare professionals collect, visualize, and apply integrated processing of salient

real-time data to formulate effective pandemic prevention, clinical treatment, and research. To do this, EAC healthcare professionals use both locally-developed and imported *Contact Tracing* apps with GPS and other location tracking solutions, *Bluetooth*-enabled or synced thermometers (as in *Internet of Things*), inter alia, to collect, analyse, and share real-time data on confirmed/suspected patients.

Meanwhile, policy makers are responding with appropriate measures such as effecting, and later easing, lockdown measures, requiring social-distance in public spaces, and address information gaps and misinformation, inter alia, to break the human-to-human transmission chain; industry (pharmaceutical, insurance, travel, inter alia) and the general public also use health data to inform their decision-making and respond with compliance. At the time of writing, there have been three waves of the COVID-19 pandemic that health specialists assisted by *AI* have been able to decipher as being driven by new variants of COVID-19, and advice made to redouble preventive measures. Resurgence of cases has been reported in the EAC linked to the new variants first discovered in the UK and South Africa. The role of health technologies and informatics is thus ever more important than before. Experiences with contact tracing in the EAC Partner States and other African countries are explained below.

## *Technology used for contact tracing in the EAC*[21]

Contact tracing apps are being widely used in the developed countries and have also gained growing usage in the EAC, other African RECs and other developing countries. Understanding the importance of contact tracing in monitoring and controlling the spread of the pandemic, the Africa Centre for Disease Control and Prevention (CDC) issued Guidance on Contact Tracing for COVID-19 in April 2020. The guidance includes recommendations for respecting citizens' rights and dignity. Examples of contract tracing using digital technology in Africa abound. Kenya has, amongst others, *Msafari* app (developed by the innovation hub *FabLab*)[22] for tracing passengers on public transport, and *KoviTrace* installable on Android and IOS phones or accessed through USSD for users without smartphones which traces contacts for 14 days based on geo-location systems.

South Africa (in SADC) has, amongst others, *Covi-ID* app that tracks individuals who may be unaware that they have been in contact with infected people. The app uses location data and device owner's infection status, stored on individuals' phones using a technology called self-sovereign identity (not on a centralized government or private-sector database). According to the *Covi-ID* developers, the app gives the user full authority and control over

***mSAFARI app for contact tracing in Kenya***

mSafari is a Global Positioning System (GPS)-enabled Vehicle Tracking Software used to locate any vehicle, car, motorbike, bus or truck in real-time, anywhere in the world using a PC, Tablet or Smartphone. All public service vehicles operators including Matatus (minibuses), taxis and motorbikes are required to enrol on the platform (using their vehicle registration numbers) and collect contact details (mobile phone numbers) of every passenger. With as many as 28.2 million Kenyans (53% of the population) using public transport on a daily basis, mSafari is a very useful and effective tool for contact tracing in Kenya.

who can access their data, how they can use such data and how long they can keep the data. Nigeria (in ECOWAS) has, amongst others, *Rapid Trace* app that uses *Bluetooth* and GPS technology to establish contact between persons. Tunisia's Enova Robotics company developed the *PGuard* robot that uses remotely controlled camera and speakers to broadcast safety instructions including on social distancing, compliance with lockdown, inter alia, in parts of the capital, Tunis.[23]

Despite assurances by app developers and health stakeholders who promote mass use of contact tracing apps, there remain concerns over data privacy and surveillance as person tracking via mobile technology means that personal information such as an individual's location and movements, and their COVID-19 status could be shared/disclosed without consent where there are no robust oversight mechanisms for protection and accountability.

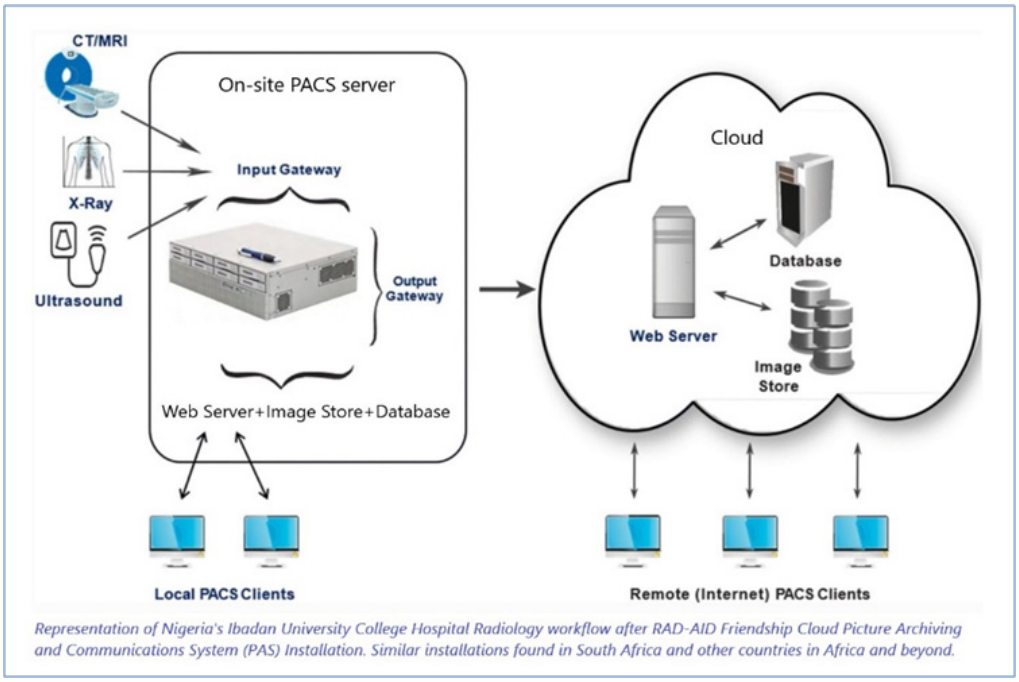
## *Technology for telehealth services in some African countries and the EAC*

Advances in, and increased application of, digital health technologies and informatics (HITs) have enabled networked local healthcare facilities and general practitioners, and in some cases external and international specialists, to remotely deliver vital and otherwise non-accessible (due to resource constraints in poor communities) high quality healthcare services to lower community-level health facilities, including related to COVID-19 treatment, in many parts of the developed world and also in the developing world. A small but growing collection of African health institutions (especially at well-resourced medical schools/colleges and universities (see Figure 5) and large hospitals) offer an interesting range of telehealth and telemedicine services including some of the following: audio and virtual consultation, *AI*-assisted medical imaging and remote viewing systems and assessment; data capture and cloud filing and retrieval of electronic health records; applying *AI* algorithms to huge amounts of medical image samples to speedily analyse and review cases; prescription and drug distribution, e.g., involving remotely controlled drones in Rwanda; online counselling, monitoring and instantaneous relay of health status of patients, coordinating deployment of health personnel, matching demand and supply of medical and pandemic prevention kits. Further, a small group of Rwandan biomedical scientists at the Integrated Polytechnic Regional College in Kigali developed and tested a locally made prototype ventilator[24] for use on acute COVID-19 cases requiring supplementary oxygen.

Remote application of HITs in telehealth and telemedicine, including in some of the above processes, reduces the risk of cross COVID-19 infection during patient-medic face-to-face visits. At the same time, a relatively small but growing number of African patients (including some who could afford to travel outside their countries and the continent, e.g., to India) are accessing and using telehealth and telemedicine as face-to-face patient-medic visits are restricted or not possible due to suspension of international passenger travel by many countries.

Smartphones and SMS are used in the EAC and other African regions to receive, relay and spread telehealth information to health workers, traced contacts (e.g., COVID-19 patients to isolate) and communities to contain the spread of the COVID-19 pandemic. A combination of digital technology and big data used in the EAC Partner States enables patients to undertake imaging and electrocardiogram assessments at resource-deprived healthcare facilities which are then transmitted online/via internet to specialists at the superior hospitals for analysis and next course of action.

**Figure 5: Part of digital technology as applied at hospital in Nigeria and in South Africa**




*Representation of Nigeria's Ibadan University College Hospital Radiology workflow after RAD-AID Friendship Cloud Picture Archiving and Communications System (PAS) Installation. Similar installations found in South Africa and other countries in Africa and beyond.*

Source: Elahi et al. (2020).

Community health workers (CHWs) in Uganda use mobile phones to improve routine CHWs' workflow efficiency concerning data collection and reporting, patient to provider communication, patient education, decision-making, supportive supervision, monitoring and evaluation (Feroz et al., 2020). Healthcare professionals from different regions within each EAC Partner State, and also in countries in other African RECs, are using telehealth systems and various digital technology platforms, including *Zoom*, *Microsoft Team*, to discuss the diagnosis and treatment of COVID-19 patients and others.

## *Tech-based social media and instant messaging for COVID-19 alerts and awareness*

EAC residents' use of social media platforms is generally low with a regional average share of 7% of the population, compared to 37% in South Africa, but is rising rapidly at a rate of 20% annually. Mobile phones are almost the primary devices used to access social media. Social media platforms play a key role of advancing information sharing, alerts, updates on the vectors and channels of COVID-19 spread, COVID-19 hots pots, number of cases, prevention and control measures, and transmission of information and data between scientists, epidemiologists, businesses, policy makers and the general public, amongst others. Social media also provides a gateway to e-meeting potential sellers and buyers, investors, amongst others. Through campaigns, 'big data' and data analytics on social media, successful businesses convert social media traffic (views, likes, share) to business opportunities from further targeted reach and advertisements, among other things.

The most frequented social media platforms in the EAC are *WhatsApp* (96% of internet users), *YouTube* (89%), *Facebook* (87%), *Instagram* and *Facebook-Messenger, Twitter*, and *LinkedIn*. The economic usefulness of social media, for businesses and e-commerce, can be measured in terms of *number of people who use it for work purposes*, number of *people that the platform reports can be reached with adverts* and reported *advertising reach* compared to total population (aged 13+), inter alia. Using the case of *Facebook*, advertising reaches about 10% (45%) of EAC (South African) residents, and uptake is growing rapidly particularly in Rwanda (by 14%) and South Sudan (by 13%); regional quarterly growth of 8.8% annually.

