DIGITAL TECHNOLOGY AND ITS RELEVANCE TO POLITICAL AND SOCIAL ECONOMIC TRANSFORMATION. CASE STUDY OF EAST AFRICAN COMMUNITY REGION

Rwigema, P. C.

The Strategic JOURNAL of Business & Change MANAGEMENT
ISSN: 2312-9492 www.strategicjournals.com
Vol. 7, Iss. 4, pp 1402 – 1436 November 26, 2020. www.strategicjournals.com, ©Strategic Journals

DIGITAL TECHNOLOGY AND ITS RELEVANCE TO POLITICAL AND SOCIAL ECONOMIC TRANSFORMATION. CASE STUDY OF EAST AFRICAN COMMUNITY REGION

Rwigema, P. C.

Ph.D, Member of Parliament, East Africa Legislative Assembly [EALA], Rwanda

Accepted: November 25, 2020

ABSTRACT

Digital revolution has taken place from the latter half of the 20th century, marking the beginning of the information age through political and social economic transformation. The ongoing digital transformation holds the promise of improving productivity performance by enabling innovation and reducing the costs of a range of business processes. But at the same time our economies have experienced a slowdown in productivity growth, sparking a lively debate about the potential for digital technologies to boost productivity. The digital transformation is having a wide-ranging impact on the business environment, creating both opportunities and challenges. Inter-related trends such as e-commerce, big data, machine learning and artificial intelligence (AI), and the Internet of Things (IoT) could lead to large productivity gains for the economy. However, disruption to existing business and social models, as well as established markets, will disrupt the lives of millions of citizens. The purpose of this paper was to assess the influence of digital technology and its relevance to political and social economic transformation in East African Community Region. The Cobb-Douglas production function is often used to analyse the supply-side performance and measurement of a country's productive potential. This functional form, however, includes the assumption of a constant share of labor in output, which may be too restrictive for a converging country. For example, labor share in the East African countries gradually increased over the last decade. In this paper, we tested whether this fact renders the application of the Cobb-Douglas production function unreliable for the East Africa economy. The study applied a more general form of production function and allow labor share to develop according to the empirical data. For the period 2000–2019, the study found out that their significant difference between the digitization and adoption of ICT in East Africa Region. The results of the study showed that some firms, especially those who had embraced new technological methods of management had adopted new information technology and had established connection in all the EAC member-states. Although some countries like Burundi and Southern Sudan had not developed fully their technological infrastructure, we found out that some firms and individual businessmen within those countries had invested on appropriate information technology and were ready to use it. The results of this study showed that the application of the latest technology to promote intercountry trade had increased the volume of trade between member states

Keywords: *Digital revolution, Political and social economic transformation, East African Community Region*

CITATION: Rwigema, P. C. (2020). Digital technology and its relevance to political and social economic transformation. Case study of East African Community Region. *The Strategic Journal of Business & Change Management,* 7 (4), 1402 – 1436.

INTRODUCTION

In the 21st century Information and Communication Technology (ICT) has been a vehicle with great potential to improve or accelerate the developmental process of any developing nation (Mahaldar & Bhadra, 2015). Basically, Information and Communication Technology has become a vital sector in the global economy, as ICT supports activities in a wide number of sectors, including Internet and Communication Networks, manufacturing, trade and commerce, finance, health, education etc (Fossen & Sorgner, 2018).

The access to internet, increase of people using mobile phones, social media and other ICT services changed the way people interact, communicate, learn and work in almost every country (Laura Schelenz 2018). For digital age, it is sectoral platforms that re-organise entire economic activities in any sector based on digital intelligence arising from data. E-commerce is a very superficial way to designate this phenomenon. Digital economy is defined by digital intelligence services, especially as they manifest in the operation of sector-wide platforms (Arntz *et al.* 2019)