The information above suggest that social media is a potent information and data mine for e-commerce ventures, investment and growth apart from the social and political roles associated with it. EAC businesses advertising on social media is rather low but EAC businesses can and should take on the challenge to open new avenues to reach consumers and capitalize on the opportunities for e-commerce offered by social media platforms. To do this, there is need for increased awareness on the impact of social media presence, enhanced capacity for data analytics on social media metrics that measure social profile, brand health, inter alia, to set and measure their key performance indicators to meet their strategic goals.

Instant messaging digital platforms[25], e.g., *WhatsApp, Facebook*, are very effective medium through which important COVID-19 pandemic-related health messaging between health authorities and the general public, as well as between/among individuals, have been provided in the EAC and the rest of the world. *We Are Social* (2020) reports 96% of 22.86 million internet users monthly in Kenya use *WhatsApp*; the proportions of internet users using *WhatsApp* in Nigeria and South Africa are 94% and 89% of 85.49 million and 36.54 million internet users monthly, respectively. *WhatsApp* is used for connecting with family and friends, professional work groups, news sourcing, file sharing, and community organizing. Using pre-existing instant messaging digital

platforms to engage communities on public health emergencies, inter alia, has the advantage of achieving relatively high public participation and effective dissemination of key messages to a large existing audience. For example, Uganda's Ministry of Health setup and ran a *WhatsApp* chatbot to provide awareness and rally citizens to follow COVID-19 prevention and control measures by disseminating accurate, trustworthy and up-to-date information on symptoms, the latest number of cases in the country, travel advisory, and countering COVID-19 fake news and myths, inter alia.

South Africa repurposed (added functionalities) its Govchat that enables residents to use the platform on *WhatsApp* for COVID-19 screening, searching for COVID-19 testing centres, report test results, and allow citizens to apply for COVID-19 relief grants from the South African Social Security Agency (SASSA). *Grassroot*, a South African not-for-profit organization traditionally championing participatory democracy, branched out to partner with sponsors and uses *WhatsApp* to collect data on water, sanitation, hygiene, waste collection, soap and sanitizers and personal protective masks in informal settlements to inform evidence-based COVID-19 pandemic-related planning and action by municipalities to help identify residents' needs in high population density areas.

## *Tech-based dashboards for information dissemination and fight against misinformation*

Information and advices on COVID-19 prevention measures, monitoring and policy formulation in the EAC and other African RECs and the rest of the world have increasingly been routed through digital dashboards/platforms, including specially designed coronavirus dashboards. Government health institutions, non-governmental organizations, private firms, individuals and other entities of goodwill have created dashboards sharing COVID-19-related information on preventative measures (face mask wearing, hand washing, social distancing, quarantine, and isolation), location of test centres and updates on number of infections, deaths, and recoveries; predictions and vulnerable COVID-19 hot spots, and fight against misinformation about the causes, transmission and safety of anti-COVID-19 vaccines. Such dashboards include *Action for Transparency* in Kenya, the Regional Centre for Mapping of Resources for Development in Eastern and Southern Africa.

In Uganda, the Women of Uganda Network, which empowers women through the use of ICT, uses the *M-Omulimisa* dashboard to relay messages to rural communities to create COVID-19 pandemic awareness, debunk myths, and counter misinformation. Uganda also established a Computer Emergency Response Team tasked with providing rapid fact-checking support for broadcasters and the general public to demystify COVID-19, and fight against fake news. Similar efforts to fight against misinformation are applied in South Sudan and the other EAC Partner States. In Burkina Faso (ECOWAS member), *leDA*, a digital health solution (created by Swiss organization Terre des hommes and the Ministry of Health in Burkina Faso) to save children's lives, has embedded a COVID-19 facility that uses *AI* to predict new outbreaks of COVID-19 in children and adults and monitor its spread in real time.

There are also initiatives at the multilateral level. For example, the WHO runs *WHO HEALTH ALERT*, an *AI chatbot*[26] and supports governments to provide accurate information to the public via WhatsApp. Also, GIZ (Germany development agency) and the European Commission Development Department, DEVCO, are co-financing a €30 million initiative for *hackathons*[27] and supporting the development of digital solutions to fight COVID-19 in low- and middle-income countries (European Investment Bank, 2020).

## *Technology used in EAC regional information collation for surveillance and policy*

The EAC has the East African Integrated Disease Surveillance Network (EAIDSNet), established in 2000 as a regional collaborative initiative of the national ministries responsible for human and animal health in collaboration with the national health research and academic institutions.[28] Ope et al. (2013) reports that its formation was a response to weak individual country laboratory capacity coupled with uncoordinated disease interventions that were making it difficult to respond in a timely manner to the outbreaks of malaria and other infectious diseases in the region. Among EAIDSNet objectives are to promote exchange and dissemination of appropriate information on Integrated Disease Surveillance and other disease control activities, and harmonize integrated disease surveillance systems in the region. Two of the major accomplishments of the EAIDSNet were establishing a Department of Health within the EAC Secretariat to support a regional health agenda and piloting a web-based portal for linking animal and human health disease surveillance (Ope et al., 2013).

The role played by the EAIDSNet in harmonizing regional responses to the COVID-19 pandemic is unclear. However, the EAC Secretariat created a special weblink at https://www.eac.int/coronavirus reporting updates about the COVID-19 situation in the region. In addition to information on EAC policy positions and strategy, it also presents regular updates on the number of cases by Partner State using data from reliable sources including EAC Partner States through their health ministries and departments, the Centre for Systems Science and Engineering at Johns Hopkins University, WHO, ESRI, Google Mobility Data. Limited data reporting by Tanzania is noted.

The weblink initiative is part of regional harmonized and coordinated COVID-19 control, response and management efforts by the EAC which started on 25 March 2020 when the EAC Secretariat convened a joint meeting of Ministers of Health and Ministers of EAC Affairs to launch the region's COVID-19 Response Plan, whereupon the Ministers directed the Secretariat in collaboration with the Partner States to establish a linkage between the national task forces on COVID-19, EAC Secretariat, and East Africa Health Research Commission (EAHRC) to coordinate and monitor the implementation of the plan (EAC/JMHE/Directive/003).

Some of the key interventions under the Plan are "building regional capacity to support Partner States on surveillance, monitoring and coordination of preparedness and response to the pandemic, and fast-tracking the implementation of Digital

COVID-19 Surveillance Tracker tool to facilitate contact tracing, patient's self-monitoring and information exchange between the EAC Partner States and EAC Secretariat." These and other key interventions under the Plan were budgeted for US$1.438 million. The importance of digital technology in implementing the EAC COVID-19 Response Plan is unmistakeable in the budget, including in the extract reported in Table 4. Interestingly, the Plan establishes an Emergency Operations Centre (EOC) at the Secretariat to serve as a monitoring and coordination centre. The performance of the Response Plan is yet to be evaluated.

**Table 4: Extract of EAC COVID-19 Response Plan budget estimates and proposed activities**

| | Area of focus and proposed activities | Level | Total Budget (USD) |
|---|---|---|---|
| **5** | **Regional capacity to support Partner States on surveillance, monitoring and coordination of preparedness and response to pandemic** | | |
| 5.1 | Establish an Emergency Operations Centre (EOC)at the EAC Secretariat to serve as a monitoring and coordination center | regional | - |
| 5.1.1 | Procure screens with electrical and all support facilities to safeguard the information and facilitate sharing (including installation) | regional | 150,000 |
| 5.1.2 | Implement a tracking system for Corona Virus disease contacts especially the truck, ship and cargo plan crew | regional | 600,000 |
| 5.1.3 | develop operating systems / partner with a provider for software and hard ware | regional | 40,000 |
| 5.1.4 | Technical support services | | 90,000 |
| 5.2 | Support for Data and Information Sharing for Covid-19 outbreak by implementing the Digital Covid-19 Surveillance Tracker at both the EAC Secretariat and the Partner States' Ministries responsible for Health including supporting for infrastructure (hardware and software) upgrade" | Regional / National | 500,000 |
| **5.3** | **Communication Support to the EAC ADHOC Regional Coordination Committee** | | |
| 5.3.1 | Communication services (internet to facilitate online meetings) | regional | 48,000 |
| 5.3.2 | Communication hand sets and airtime for all members if the EARCC and sub committee members | regional | 8,000 |
| 5.3.3 | Modems | regional | 1,000 |
| 5.3.4 | Zoom online meeting services (registration licenses) | regional | 1,200 |
| 5.3.5 | Air time for EARCC for 12 months | regional | 90,000 |
| | **Sub total** | | **1,438,200** |

Source: EAC Secretariat (2020b).

On 26 June 2020, the African Development Bank (AfDB) approved a US$9.52 million grant to strengthen responses to the COVID-19 pandemic in East Africa and the Horn, and in the Comoros (EAC, 2020c). Key spending items supported under the grant are procurement of essential medical supplies, including testing kits and to train health workers, bolstering health systems and disease surveillance, enhancing infection prevention and control, and to improve regional coordination by the EAC and the Intergovernmental Authority on Development (IGAD) to contain cross-border transmissions.

# Role of technology in addressing challenges in education in the EAC

## *Recent developments*

The EAC has a long history of using technology in education involving school radio and television programmes to the present digital technology for e-learning. However, in person and face-to-face learning has been and will remain the main modus operandi for the foreseeable future due to telecommunication infrastructural deficiencies, high cost of relevant technology devices against low household disposable incomes, limited supply of suitably qualified and experienced e-educators, content and ICT developers, among other constraints. COVID-19 control social distance measures, including suspension of face-to-face learning, made e-learning and application of other technologies in distance learning the most viable and last resort to continue learning remotely. During the crisis, the EAC has witnessed a surge in the creation and uptake of existing and innovative e-learning solutions catering for all levels of education ranging from pre-school to primary, secondary, tertiary, vocational, and professional training.