African countries have the potential to benefit from digitalization in various development domains (Freddi, 2018). For such development, it is required for the African states (as well as for the rest of the world) to take measures for a digital future (Banga & Velde 2018), to facilitate a digital enabling environment, (Velde 2018) and to enhance learning, discussion and exchange platforms about the opportunities, engagement and challenges of digitalization in Africa. These platforms can give a strong basis for any action and initiatives in digitalization (Laura Schelenz 2018). At the same time, a mutual shared understanding on the meaning of digitalization is not self-evident. According to (Parviainen, et al. 2017), "the term digitization refers to "the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form." It can be considered in a common sense that digitalization means the integration of digital technologies into everyday life at processes, organizational, business and other society domains. Often the specific role of digitalization on business models is emphasized. Then digitalization focuses on the adoption and the use of digital technology by the key market players and other key players including distributors, producers, consumers, film practitioners, associations, policymakers and politicians (Park & Choi, 2019). This paper seeks to give a general overview on the challenges and opportunities of digitalization in the African context and it will focus on several societal aspects such as labor, agriculture, education, media, gender, etc. Although none of these topics will be dealt in details, but the paper can give a broader overview of the possible wide-ranging effects of digitalization in East Africa region. Finally, the case of Rwanda will be highlighted in order to give some current insights of concrete digital development.

Digitalization as an opportunity for the African Labour Market

Digitalization and digital business can have several impacts on the African labor market. Digitalization processes often promote more efficiency, since they replace workers or employees from forms of routine of human workforce to automated processes, (Moavenzadeh 2015); (Vries 2008).

Though digitalization in goods and services production seems to reduce jobs when it comes to human capital, the emerging African market is relying on export, thus e-commerce increases employment opportunities with the creation of new services and new jobs (Master Card 2019) (Blix 2015); (Ibrahim, et al. 2019). Furthermore, employees could shift from their work to a more creative, cognitive work. By the use of digital communication platforms and intranet, some jobs are not bound to a certain location anymore. This can enable employees to work from their homes, to travel less for work and to combine different jobs and such incentives proved to improve efficiency and productivity (Ibrahim, et al. 2019).

However, negative impact on labor market has been also highlighted; for example, the difference

between decrease in return to labor and increase in return to capital investment (Ibrahim, *et al.* 2019). Some employment sectors are more at risk to experience job losses than others. Simple (manual) labor, which can be replaced by computers, robots, and other digital technologies are more in danger than jobs that rely on creativity, knowledge and human interaction (Katz, 2017).

The mentioned improvement by digitalization can only occur, when governments are willing to invest in digital infrastructure such as broadband internet and ICTs (Ibrahim, et al. 2019). In Africa, this poses a challenge, as many countries still cannot provide stable internet access to its citizens. While Western and Eastern Africa only have an internet penetration of 39% and 27%, in Southern and Northern Africa 49% and 59% of the population have regular access to internet. Africa also presents the highest growth rates of Internet users with 20% more users compared to 2017, (Perci & Kojo 2013), hence, digitalization can be considered for Africa, as an opportunity to participate in the global digital economy (Prakash 2019).

On one hand, a digitalized economy is the rise of robotization and artificial intelligence in production that has the potential to increase productivity and, in some ways, replace human workforce and affects employment in different services in the economy. On the other hand, new sectors like e-commerce and other digital business models emerged as new digital economic platforms to perform as matchmakers between demand and supply on the market and therefore new market opportunities (Banga and Velde 2018). Research acknowledged that changes brought by new technology and digitalization brought about new innovations in production, manufacturing and service. Not only is digitalization affecting the labor force and accessibility to jobs but in some cases, robots also replace brains. From consumers, producers and workers perspectives, it implies a wide range of novelties. This requires countries and Trade Unions in Africa to find new adaptation strategies, new education systems and digital skills development that integrate new changes in the economic development (Christian Bührer 2017).

How does 'the digital' make a political and social difference, and how do we make sense of this difference? We have been surrounded by claims and controversies about the effects of information and communication technology since the 1970s, when the advent of micro-electronics gave factual traction to the notion that an 'information society' was in the making (Fuchs, 2013; Webster, 2014). The focal point of these claims and controversies has evolved over time, from 'the information society' in the 1970s and the 1980s to 'the network society' in the 1990s (Castells, 1996; van Dijk, 2006) to the revolutionary potential of 'Big Data' today (Mayer-Scho¨nberger and Cukier, 2013), whereby the 'world is being turned into digital data and thus transformable via digital manipulation' (Packer, 2013: 297). These claims highlight different matters of concern with regard to the growing availability and use of digital devices, from the organization and division of labour to the texture of inter-personal relations, or the functioning of political communities. Diverse as they may be, however, these claims display two shared characteristics. First, these claims assign agential power to 'the digital', effectively arguing that it is fostering epochal political and social change (Ruppert et al., 2013: 26). This is the problem of singularity. Second, this agential power is deemed to be exercised in a relation of exteriority to politics and society, as an external or autonomous driver for transformations in existing political and social orderings.