## *Technology initiatives by education institutions*

Education and learning facilitating institutions have responded to the demand for remote learning during the crisis by expanding existing and/or setting new online digital learning solutions, adapting and developing teaching materials for e-teaching, and expanding outreach and access for anyone who can afford, developing capacities for e-teaching and e-learning, and information spread, inter alia. For example, almost all EAC universities have expanded e-learning provision though the quantity and quality vary depending on existing ICT capacities and new investments. Some tertiary institutions in Kenya (e.g., Kenyatta University Digital School of Virtual and Open Learning), Rwanda, Tanzania (e.g., Centre for Virtual Learning at Dar es Salaam University), and Uganda already had dedicated digital learning programmes, and with upscaling in some cases, facilitated a smooth shift to e-learning for most of the tuition during the crisis.

## *Platforms and innovative initiatives for offline e-learning*

Following the challenge of closure of learning institutions as one way of controlling the spread of the COVID-19 pandemic, the EAC has witnessed a rapid growth in the provision of learning services via online platforms to overcome the challenge. EAC-domiciled e-learning platforms have been created and offer learning opportunities (some for a fee, others gratis) for all students who can afford digital devices and internet fees to

learn online. E-learning and dissemination of, or access to, learning materials (classes, reading text, assessments, inter alia) are made available via *Zoom, YouTube channel, WhatsApp, Telegram* and *Google Classroom,* among other electronic media platforms. Using these media, teachers provide online tuition, interact and directly share digital learning materials with students, conduct assessment and provide feedback. Some primary and secondary schools have introduced online lessons for the first time, while others expanded what they already had. For example, following the breakout of the COVID-19 pandemic, in March 2020 the Rwanda Education Board (REB) launched the REB e-learning platform "where a teacher can create a class, create lessons and enrol students to be able to read and do the formative assessments and get feedback automatically".[29] The REB E-learning User Guide specifically notes: "*Due to ongoing global issue of COVID-19 pandemic that has affected all sectors and resulted into closing schools to avoid the spread of the coronavirus, REB has established an online learning platform to help students continue with their studies*."[30] The platform allows teachers to detect slow learners and talented learners and help them individually in their learning activities. In Rwanda, local developers supported by UK and US investors developed *Homeskul*, an e-learning portal where students interact with experienced teachers through videos, access study materials, and live-chat for tutorials and review.

To overcome the challenge of closed learning institutions due to the COVID-19 pandemic, more and more EAC learning institutions have also made use of overseas-based e-learning platforms such as *Moodle* (https://moodle.org/). *Moodle* is a virtual learning environment accessible from anywhere in the world. *Moodle* is a central point to access teaching and learning resources for all learners for: modules, lecture notes, external learning resources, self-test exercises and assessments, online learning activities, assignment submissions and group project collaborations.[31] *Moodle* currently has 261,000,000 users accessing 35,000,000 online courses from 181,000 sites of which 50,000 were registered since COVID-19 hit, in 240 countries. The mobile version of *Moodle*, *Moodle* App, was accessed on 4,504,000 active devices in March 2021, up from 1,305,000 in March 2020; and 15 million more new e-learning activities were created on registered *Moodle* sites in March 2021, compared to the previous month.

"During school closures due to the COVID-19, *Moodle* is the platform behind thousands of schools and organizations worldwide who are relying on online learning."
*Moodle*: https://moodle.org/

The uptake of *Moodle* in terms of number of sites in the EAC is small in global terms, but important at the Partner State level considering the limited options and opportunities for the majority of the learning students in the region. Also, the number of sites does not tell us the number of individual users/learners at the base. The

numbers of *Moodle* sites by EAC Partner States as at April 2021 are: Kenya 508 sites, Uganda 190 sites, Tanzania 83 sites, Rwanda 56 sites, Burundi 18 sites, and South Sudan six sites.

In other initiatives, UNICEF Kenya and Safaricom launched the 'Connecting Schools Initiative' where so far seven public primary schools have been connected to the internet to support e-learning and use of digital tools benefiting more than 1,000 students, including children with disabilities. To alleviate the cost of accessing e-learning, some of the EAC mobile network providers offer free access to select educational websites to support home-schooling. For example, MTN Uganda in partnership with the Ministry of ICT and the Ministry of Education allow free access to the National Curriculum study content from pre-primary to university and more (MTN Uganda, 2020). Safaricom-Kenya doubled bandwidth offered on fibre connections to homes for more efficient home-learning and off-school entertainment, as well as reducing rates for data access to specific educational content for various universities and other learning institutions (Safaricom Kenya, 2020). MTN Rwanda waived internet charges for students to support their e-learning during the crisis (Iliza, 2020). Similar initiatives are also implemented in the other Partner States.

In South Sudan, the government with the support of UNESCO under the Capacity Development for Education (CapED) programme uses the radio broadcast technology to provide offsite learning during the crisis. 'Education on Air' broadcasts live daily lessons to primary and secondary pupils covering English, Science and Mathematics.[32] Teachers and pupils have live interaction, asking and answering questions. An innovative solution to the problem of limited internet coverage, particularly in rural areas, is the application of Solar-Powered Educational Learning Library (SolarSPELL), a student-centred initiative hosted at Arizona State University. *SolarSPELL* was launched in 2019 in South Sudan, and since the COVID-19 crisis it has been instrumental in serving unconnected schools and communities (Hosman, 2020).

*SolarSPELL* is a relevant, education-focused, ultra-portable and offline digital library. It generates its own Wi-Fi hot spot to which any Wi-Fi-capable device can connect and freely surf the library's expansive yet localized open-access content. It overcomes telecommunication infrastructure deficiencies, and allows children to continue their schooling from home by both listening to a teacher via a radio broadcast, and following along using a digital textbook. *SolarSPELL* units are taken to specific schools at coordinated times which are announced on local radios; parents go to the schools to download textbooks and other supplementary educational materials onto their smartphones or devices.

## *Technology for sharing information on e-learning resources*

Governments, the private sector and some members of the public have undertaken initiatives to gather, organize, and share e-learning resources available within their countries and the region. For example, in Uganda ICT-specialist Rogers Mukalele (https://www.mukalele.net) presents a list of useful e-learning sources and links including lists of 'Public Educational Resource Sharing Platforms', 'Resourceful School Websites', 'Educational Resource Repositories', 'Platforms with courses for students by Ugandan school teachers', 'Individual Ugandan Blogs with Educational resources and classwork', and others. The Rwanda Education Board runs an e-learning platform "where a teacher can create a class, create lessons and enrol students to be able to read and do the formative assessments and get feedback automatically"[33].

## *Challenges and way forward for e-learning*

Digital technology in education offers a great opportunity for continuity in learning during the COVID-19 period; however, it is not patronized by large segments of the EAC population, particularly in rural areas for a variety of reasons, some of which are summarized in Table 2. The challenges hindering mass uptake of digital technology in education include low disposable income and poverty (50.3% living on less than US$1.90/day), digital illiteracy which means limited home-schooling support from parents/guardians, lack of/unreliable electricity, low internet usage (22.7%), low internet speeds, insufficient mobile network infrastructure particularly in rural areas, unaffordability of devices and services, low availability of relevant content and services, and shortage of e-teaching skills, inter alia.

The crisis has increased governments' attention to developing e-learning capacities

by addressing some of the challenges through increasing budget spending on provision of portable equipment, maintaining zero taxes on imported e-learning equipment, working with telecommunication stakeholders to reduce or waive fees, developing and retooling teachers' ICT skills, e.g., National ICT Teachers Retooling workshops for ICT teachers from over 1,027 Uganda's secondary schools and tertiary educational institutions supplied with government-funded ICT laboratories, inter alia.

These efforts, while commendable, are inadequate to provide a critical mass of digital technology, supporting capacities and institutions for effective e-learning

in the EAC. Even where ICT teacher training is provided, there remain wide digital skills gaps among most school managers, teachers and students. The plight of learners with learning difficulties (conditions that inhibit a learner's ability to gain knowledge and skills at the same rate as his or her peers) has been intensified during the COVID-19 crisis as the majority would not have had close and adequate support from home-schooling and access to specialist/qualified teachers.

> "E-learning is good for fast learners who grasp lessons easily, but not for slow learners who need a teacher's physical presence to pause and explain where they do not understand during a lesson.
> "There are children who take a long time to understand and you have to give different examples and illustrations for them to grasp things. You give them exercises and do corrections until they grasp."
>
> *Wilson Byaruhanga, Head Teacher of Nyamata High School in Bugesera District, Rwanda. The New Times of Rwanda, 1 April 2020.*

In addition to the efforts in the foregoing, the EAC needs to: build more capacity to provide e-learning in familiar languages and contexts for enhanced relevance, assimilation and application of knowledge; develop a set of national guidelines to help design (cost-effective interoperable and scalable learning management systems, inter alia) and deliver effective e-learning; and find avenues for ensuring long-term sustainability of donor-funded e-learning platforms and programmes.

## Technology used in sustaining commerce

Comprehensive data sets on the volume and values of e-commerce are hard to come by in many developing and least developed countries, including those in the EAC. A recent study by the EAC Secretariat (2020a) reported finding "insufficient data on e-commerce transactions and volumes for both goods and services, in particular services", and recommended improved data collection on e-commerce as a priority to support evidence-based policy making, business analysis, and investment.

### *State of e-commerce preparedness*

Studies conducted by UNCTAD provide a glimpse on the state of e-commerce across the globe by focussing on, among other things, four factors highly related to online shopping and for which there is wide country coverage (see Table 5) and a Business-to-Customer (B2C) E-commerce Index is calculated. According to UNCTAD, the B2C E-commerce Index is a measure of an economy's preparedness to support online shopping.[34] Out of the six country categories/regions, and relative to the world, Africa was found to have, not only the lowest B2C e-commerce preparedness on all four factors as well as the overall index in 2019, but also to have headed in the wrong direction of the prevailing digital divide as its latest (2019) performance slipped behind the previous year's.

**Table 5: UNCTAD B2C e-commerce index 2019 by region**

| | Share of individuals using the Internet (2018 or latest) | Share of individuals with an account (15+, 2018 or latest) | Secure Internet servers (normalized) (2018) | UPU postal reliability score (2018 or latest) | 2019 Index value | 2018 Index value |
|---|---|---|---|---|---|---|
| **Africa** | **25** | **40** | **29** | **22** | **29** | **30** |
| East, South & Southeast Asia | 53 | 59 | 57 | 59 | 57 | 57 |
| Latin America & the Caribbean | 59 | 53 | 53 | 28 | 48 | 46 |
| Western Asia | 75 | 58 | 49 | 52 | 59 | 57 |
| Transition economies | 67 | 58 | 62 | 65 | 63 | 65 |
| Developed economies | 86 | 93 | 87 | 82 | 87 | 86 |
| World | 57 | 60 | 55 | 49 | 55 | 55 |

Source: UNCTAD (2019).