Digitization in East African Region

East Africa region is cognizant that the sustainable development of ICT and digital capacity is key to build the region economy, with increased competitiveness. However, for the EAC region to move towards a Digital Community, it must be enabled by investments in research and investment in innovative ICT and digital technologies. The EAC committed to invest in ICTs to ensure that the region transforms from an agriculture-led economy

to a service and industry led economy. In fact, the region observed how Information and Communication Technology has spurred product innovation in the financial sector, with the M-Pesa and Mobile Money system, increasing financial inclusion, efficient and fast financial transactions. The development of ICT infrastructure and capacity was therefore identified as a regional priority for sustained economic growth of the EAC Partner States as per the EAC Vision 2050 and the 5th EAC Development Strategy (EAC Facts and Figures 2014).

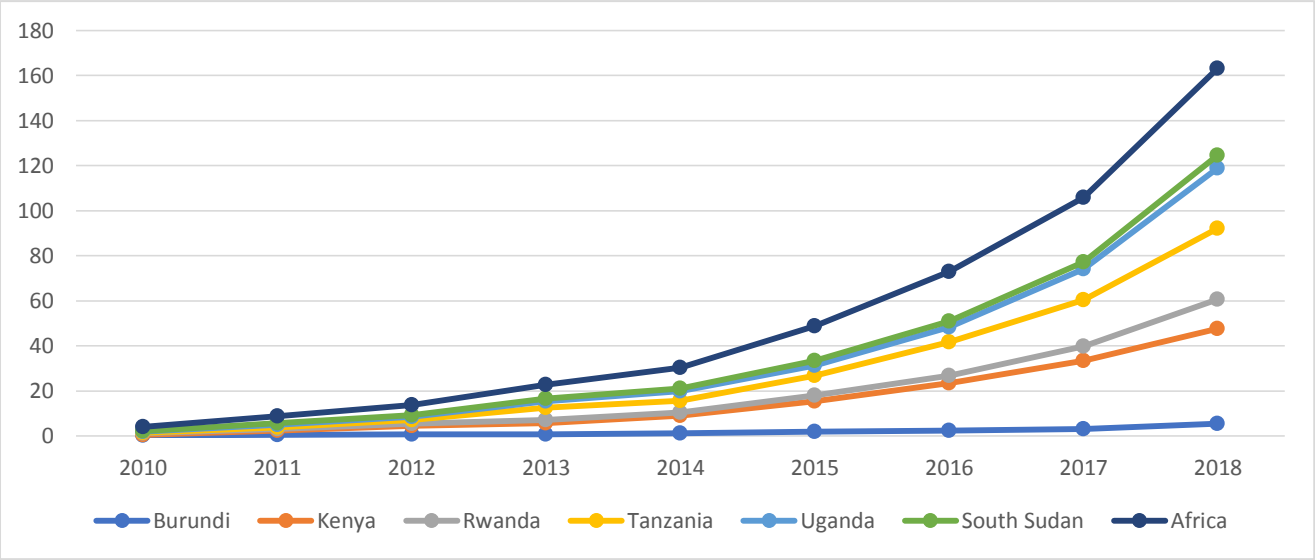

Figure 1: Mobile phone penetration in EAC Countries, 2010-2018
Source: ITU, ICT indicators, 2019

Mobile phone penetration is steadily increasing in all Partner States, with current penetration rates ranging between 50 percent and 75 percent across the Partner States. Recent deployments of both backbone and last-mile broadband networks have remarkably improved ICT penetration in the EAC. In each Partner State, at least, one backbone broadband network with a country-wide reach has been implemented and recent deployments of cross-border broadband links and submarine networks have strengthened international broadband connectivity.