The EAC's comprative standing at global level is weak on the UNCTAD B2C E-commerce Index 2019 but compared favourably at the continent level where Kenya, Tanzania and Uganda ranked 5th, 8th and 13th, respectively (see Table 6).

Only Kenya has one (*"Share of individuals with an account, 15+, 2017 or latest"*) of the four factors that is almost at par with the top-10 countries in the world, and second highest in Africa. Otherwise, EAC Partner States' average measures on all four factors of e-commerce prepraredness (ranging from 18 to 49) are distantly below the world's top-10 e-commerce economies (indexes 79 to 100). The region's average slid backwards, dragged by slippages in Uganda, Rwanda, and Burundi between 2018 and 2019.

The marked differences between the world's leading e-commerce economies and Africa in general, and EAC in particular, point to a digital divide that excerbates the latter poor economies' declining relative significance in global value chains and trade. This calls for concerted policy and resource investments in digitalization to lay solid foundations for effective and gainful participation in global value chains and trade in the post COVID-19 era where digital technology is indispensable.

The levels of the EAC's e-commerce preparedness, reported in Table 6, are strongly correlated with the level (estimates) of e-commerce and the extent to which e-commerce has played an enabler role in addressing COVID-19 challenges. Recent e-commerce performance in the EAC Partner States is highlighted hereunder.

**Table 6: EAC and other selected countries' UNCTAD B2C e-commerce index, 2019**

| Global Rank 2019 | Africa 2019 | Economy | Share of individuals using the Internet (2018 or latest)* | Share of individuals with an account (15+, 2017 or latest)* | Secure Internet servers (normalized) (2018) | UPU postal reliability score (2018 or latest) | 2019 Index value | *Index value change (2017-18 data) %* | 2018 Index rank |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Netherlands | 95 | 100 | 98 | 93 | 96.4 | *0.3* | 1 |
| 2 | | Switzerland | 94 | 98 | 95 | 95 | 95.5 | *0.0* | 3 |
| 3 | | Singapore | 88 | 98 | 97 | 97 | 95.1 | *-0.2* | 2 |
| 4 | | Finland | 94 | 100 | 90 | 94 | 94.4 | *0.7* | 13 |
| 5 | | United Kingdom | 95 | 96 | 88 | 98 | 94.4 | *-0.8* | 4 |
| 6 | | Denmark | 98 | 100 | 100 | 79 | 94.2 | *2.1* | 10 |
| 7 | | Norway | 97 | 100 | 86 | 91 | 93.4 | *-1.1* | 5 |
| 8 | | Ireland | 82 | 95 | 95 | 100 | 93.3 | *-0.1* | 7 |
| 9 | | Germany | 92 | 99 | 94 | 86 | 92.9 | *0.9* | 12 |
| 10 | | Australia | 87 | 100 | 89 | 91 | 91.8 | *-0.7* | 11 |
| 58 | 1 | Mauritius | 59 | 90 | 78 | 47 | 68.4 | *-2.2* | 55 |
| 70 | 2 | Tunisia | 64 | 37 | 52 | 79 | 58.1 | *0.1* | 79 |
| 76 | 3 | South Africa | 56 | 69 | 81 | 11 | 54.4 | *0.8* | 77 |
| 79 | 4 | Nigeria | 42 | 40 | 48 | 83 | 53.2 | *-5.5* | 75 |
| 88 | 5 | **Kenya** | 43 | 56 | 49 | 47 | 49.0 | *2.9* | 89 |
| 96 | 8 | **Tanzania** | 25 | 21 | 33 | 69 | 43.3 | *1.1* | 110 |
| 105 | 13 | **Uganda** | 24 | 33 | 30 | 42 | 38.8 | *-10.1* | 99 |
| 121 | 22 | **Rwanda** | 26 | 37 | 35 | 17 | 30.9 | *-8.1* | 116 |
| 150 | 41 | **Burundi** | 10 | 7 | 21 | 6 | 9.0 | *-8.9* | 147 |
| | | **South Sudan** | 8 | 9 | | | | | |
| | | **EAC Average** | **18** | **49** | **34** | **36** | **34** | ***-4.6*** | **112** |

Source: Adapted from UNCTAD (2019). * Other data from Hootsuite & We Are Social (2020).

## *Scope and scale of e-commerce facilitated by technology*

Comprehensive data sets on the dimensions and scope of e-commerce in the EAC are still developing, hence, it is only possible to paint a partial impression of the phenomen. The available pieces of information suggest that the EAC is on the right track, but the track is long and needs further development to allow reaping greater benefits from e-commerce. Despite the current underdevloped state of e-commerce market environment, the levels and growth of e-commerce during the past few years would clearly suggest that it has been very instrumental in easing the congestion in economic activities due to the COVID-19 pandemic. The next paragraphs discuss the role played by e-commerce to ease the challenges brought by the COVID-19 crisis, at least in some of the EAC Partner States.

**Burundi:** Burundi has relatively low digital technology capacity and activity in terms of mobile connections, internet usage, financial inclusion, and mobile connectivity. As a result, e-commerce plays a limited role in its economy. Total e-commerce was projected to be worth US$5 million or 0.14% of GDP in 2020, with an average per-user spending an estimated US$8.19[35] (see Table 2). Driven by COVID-19 crisis-induced surge in demand for online-supported transactions, e-commerce was forecast to grow by 20% in 2020. In terms of commodity composition, fashion products dominate, estimated at US$2 million in 2020, followed by electronics and media products. The latter two are products in highest demand during the COVID-19 pandemic for communications and information access and sharing, inter alia.

**Rwanda:** Rwanda has modest levels of e-commerce preparedness with the best metrics on mobile network infrastructure (index score 63 out of 100), one of the highest mobile connection rates (73% of population), second fastest internet speeds in the EAC (17.3Mbps), and highest quarterly growth in advertising reach (*Facebook*, 14%), inter alia, in 2019. The COVID-19 crisis has increased the relative importance of e-commerce as a result of which e-commerce revenue was forecast to grow by 21% per annum to US$62 million in 2020 and US$132 million by 2024. Commonly purchased products were fashion, electronics, and media, the latter two being particularly useful for information exchange during the pandemic. The average spend-per-user was estimated at US$25.13[36], more than thrice the spending in Burundi. However, some setbacks that have slowed the pace of e-commerce, as seen in falling number of mobile connections (by 1.6% in 2019) and web traffic using mobile phones (by 3.5%), generally lower scores on other metrics including financial inclusion and mobile connectivity (excluding mobile network infrastructure) and poverty (56.5% of residents living on less than US$1.90 a day).

**South Sudan:** Estimates on the size of e-commerce and projected future scale are not available for South Sudan. However, the metrics of mobile connections, internet usage, highest average mobile connectivity index (58) in the EAC and disposable income (the second highest EAC GNI per capita of US$1,090 per annum during 2015-2019) reviewed suggest that the country has promising potential for e-commerce, and the COVID-19 crisis is likely to have increased e-commerce. The path to realizing the potential, however, is full of challenges such as underdeveloped institutional frameworks, logistics, amongst others.

**Tanzania:** Tanzania is a regional e-commerce powerhouse awaiting discovery. It boasts the largest population, third highest disposable income (annual GNI per capita of US$1,004 during 2015-2019), highest literacy rates (73% for females), highest urban population (34%), the second highest proportion of residents using the internet (see Table 2), and a sizeable percentage of transactional web traffic, inter alia. To realize full potential, Tanzania will need to overcome deficiencies in mobile network infrastructure (only ahead of Burundi), relatively high cost of devices and services,

limited availability of relevant content and services, low financial inclusion (only better than one Partner State), low average spend-per-user estimated at US$22.80, inter alia. Earlier data show mobile money transfers valued at US$21.73 billion during a 10-month period between July 2016 and April 2017.[37] The values should be greater for later years up to 2019 and especially in 2020 with growth in mobile money account ownership and the COVID-19 crisis that has tended to increase the relative importance of mobile transactions. The challenge is to translate most of the mobile transfers into effective e-commerce and investment. Despite these conditions, and propelled by trends in key factors and the COVID-19-induced demand, e-commerce was estimated to be worth US$160 million in 2020.[38] Further growth is projected at 18.2% annually over 2020-2024 to yield an e-commerce worth US$312 million by 2024.

**Uganda:** The value of e-commerce is projected to increase from a 2019 estimate of US$143.6 million to US$173 million in 2020 (growth by 20.5%) driven by positive trends in key determinants including high literacy rates, growth in mobile connections, 3G-5G broadband connections (49% of connections), growth in social media consumption (27%), mobile money account ownership (51% of persons aged 15+ years) as well as the drive to new normalcy (through diversification of platforms) manifested in adoption and application of more digital technology during the COVID-19 crisis. Available data also show the dominant products in e-commerce have been fashion goods with an estimated value of US$58 million and electronics and media with a combined value of US$50.8 million. GSMA estimates a doubling in mobile money transactions value and more than doubling in volume terms in 2020 over 2019. The average revenue per B2C consumer was estimated at US$22.73 within the range of values seen in Rwanda (US$25.13) and Tanzania (US22.80), all of which are well below the values in South Africa (US$232) and the Netherlands (US$1,986).

**Kenya:**[41] Greater data availability on Kenya provides an opportunity to appreciate better the prevailing state and potential of e-commerce in the EAC (see Table 7). A respectable one-third (28.6%) of Kenya's population purchased consumer goods online, though this pales in comparison to the rates in South Africa (52%) and the Netherlands (82%). E-commerce in consumer goods was valued at decent levels (by EAC standards) of US$640 million, but it pales in comparison to South Africa (US$3.31 billion) and the Netherlands (US$14.53 billion). Kenya's apparent low level of money sophistication involved in online purchases explains these disparities. The bulk of Kenya's payments for online purchases are made using cash (44%, mostly *Cash-on-Delivery*), followed by 'other' means (33%) which is principally mobile money accounts and credit cards (23%). Jumia Kenya platform exceeded the national average: 70% of

There were 47.6 million active mobile money accounts and more than 200,000 agents through which transactions worth US$3.6 billion were processed in 2018. Continued growth of mobile money is supported by increasing adoption of mobile payments by major sectors of the economy, such as financial services (for instant short-term loans supported by more than 300 loan apps in

Text adapted from *Jumia, KENYA Mobile Report 2019.* See https://www.jumia.co.ke/sp-mobile-report/

online purchases were by mobile money, 30% by cash-on-delivery and card payments. More advanced and secure forms in bank transfer (65%) and credit card (41%) are the principal medium for effecting online purchases in the Netherlands and South Africa, respectively.

The depth of penetration of digital technology is also measured by the values of digitally-enabled consumer payments (for all products and services) for which Kenya achieved US$2.3 billion, representing notable 2.4% of GDP in 2019 — comparable shares of 2.2% and 3.3% for South Africa and the Netherlands, respectively, show Kenya is competitive on this measure.

Digital advertising has also been an important activity and source of revenue for Kenya, estimated at US$244 million, the lion's share being from social media advertising (US$115 million) in 2019. Though starting from the lowest base of the three countries (South Africa's US$1.37 billion) and the Netherlands' US$3.75 billion), digital advertising is growing fastest in Kenya (15%) compared to South Africa (13%) and the Netherlands (12%) annually. Kenya has got some ground to cover to catch the likes of South Africa and the Netherlands running a few bends ahead in terms of digitalization in general and e-commerce in particular.

Kenya's encouraging trends in underlying factors such as a relatively high GNI per capita (US$1,482) and growing per capita disposable income (3%), high mobile connections and internet usage rates, fastest internet speeds in EAC, financial inclusion and mobile connectivity, online consumer purchases and digital advertising, inter alia, all add up to fuel digitalization and e-commerce growth. The COVID-19 pandemic added further impetus to adoption of digital technologies and e-commerce, which (e-commerce) is predicted to be worth US$1.093 billion in 2020 and US$2.243 billion by 2024.[42] The range of products involved include home electronic appliances and media (US$431 million), fashion and apparel, groceries, food, furniture, mobile phones, flowers, beauty products, pharmaceuticals, vehicles, and real estate.

## Table 7: Overview of e-commerce in East Africa*

| | Kenya | South Africa | Nether-lands | *Kenya as % of South Africa* | *Kenya as % of Nether-lands* |
|---|---|---|---|---|---|
| **Online purchases of consumer goods in 2019** | | | | | |
| Number of people purchasing consumer goods online (million) | 15.2 | 30.5 | 14.1 | *49.8* | *107.8* |
| As share of total population (%) | 28.6 | 51.8 | 82.0 | | |
| Value of the market of consumer goods purchases (US$ million) | **640** | 3,310 | 14,530 | *19.3* | *4.4* |
| Average annual revenue per online consumer (ARPU) goods shopper (US$) | 42 | 109 | 1,031 | *38.5* | *4.1* |
| Online consumer goods ARPU as percent of GDP per capita (%) | **2.5** | 1.7 | 1.9 | | |
| Average annual online spend per B2C consumer (US$) | 24 | 80 | 2,098 | *30.0* | *1.1* |
| Mobiles' share of B2C E-commerce transaction value (%) | 51 | 45 | 49 | | |
| **E-Commerce purchases by payment method** | | | | | |
| Credit card (%) | 23 | 41 | 19 | | |
| Cash (%) | 44 | 11 | 0 | | |
| Bank transfer (%) | 0 | 20 | 65 | | |
| E-wallet (%) | 0 | 17 | 8 | | |
| Other (%) | 33 | 11 | 8 | | |
| **Size and growth of the digital payments market in 2019** | | | | | |
| Number of people making digitally-enabled payments (million) | 9.5 | 34.7 | 14.9 | *27.4* | *63.8* |
| Total annual digitally-enabled consumer payments (US$ million) | **2,300** | 8,050 | 29,570 | *28.6* | *7.8* |
| Annual change in digitally-enabled consumer payments (%) | 19 | 14 | 10 | | |
| Average annual digital payments per digital payment user (US$) | 242 | 232 | 1,986 | *104.3* | *12.2* |
| **Value of the Digital Advertising market** | | | | | |
| Total digital advertisement spends in 2019 (US$ million) | **244** | 1,370 | 3,750 | *17.8* | *6.5* |
| Spend on Digital Search Advertisements in 2019 (US$ million) | **90** | 685 | 1,680 | *13.1* | *5.4* |
| Spend on Social Media Advertisement in 2019 (US$ million) | **115** | 441 | 831 | *26.1* | *13.8* |
| Spend on Digital Banner Advertisement in 2019 (US$ million) | 17 | 113 | 648 | *15.0* | *2.6* |
| Spend on Digital Video Advertisement in 2019 (US$ million) | 12 | 71 | 330 | *16.9* | *3.6* |
| Spend on Digital Classified Advertisement in 2019 (US$ million) | 10 | 61 | 265 | *16.4* | *3.8* |
| **Digital Advertising market value growth** | | | | | |
| Year-on-year change in Total digital spend (%) | **15** | 13 | 12 | | |
| Year-on-year change in Digital Search Advertisement spend (%) | **12** | 9.8 | 13 | | |
| Year-on-year change in Social Media Advertisement spend (%) | **18** | 19 | 19 | | |
| Year-on-year change in Digital banner Advertisement spend (%) | **15** | 9.5 | 5.5 | | |
| Year-on-year change in Digital Video Advertisement spend (%) | **17** | 17 | 9.1 | | |
| Year-on-year change in Digital Classified Advertisement spend (%) | 4.2 | 3 | 3.8 | | |

Note: *Data are for Kenya, not available yet for the rest.
Source: Hootsuite & We Are Social (2020).

## Technology used in supporting trade facilitation during the COVID-19 pandemic

EAC customs administrations and other trade-regulatory and supporting agencies use technology in varying forms, formats and extent for trade facilitation (TF). The WTO defines TF as activities, practices, and formalities involved in collecting, presenting, communicating, and processing data required for the movement of goods in international trade. The EAC Customs Management Act (CMA) 2004 is built on best practices on TF contained in the WTO TFA, the WCO Revised Kyoto Convention (RKC), and other international conventions that promote the application of technology for paperless TF to minimize trade costs and support trade competitiveness. For example, EAC Partner States use electronic Customs Management Systems (CMS), e.g., *ASYCUDA World* to undertake TF and also as a platform for interlinking with other trade regulatory agencies (agriculture-fisheries-forestry, health, immigration, police, financial institutions (for e-payments), inter alia, in a single window system[43]. The CMSs allow for more efficient conduct of risk analysis, expedited trade clearance for traders in the Authorized Economic Operator Programme, payments of trade taxes, coordination and management of border points, cargo and truck tracking systems, inter alia. The EAC is a Single Customs Territory with national CMSs linked under the Revenue Authority Digital Data Exchange (RADDEx) system that seeks to reduce time and transaction costs of cargo clearance by providing a secure mechanism of confirmation of transit, export and import cargo details. The EAC is also implementing a web-based mechanism for reporting, monitoring and eliminating NTBs encountered by traders in the region. The mechanism allows reporting NTBs via mobile phone short message service (SMS). Up to 66% of reported NTBs up to 2019 were resolved bilaterally between concerned parties.

The COVID-19 crisis, with its restrictions on face-to-face interactions, has heightened the significance and shift towards more paperless and contactless procedures involving the application of digital solutions and automated processes to allow continuation of safe, cross-border trade (Atkinson & Stevens, 2020). EAC Partner States have used available TF technologies (in the context of CMSs) and new innovative solutions on reporting NTBs, to cushion against some of the effects of the COVID-19 crisis by allowing for more expedient trade clearance which would otherwise have been more challenging with entirely paper-based and direct face-to-face and physical presence. Some elements of paper-based processes and procedures and face-to-face interactions still exist and were in large part a factor that led to long queues (in some cases more than 50km) of cargo traffic at the border during the first wave of the pandemic. For example, due to lack of special protocols on recognition of COVID-19 testing and certification, cross-border truck drivers encountered challenges of having to take/present multiple COVID-19 test certificates to different border agencies on each side of the border, resulting in delays, long truck queues and extra

costs on trade. In response, the EAC, with support from donors, introduced a regional mobile-phone application COVID-19 surveillance system for trucks and their crew called Regional Electronic Cargo and Driver Tracking System (RECDTS). The RECDTS eliminates the need for multiple testing in different Partner States, and controls use of fake certificates, thereby ensuring smooth flow of cargo traffic across EAC borders (EABC, 2020).

Different Partner States have different levels of digitalization of TF due to resource constraints, meaning that paper-based documentation, exchange of information and largescale human examination and determinations are still commonplace. Digital technology has been useful during COVID-19 by permitting electronic trade clearance and tracking. However, low application of AI in the systems means that human involvement is heavily involved. It is in this context that COVID-19 control measures (lockdown, reduced staff deployment in businesses, government trade regulatory agencies and banks, inter alia) undermined the progress and gains from investments in TF digitalization. However, the situation would have been worse without the available level of TF digitalization.

The lesson here is that more sophisticated technology is needed to enhance e-TF which would also be useful for cross-border management of major health crises such as the COVID-19 pandemic.

## Technology used for meetings in workplaces during the pandemic

Social distancing and lockdown measures meant that commonly used face-to-face work-related meetings, workshops and conferences were unfeasible. Before the COVID-19 pandemic, offsite meetings and conferences were available via *Skype, FaceTime,* and others, but these were rarely used. Since the mid 2010s, the EAC Secretariat and Partner States received support from TMEA to run Skype call-conferences from office premises to save on travel and logistics costs, inter alia. But with COVID-19 measures, this facility was not available — that is, due to social distance requirements staff were not able/allowed to sit around a table in a conference room to use the service. Instead, other platforms such as the recently developed *Zoom, Microsoft Teams*, supported by *Skype* and *FaceTime, Skype* accessible on personal devices, inter alia, have become the medium of choice for the EAC and the rest of the world working remotely to beat the restrictions placed on indoor meetings and gatherings to control the spread of COVID-19. Working from home on these platforms has proven to be, not only a workable substitute, but also big on time and resource savings as professionals are able to engage in multiple meetings involving peers located across the world which would otherwise have entailed logistical and costs challenges. It has also been commented that worker productivity has tended to be high (from time savings travelling to workplaces, and less stress in relaxed environment) and some see working from home will be part of the work-mix in the new normal post

COVID-19. For lack of institutional level survey data, this paper is unable to provide an extensive coverage on the use of technology to alleviate the challenges caused by restrictions on face-to-face contact in workplaces.