The performance of the supply side of an economy is often identified with the growth rate of potential output. Potential output is not observed in reality, however, and has to be approximated. The use of the production function method for the measurement of potential output growth takes into account different sources of an economy's productive capacity, namely the contributions of labour, capital and total factor productivity, the latter containing information about technological and allocative efficiency and hence about the supply-side functioning (Gigineishvili, Mauro & Wang, 2014).

In 2013, the AU (African Union) founded the SMART Africa initiative, which aims to achieve socio-economic development through ICT's (Information and Communications Technology). It involves the strengthening of broadband connections and the implementation of e-government features (Bridges *et al.* 2013). These include electronic services for citizens, electronic IDs, unified communication and a cloud-based infrastructure through a digital government platform. The member states also commit to promote and fund e-applications, e-education, e-health, e-tourism, e-agriculture and e-commerce. The goal is to harmonize policies and frameworks, to generate more demand for goods and expand markets, to attract large-scale investments and to create new industries and jobs (Stiglitz, 2013).

Considering of economic development, the newly created African Continental Free Trade Area

(AfCFTA) also commits to widen its free-trade approach to the digital sphere by pursuing data flow across national boundaries. Digitalization has transformed Africa also in the use and access to the financial services, retail payment like mobile money transfers and based payment and digital transport has been increased in recent years as well (Finger, 2007). It is also important to acknowledge the impact of digitalization on development of sustainable business model and revenue administration. However, adoption of effective policy can facilitate digital associated investment and promote tax incentives to encourage innovation (Njuguna, 2018).

With an aim to achieve the regional objectives in Science, Technology and Innovation, including ICT, the EAC established the East African Science and Technology Commission (EASTECO) in June 2007 whose mandate is to promote and coordinate the development, management and application of Science, Technology and Innovation for socio-economic development. As per the protocol establishing the Commission, EASTECO has among other objectives the development, adoption and utilization of information and communication technology, as well as the adoption of new and emerging technologies. In this regard, the EASTECO Strategic Plan 2017-2022 is targeting to enhance regional capacity in ICT for efficient productive and social sectors through the i) support for innovations in and using ICT at a regional level; and ii) use of ICT as a tool for driving economic growth.

In 2017 the Rwandan Government rolled out a new system of teaching in collaboration with a well-known software US-American enterprise. In general, the aspects range from helping students access computers and basic software installed in them, digitize subject content delivered in schools, and help students get access to internet in their schools. In the long term it is aimed to implement smart classrooms in every school in the country. It is planned under the partnership that by the year 2020 all schools in the country will have two smart classrooms and all subjects will have been digitized. Another example is the "One Laptop per Child" (OLPC) project in Rwanda (Ayodeji et al. 2013)

Rwanda not just aims to improve its own digital economy but also to share a pan-African platform for exchange and digital prosperity. In the past years, Rwanda hosted several hundred of ICT stakeholders at summits. Throughout these exchanges various challenges became transparent.

The government of Rwanda has adopted Irembo is one example of the substantial public investment in digital infrastructure and digital service delivery highlighted in the Rwanda Economic Update (REU15) Accelerating Digital Transformation in Rwanda. The investments, as well as enabling regulatory reforms, has helped Rwanda achieve some of the highest 3G and 4G network coverage rates on the continent, bringing virtually all Rwandans within range of mobile broadband. By 2019, mobile internet subscribers numbered 7million – 58.3 for every 100 people. It has also facilitated digitalization of other services, among them financial (mobile money, mobile banking services), agriculture (e-Soko), health (Mobile e-Health), and administrative services (Irembo).