## Technology used by governments for pandemic management and public services

EAC Partner States are increasingly using online platforms, Internet of Things (IoT), and other digital technologies to manage the COVID-19 pandemic (e.g., through messaging and remote delivery of certain services), in addition to other government services as provided before the pandemic. Governments online services are offered via interactive portals, websites, searchable databases, procurement, file sharing, video conferencing for meetings and service delivery (e.g., e-judicial hearing of cases in Kenya), notice board and messaging, inter alia. To support e-government, Burundi adopted a National ICT Policy Plan (2010–2025); and draft legislation for e-commerce is under review. Kenya introduced its e-government strategy in 2004 with the objective of making the government more result-oriented, efficient and citizen-centred through the use of internet and other channels of communication. Rwanda created *IREMBO* (meaning gateway), a single window platform for all public services and permitting delivery of 24/7 self-service, "cash-less" and "paper-less" government (Twizeyimana et al., 2018). Rwanda's drive for national digitalization, including e-government, is anchored in the National Information Communication Infrastructure (NICI) Plan (2000–2015) and the Smart Rwanda Master Plan (2016–2020). The NICI Plan contains the legal and regulatory framework and plans to build ICT infrastructure such as telecommunication networks, national fibreoptic backbone, a submarine cable and an integrated national data centre. The Government of Uganda has undertaken to digitize some of its services relating to COVID-19 messaging, the Kampala Capital City Authority (KCCA) runs a 24/7 toll-free line for reporting COVID-19 cases, and the official Ugandan COVID-19 website maintains frequent updates on cases and resources available to support prevention and control of the pandemic.

In Tanzania, e-government services, initiatives, policies, laws, regulations, standards, and guidelines are coordinated, overseen and enforced by the e-Government Authority (e-GA) of Tanzania established in 2019 under the e-Government Act, No. 10 of 2019.[44] The e-Government Authority succeeded the e-Government Agency (semi-autonomous institution established in 2012 under the Executive Agencies Act of

1997) which itself took over from the work of the then Directorate of Management of Information Systems (DMIS) in the President's Office. Table 8 illustrates the wide range of e-government services provided in the EAC using the case of the Tanzanian Government. The listing is provided by the e-Government Authority of Tanzania. There are e-government services for public institutions, citizens, businesses, government ministers and students (education) whose stated goal is to give "access to information and services online through a variety of systems". This study does not have the resources to evaluate the relevance of the information provided on the weblinks, the efficacy of the e-government services provided or how the systems operate, inter alia. However, some of the links provided are unreachable. Also noteworthy is the absence of a portal for COVID-19; the link to 'Government of Tanzania Hospital Operations' does not have leads to information on COVID-19 situation in the country.

For lack of space and time, this paper is unable to provide complete coverage of e-government services in the other five EAC Partner States. Using the case of Tanzania, however, we are able to state that the governments in the region were able to continue providing some level of government services to public citizens, the trading community, public institutions, students and other interested parties with online access even where there are challenges of connectivity, limited scope of service vis-a-vis in the normal face-to-face times, and missing information on certain aspects.

Figure 6 reports a snapshot of the application of e-government in the EAC using the case of one EAC Partner State, Kenya, due to space limitations and data availability. Based on the 2016 survey, an average of 43.4% public institutions offered e-government services in Kenya. E-services were highest among public learning institutions (74.3%) followed by corporate state agencies (60.2%), while hospitals had lowest proportion of 24.7%. It is expected that the proportions will increase with time guided by the e-government strategy. E-government activity (Figure 7) was dominated by email correspondence reported by nearly all (98.3%) institutions. Up to 58.8% of the institutions used the internet for data collection, 52.3% for providing public services, and 52% for receiving feedback from the public. Interestingly, there was no reported use of the technology for virtual meetings, which can be explained by the fact that its technology only became widely available in the latter years. E-government virtual meetings have been widely availed during the pandemic in all EAC Partner States.

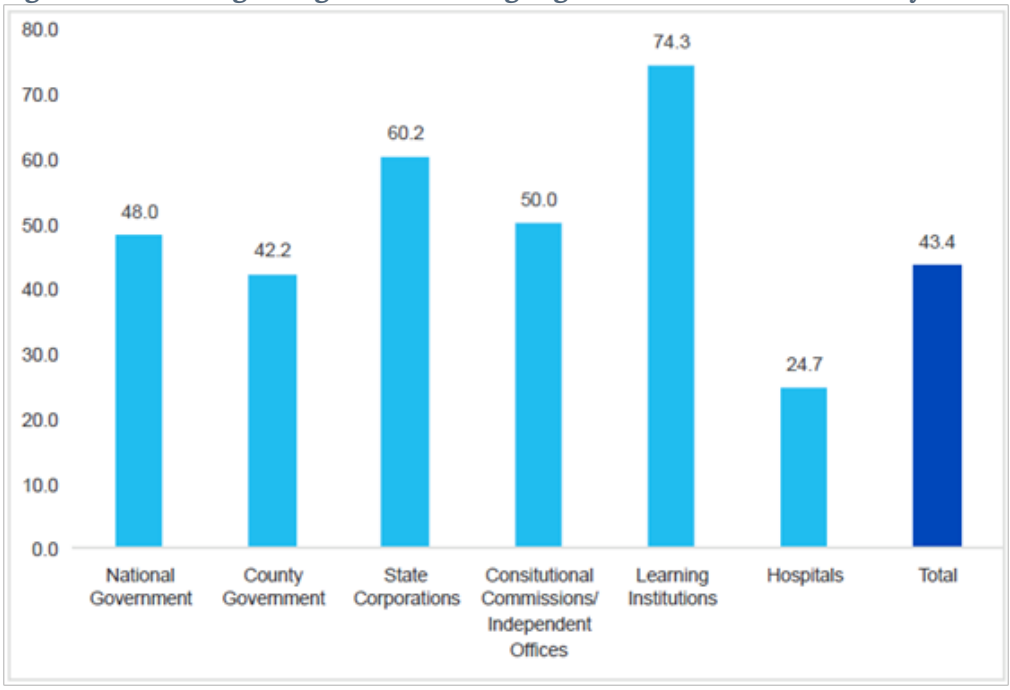
## Table 8: Tanzania e-government services for access to information and services online through a variety of systems

| | Government and Citizens (G2C) | Government and Students (G2S) | Government and Trade (G2B) | Government and Government (G2G) | Government and Ministers (G2E) |
|---|---|---|---|---|---|
| GOAL | *Empowers citizens to access information and services online through various systems* | *Enables students to access information and services through the internet through various systems* | *Enables business sectors to access information and services through the internet through various systems* | *Empowers public institutions to access information and services online through various systems* | *Empowers workers to access information and services online through various systems* |
| 1 | Corruption Complaints Dial *113# or SMS 113 | Academic Registration Information System | Agricultural Trade Information | Aid Management Platform | e-Permissions |
| 2 | Donor Funds Management | Academic Transcript | Brela Online Registration System | Enterprise Resources Management Suite (ERMS) | ERMS |
| 3 | e-Immigration | CBE Online Application System | CAS Lake Victoria | Government e-Office System | Government Lawyers Database |
| 4 | Electric Emergency Services | Electronic Document Management System | Chemicals Permits Management | Government e-Payment gateway Portal | Government of Tanzania Hospital Operations |
| 5 | Employment Portal | Health Insurance Verification | Fiscal Device Management | Government ICT Project Management | Government Real Estate Management System |
| 6 | e-Ticketing and Cargo System | IAA e-Learning | Fisheries Management System | Government Mailing System | IFM Staff Information System |
| 7 | e-Wallet Dial *152*00 # | IAA e-Library | Gaming Licensing, Inspection and Compliance Application | Government Mobile Portal | IMF Payment Portal |
| 8 | Experts Database Registration System | IFM Payment Portal | Government Mobile Portal | Government of Tanzania Hospital Operations | Salary Slip Portal |
| 9 | Ferry Tickets management System | IFM Student Information System | Importation/Exportation Inspection Management | Government Real Estate Management System | TSMS |
| 10 | Food and Agriculture Statistics | IRDP e-Library Information System | Integrated Electronic Payment System | Help Desk | |
| 11 | GePG Helpdesk | IRDP Student Information System | Port Manifest Declaration | IMF Payment Portal | |
| 12 | Government Mobile Portal | Learn Management System | Ports Cargo Management | Online Performance Management System | |
| 13 | Individual Online Tin Application | LGTI Learn Management System | Prawns Database System | Payment Information Verification | |
| 14 | Mobile Motor Insurance Sticker Validation: SMS to 15200 | Members and Examinations Management System | Special Load Permit System | Portal Citizens | |
| 15 | National Health Portal for Tanzania | NACTE Bills Request | TANCIS | Workers Compensation Self-Service | |
| 16 | NEMC Online Map Server | NBBA Payment Portal | Tanzania Extractive Industries Transparency Initiative | | |
| 17 | Net Asset Value | Online Admission System | Tanzania Imports Insurance Portal | | |
| 18 | Online Luku Vendors Locating | Online Loan Application and Management System | Tanzania Mining Cadastre Portal | | |

| | Government and Citizens (G2C) | Government and Students (G2S) | Government and Trade (G2B) | Government and Government (G2G | Government and Ministers (G2E) |
|---|---|---|---|---|---|
| 19 | Online Reporting Power Outage Service | OUT e-Library | Tanzania National e-Procurement System | | |
| 20 | Parts Payment System Portal | PSPTB Online Registration System (ORS) | Tanzania Veterinary Association Education Portal | | |
| 21 | Property Management | Secondary School Examination Registration | Tax Payment Registration | | |
| 22 | RAE E-Library | Student Information System | Tax Stamp Management | | |
| 23 | Register Artist Products | Student Information Verification | TIRA RBS System Portal | | |
| 24 | TACAIDS Online Library | SUA e-Library | Tourist Hunting Revenue Collection | | |
| 25 | Tanzania Socio Economic Database | Technical teachers Registration System | TPB Cash Collection Portal | | |
| 26 | Tanzania Tourism Portal | TIA Student Information System | TRA Online Gateway | | |
| 27 | Tenant Management | TPSC Academic Registration System | | | |
| 28 | TIRA Portal | UDSM Virtual Library | | | |
| 29 | TRA Online Gateway | Universities Information Management System (UIMS) | | | |
| 30 | Used Vehicle Valuation System | VETA Trainee Management System | | | |
| 31 | Water and Energy Licensing and Tariff | | | | |