First, many firms and entrepreneurs still face the problem to raise capital for their business purposes. Many investors dare the risks that come alongside and need to get convinced by minimizing the potential risks by advanced business strategies. Secondly, growth of digital business within just one country is limited. A relatively small market like Rwanda, needs to expand its digital businesses to other markets in the long term. This includes building fruitful partnerships in other states (especially neighbour countries) that is also made in a diplomatic way. Fourthly, it is crucial to develop skills and talent among the population. Rwanda already puts efforts to educate its youth regarding future challenges and digitalization. Finally, it is required to establish an overall awareness and sensitization among the people. For instance, when it comes to cashless economies, they are advancing rather slowly in Rwanda. Rwanda's Vision 2020 seeks to transform the economy from a cash-based

economy to a digital-driven economy, among other targets (Ministry of Finance and Economic Planning, 2014). To achieve this, the government and central bank have been at the forefront of promoting technology among financial sector players and the business community over the past few years. In this context, different actors such as banks and other companies made lots of efforts (UNIDO & UNCTAD, 2011).

Through the EAC Vision 2050, the region committed to prioritize reducing the digital divide among Partner States and to focus on regional ICT investment programs that target

- The consolidation of connectivity between regional and national backbones and leveraging private investment;
- The integration of ICT in the delivery of public services and in sector projects;
- Leveraging ICT innovation applications for transformation of public services and economic competitiveness;
- Knowledge management and sharing

On-going ICT projects in East Africa community states

The ongoing projects for ICT development incudes:

- East African Community Broadband ICT Infrastructure Network

The aim of this project was to establish and operate a cross-border broadband infrastructure network within the EAC.

- EAC Legal Framework for Cyber Laws

A legal framework for cyber laws provides guidelines on the enactment and enforcement of laws that promote the deployment of e-government and e-commerce services.

- Analogue-to-Digital Broadcast Migration (ADBM)

From 2015, most countries in the world will have switched their terrestrial broadcast systems from analog technologies to digital technologies. Digital terrestrial broadcasting offers several advantages over analogue broadcasting. Besides providing more broadcast channels, digital broadcasting offers more services than can be provided by analog technologies.

ADBM requires government interventions on several areas including policy and regulatory regime, technology standardisation, spectrum plans and business and consumer preparations. To that effect, the EAC Secretariat is working with the International Telecommunications Union and the European Union to support a programme for harmonising ADBM among EAC Partner States.

Literature Review

African Trade Unions in a Digitalized Labor Market

For trade unions, the digitalization of the labor market entails a variety of challenges. Artificial intelligence and robotization cannot only cause the replacement of workers by machines, but they can also change their roles as part of the production process. The role of trade unions would be to support and facilitate digital networks and industrial cooperation through social dialogues. Trade Unions can develop education programs that include research and policy brief to inform policy makers and influence policy change or adoption of new ones. Trade unions should ensure that, the transition to digitalization should be fair with attention to social justice and economic inclusiveness and increase of new job for workers.

Environmental protection and efficient use of resources should not be forgotten by encouraging entrepreneurship in recycling, land restoration and reduction of CO2 emission, (Trade Union Advisory Committee for Organization, 2017); (Degryse 2016, Degryse 2016). In the development of the 21 century, trade unions bear the responsibility to fight for sustainable industrial policies, education and social programs that empower and allow workers to embrace and benefit from the new era of digitalization, rather than bearing its costs (Degryse 2016).

New applications such as Uber don't require high level skills, it is simple and affordable by many people. This example has proved that trades unions should look into simple and appropriate ways to allow and engage workers in e-commerce and

digital economy (Degryse 2016); (Ibrahim, et al. 2019). According to (Blix 2015) "Improvement in technology led to higher demands on labor, which in turn improved output and generated real wage growth" and added that in the past, there was a key role of trade unions in balancing power between factory owners and workers.

Situation analysis of ICT Developments in the EAC Region

Access to and usage of ICTs is essential for the socio-economic development of the Community. Despite challenges in formulating and collecting relevant ICT statistical indicators, there are indications that there have been steady and impressive developments in ICT infrastructure and services in the EAC Partner States. The main ICT indicators currently available on a regular basis are related to fixed voice and mobile subscriptions; access to and utilization of backbone carrier networks; access to radio and television broadcast services; access to and use of internet services; and tariffs on communications services. With the exception of fixed voice telephony and postal mail services, both of which are declining, all other available access indicators point to sustained growth in the sector across the EAC region. Mobile phone penetration is steadily increasing in all Partner States, with current penetration rates ranging between 50 percent and 75 percent across the Partner States. Recent deployments of both backbone and last-mile broadband networks have remarkably improved ICT penetration in the EAC. In each Partner State, at least, one backbone broadband network with a country-wide reach has been implemented and recent deployments of cross-border broadband links and submarine networks have strengthened international broadband connectivity. Also noteworthy is that in line with the Geneva 2006 Agreement on Digital Broadcast Migration, migration to digital television broadcast services has been achieved to varying degrees in the Partner States (World Trade Report 2010). Furthermore, in tandem with developments in ICT infrastructure, great strides have also been made with respect to the development and deployment of ICT applications and services. Partner States continue to develop and roll out e-government services and the rapid adoption of electronic payment services, especially mobile money, have spurred access and use of internet services. The foregoing developments within the ICT sector have also been accompanied by an overall trend of falling prices and higher quality services.