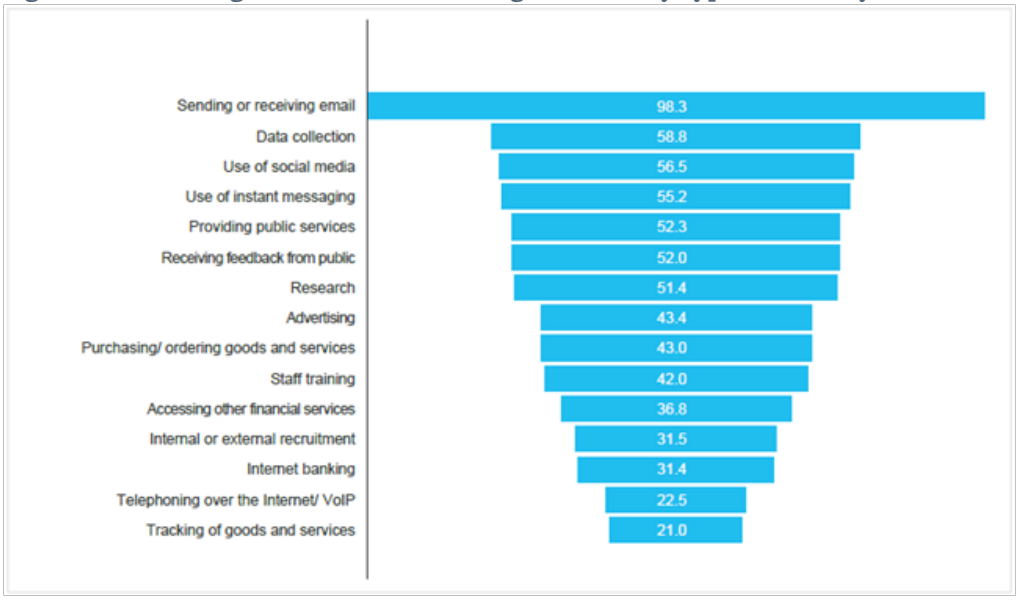
Source: https://www.ega.go.tz/ Accessed, 3 April 2021.

**Figure 6: Percentage of agencies offering e-government services in Kenya**




Source: KNBS Public Sector ICT Survey Report 2016.

**Figure 7: Percentage of institutions using internet by type of activity**




Source: KNBS Public Sector ICT Survey Report 2016.

# 5. Conclusion and policy implications

## Summary of findings and conclusions

The study examined the role of technology in addressing the challenges to normal life caused by the pandemic in the EAC, and uses the findings to draw policy implications for increasing the role of technology application to support recovery as well as facilitating sustainable economic growth and development in the region. The primary focus of the study is on the innovative ways in which technology has been used in the EAC to try to get on with life as normal during the pandemic, rather than try to delve into the broad spectrum of roles and application of technology, and/or all the myriad of issues surrounding technology development in the region. Other relevant completed research works with wider scope are referenced in this study. To understand the role of technology in these time settings, it was important to also investigate the state of play of factors that determine technology inclusion and adoption in the context of the EAC. The main findings of the study are as follows:

State of underlying factors for technology adoption and application in the EAC:

I. The fundamentals for technology adoption are rather weak in the EAC due to low average US$783 annual disposable income per capita which is comparatively lower than the LDCs' average of US$1,028. Furthermore, large segments (37%-73%) of the population live below the poverty line, living on less than US$1.90 a day. This suggests a sizeable section of EAC population cannot afford technologies – smartphones cost on average US$86 and only 34% of EAC residents can afford 1GB of mobile data per month.

II. There is an apparent low level of digital literacy – literacy for adults is 63.5% among females and 74% among males, implying that a sizeable proportion of adults would have little or no basic understanding of digital technology. Low digital literacy would also explain a large part of the EAC low internet usage (average 23% of smartphone owners). This means the majority do not have direct access to digital information and data on COVID-19 control and response measures, inter alia. They receive such information through other medium.

III. Fewer females than males participating in e-commerce – only 27% of EAC residents are banked, with limited use of more secure means (credit and debit

cards) on online transactions, though ownership of mobile money accounts (39% in 2019 before COVID-19) is growing.

IV. EAC has low availability of local and relevant content and services, in local languages, due to shortage of skilled local developers of bespoke solutions for mass communication of pandemic control information and alternative ways of carrying on with life as normal.

V. EAC Partner States have spatially limited and slow telecommunication network, with connectivity speeds ranging from 9.1Mbps to 20.6Mbps, with the average of 14.6Mbps being less than half of South Africa's 31.4Mbps.

VI. Some businesses and public institutions, e.g., in health, education, border control agencies, public and private sector workplaces, inter alia, have access to and use more sophisticated technology applications, standard and supercomputing, scanning and imaging devices, radios, drones, big-data, AI-operated, cloud-computing, audio and video-conferencing, inter alia.

**Despite the weak fundamentals, technology has been a useful enabler for addressing challenges caused by the COVID-19 crisis, and support near-normalcy.**

The COVID-19 control measures led to disruptions, restrictions, and suspension of human face-to-face or physical socializing which resulted in challenges in the provision of healthcare, education, exchange of goods and services, trade facilitation, public and private business meetings/conferences, and public services, inter alia, that hitherto relied on such human physical presence/socializing and face-to-face interactions.

VII. **Healthcare:** EAC healthcare professionals and researchers, policy makers, COVID-19 task forces, information broadcasters, community leaders, law enforcers, and a few common people have used individual or combinations of technology solutions to generate data, information and messages to control the spread of COVID-19. Technology has been used to facilitate data-intensive COVID-19 surveillance, control and management of the pandemic through generation, distribution and sharing information and data on testing and analysis of infection cases and rates, monitoring transmission and hot spots, devising and effecting methods for contact tracing and enforcement of appropriate measures (e.g., quarantine, self-isolation, advice, and support), inter alia, which would have been time-consuming and costly including in terms of loss of lives. Technology is also used in drone deliveries of medicaments, telehealth and telemedicine—though limited use—as in audio/video consultations and counselling, fact-checking and dispelling misinformation and myths (common on social media), amongst other things.

VIII. **Education:** EAC-domiciled and access to overseas/international e-learning platforms for schools and organizations have multiplied in number and content

offering modules, class notes, external learning resources, self-test exercises and assessments, online learning activities, assignment submissions and group project collaborations to the benefit of the learning community that have their schools closed due to the COVID-19 pandemic. However, e-learning is yet to be accessed by the majority of the population due to constraining technology inclusion factors.

IX. **Commerce:** EAC Partner States have witnessed increased e-commerce and related online traffic for mobile money transfers, banking and online purchases of goods and services to circumvent the challenge of closed business premises and markets, where possible and subject to residents having online access. But e-commerce is still in infancy with gaps in institutional frameworks and low participation rates among the region's residents, particularly females.

X. **Trade facilitation:** To overcome the challenge of restricted physical contact, EAC Partner States have stepped up usage of paperless and contact-free trade clearance procedures and processes involving customs and other trade regulatory agencies responsible for border security and implementing trade taxes, sanitary and phytosanitary, technical standards and other requirements using national customs management systems incorporating national electronic single window systems, application of bespoke solutions for issuance and mutual recognition of COVID-19 test certificates at border points in the EAC, reporting and resolution of non-tariff barriers against regional trade, inter alia. Issues of outstanding implementation of harmonized trade regulatory requirements and need to deepen application of technology have been brought into more light by the pandemic, and reactive technology solutions have helped somewhat but more work remains.

XI. **Digital communication technologies used:** Apps/digital platforms/information dashboards/ chatbots that use *AI*, social media (*WhatsApp, Facebook, Instagram,* others); professional meeting platforms on *Zoom, Microsoft Teams, Meet Now, Skype,* inter alia.

## Policy implications

The paper found that, despite increased technology application, there is room for technology to play an even greater role supporting social, economic and other aspects of life in general and addressing the challenges caused by the crisis at hand. To achieve this, the EAC should improve access to technology for the majority, especially among women and rural communities; support creation of an enabling environment for technology development; and expand and develop telecommunication network infrastructure, inter alia. Specifically, the EAC should:

(a) Intensify technology adoption through pursuing open, pro-growth and poverty reduction policies to support increased digital technology knowledge and skills.

In particular, the plight of women should be highlighted and given top priority (e.g., tech-buy incentives and training using existing community 'women's groups') to address societal biases on women in technology adoption and application yet they remain the fulcrum of household socioeconomic life in many parts of the region. The African Union Commission (2021) has similar sentiments and recommendation on the question of increasing participation in technology adoption and application, thus urging African countries to "ensure universal access to the digital solutions best suited to local contexts. In addition to communication and energy infrastructure, a full range of public policies are needed to achieve positive digitalization for all. This will involve reducing inequalities, especially between women and men, and between megacities and rural areas, as well as the cost of accessing data, which is often higher than in other regions of the world."

(b) Introduce ICT syllabuses, with supporting ICT equipment and infrastructure, at the earliest levels of learning through tertiary education, adult and community digital literacy education via mobile and/or resident clinics. The call for policies and initiatives to expand digital literacy and digital skills are in line with the Digital Transformation Strategy for Africa (2020-2030) objective of offering "a massive online e-skills development programme to provide basic knowledge and skills in security and privacy in digital environment to 100 million Africans per year by 2021 and 300 million per year by 2025."

(c) Introduce new and harmonized regional legal and regulatory frameworks on technology to spur research and development, market entry and competition for developers and device producing value chains, data privacy and data security to entrench consumer protection and confidence transacting using technologies (for online transactions: eliminate fraud and product quality assurance, a buyer-seller arbitration, refunds, amongst others), and intellectual property rights, inter alia. These improvements will allow optimization of innovation, scaling and wide uptake of digital solutions and ultimately catalyse increased digital-driven social-economic development. Harmonization of regional policies on technology is also echoed in the AUC's Development Dynamics 2021: Digital Transformation for Quality Jobs (AUC, 2021).

(d) The EAC should invest more in telecommunication infrastructure accessible to all communities. In the short term, and especially to support COVID-19 responses (information generation and dissemination), existing and new initiatives in this regard should be implemented fully and expeditiously. Invest in installing broadband connectivity to public institutions, including secondary schools, for greater internet speeds, improved online learning experience and research, and stimulate creativity and innovation.

(e) Invest more in technologically advanced healthcare IT systems to increase the use of health informatics technology in pandemic responses, general healthcare systems and capacities (e.g., 5G, big data) that share digital images and reports.

This will also permit greater access for patients to more healthcare specialists including from other countries (imported health services) especially for areas where there are acute skill shortages. Similar investments should be made in e-government for more cost-effective public service delivery and performance, and trade facilitation to support trade as the engine of growth.

(f) Review and upgrade public online telehealth, telemedicine, e-learning, e-commerce and other useful platforms for standardization, enhanced resource and data sharing for easier application of 'big data' and research and effective oversight, inter alia.

(g) To develop e-commerce, the EAC should fully implement the recommendations made by its recent E-Commerce Comprehensive Assessment which cover a wide range of important issues including on the regulatory environment, e.g., data security and consumer protection, intellectual property rights, and developing and harmonizing national address systems for door-to-door service, among other things.

(h) The EAC should explore improving existing mechanisms (e.g., https://www.eac.int/covid-19 and others funded by the AfDB and other donors) for gathering, harmonizing and timely disseminating COVID-19 information to inform monitoring and response in the region. All EAC Partner States should be encouraged to supply real-time data and information on the true picture of COVID-19 situation on the ground to help fight and eradicate the pandemic in the region.

# Notes

1. Daily cases reached highest count of 845,443 on 8 January 2021. Thereafter, daily cases dropped but resurged from February 2021.

2. See https://www.worldometers.info/coronavirus/ Accessed, 2 April 2021, 16:00 GMT.

3. See https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen Accessed, 20 November 2020.

4. Mention must be made that different countries, including in the EAC, differed in the level of restrictiveness of the measures; but since they are all linked in global value chains, they have all been adversely affected.

5. IoT: A system of interrelated digital machines, mechanicals, computing devices, sensors, other objects and the Internet, based on some communication protocols between the objects, to realize the intelligent management of information.

6. GNI is calculated using national accounts data converted into US$ using the World Bank Atlas method to control for short-term exchange rate fluctuations.

7. See Digital Transformation Strategy for Africa (2020-2030), at https://au.int/en/documents/20200518/digital-transformation-strategy-africa-2020-2030 Accessed, 12 October 2020.

8. The ideal situation is where data is readily available and comparisons are done on the basis of country by country, region by region, inter alia. As it has been mentioned already, this study was conducted within a very tight budget and time schedules at one of the peaks of a raging pandemic, thus, it was not practically possible to amass data (like that reported in Table 2) for other African regional economic communities let alone all 54 African countries to be able to make region-by-region comparisons. Instead, the Netherlands and South Africa were picked for they are some of the highly rated countries globally and in Africa on the relevant metrics reported by UNCTAD and the World Bank. The bigger issue is that, it is the performance or state of play of individual EAC Partner States that is the primary focus; if their metrics show less than 100% attainment in aspects of interest then that is of concern and needs improving. Comparisons with South Africa and the Netherlands are secondary.

9. See https://www.dignited.com/56084/countries-testing-5g-in-africa/ Accessed, 8 November 2020.

10. See https://www.totaltele.com/505808/Africas-first-5G-network-goes-live-in-South-Africa Accessed, 8 November 2020.

11. See https://www.safaricom.co.ke/about/media-center/publications/press-releases/release/1039 Accessed, 2 April 2021.

12. See https://www.eac.int/financial/financial-sector-development

13. See https://www.eac.int/financial/capital-markets-infrastructure

14. See https://www.eac.int/press-releases/146-gender,-community-development-civil-society/1158-50-million-african-women-project-to-help-reduce-to-zero-gender-inequalities

15. See https://www.eac.int/health/medicines-and-food-safety-unit#:~:text=The%20EAC%20Medicines%20Registration%20Harmonisation%20(MRH)%20Project&text=Increased%20technical%20capacity%20and%20efficient,quality%20and%20affordable%20medicines%3B%20and

16. The EAC (2020a) survey conducted a total of 36 interviews and 290 surveys across all the six EAC Partner States and across all the e-commerce ecosystem stakeholders.

17. See https://coronavirus.jhu.edu/region/kenya Accessed, 16 December 2020.

18. "Big data" is defined as "extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions". See https://languages.oup.com/google-dictionary-en/ Accessed, 7 November 2020.

19. The Oxford Languages dictionary defines *AI* as "the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages". See https://languages.oup.com/google-dictionary-en/ Accessed, 7 November 2020.

20. The paper or depiction does not suggest full capacity and/or efficiency in all EAC healthcare systems.

21. The COVID-19 virus being primarily transmitted human-to-human through respiratory droplets and contact routes (touching a contaminated surface and then touching your eyes, nose or mouth before washing your hands) means that people who come in close contact (within six feet) with an infected patient over a cumulative period of 15 minutes or longer need to be identified and traced so they can isolate.

22. See https://www.standardmedia.co.ke/health-science/article/2001365263/app-uses-passenger-data-to-trace-virus-path

23. See https://enovarobotics.eu/

24. https://www.france24.com/en/20200519-we-can-get-it-done-here-african-tech-tackles-coronavirus-locally

25. *A digital platform* can be thought of as the sum total of online medium for exchange of information, goods, or services between producers and consumers as well as the community that interacts with said platform. Digital platforms take different forms depending on their specific purposes. Examples of digital platforms by function include: Social media platforms, e.g., *WhatsApp, Facebook, Twitter, Instagram, and LinkedIn;* Knowledge platforms, e.g., *Wikipedia, Google, etc*.; Media sharing platforms, e.g., *YouTube, Spotify;* and Service-oriented platforms, e.g., *Jumia, GumTree,* inter alia.

26. A "chatbot" is a computer program/software application (applying artificial intelligence) used to conduct an online chat conversation via text or text-to-speech, instead of providing direct contact with a live human agent. Chatbots are used widely by banks, insurers, media companies, e-commerce companies, airlines, hotel chains, retailers, healthcare providers, government entities and restaurant chains to answer simple questions, increase customer engagement, for promotion, inter alia. https://en.wikipedia.org/wiki/Chatbot

27. A "hackathon" is a competitive event in which people work in groups on software or hardware projects, with the goal of creating a functioning product by the end of the event. See https://www.dictionary.com/browse/hackathon Accessed, 8 November 2020.

28. See https://www.eac.int/health/disease-prevention/east-african-integrated-disease-surveillance-network Accessed, 2 November 2020.

29. See https://elearning.reb.rw/ Accessed, 5 November 2020.

30. The Rwanda Education Board E-learning platform is used as a representative of e-learning initiatives that have sprung up in the EAC to address the challenge of school closures due to the COVID-19 pandemic. For lack of space, the paper does not make an evaluation of the pros and cons, successes or weaknesses of the REB e-learning platform, nor does it cover similar initiatives that have sprung up in all other EAC Partner States, which would of course require comprehensive surveys that stand beyond the scope of this limited study.

31. "Moodle is a free and open-source learning management system (LMS), developed on pedagogical principles. It is used for blended learning, distance education, flipped classroom and other e-learning projects in schools, universities, workplaces, and other sectors." Wikipedia: https://en.wikipedia.org/wiki/Moodle Accessed, 5 November 2020.

32. See https://en.unesco.org/news/teachers-trained-distance-teaching-through-radio-south-sudan Accessed, 10 November 2020.

33. See https://elearning.reb.rw/ Accessed, 10 November 2020.

34. The methodology for measuring the Index is found in: UNCTAD (2017). *UNCTAD B2C E-commerce Index 2017.* UNCTAD Technical Notes on ICT for Development No. 9.

35. See https://www.statista.com/outlook/243/183/ecommerce/burundi

36. See https://www.statista.com/outlook/243/305/ecommerce/rwanda

37. https://datareportal.com/reports/digital-2020-tanzania Accessed, 7 November 2020.

38. https://www.statista.com/outlook/243/344/ecommerce/tanzania Accessed, 7 November 2020.

39. https://www.statista.com/outlook/243/337/ecommerce/uganda Accessed, 7 November 2020.

40. https://www.gsma.com/sotir/wp-content/uploads/2020/03/GSMA-State-of-the-Industry-Report-on-Mobile-Money-2019-Full-Report.pdf Accessed, 7 November 2020.

41. Kenya has provided more data (to Hootsuite & We Are Social, among other data repositories) than the other EAC Partner States. This allows a better understanding of the state of e-commerce in the country.

42. https://www.statista.com/outlook/243/247/ecommerce/kenya Accessed, 9 October 2020.

43. Single window system is designed as a facility that allows parties involved in trade and transport to lodge standardized information and documents with a single-entry point to fulfil all import, export, and transit-related regulatory requirements. If information is electronic, then individual data elements should only be submitted once.

44. See https://www.ega.go.tz/ Accessed, 3 April 2021.

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# Mission

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Middle East Bank Towers,
3rd Floor, Jakaya Kikwete Road
Nairobi 00200, Kenya
Tel: +254 (0) 20 273 4150
communications@aercafrica.org