In a few short years, the proliferation of mobile phone networks has transformed communications in sub-Saharan Africa. It has also allowed Africans to skip the landline stage of development and jump right to the digital age.

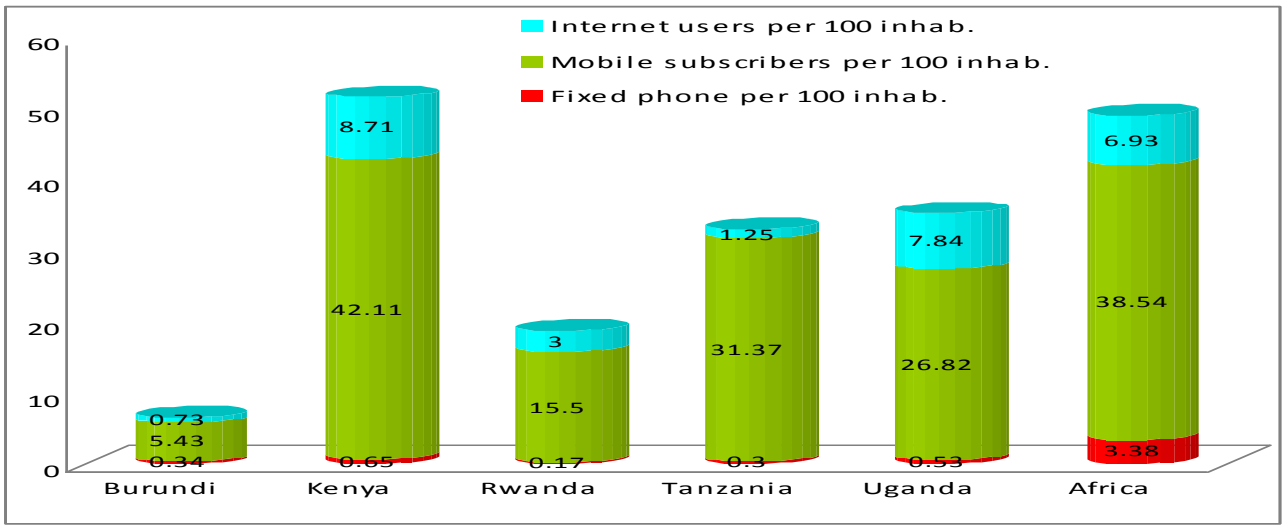

Figure 2: ICT Penetration in the EAC Countries

Source: ITU, ICT indicators, 2019

Cell phones have different uses for different people, but sending text messages and taking pictures or video are the most popular activities among mobile owners. In a few nations, such as Kenya, Rwanda, Uganda and Tanzania, mobile banking is also relatively common. Other activities, such as getting political news, accessing a social networking site, getting health and consumer information and looking for a job are done less frequently.

On broadband growth, Rwanda, Uganda and Kenya were first countries in East Africa set to roll out a high-speed Fourth Generation (4G) broadband network that delivers download speed of up to 100 Megabytes per second. Internet usage in Uganda stands at 17 per cent, Rwanda at 8.3 per cent, Kenya (41.1 per cent), Tanzania 13 per cent and Burundi (2 per cent).

Uganda

There are a number of e-government initiatives in EAC region that have been implemented. In Uganda a National Electronic Government (e-Government) framework was developed in 2010. The framework was developed to guide the Uganda Government on efficient use of ICT in public administration in order to improve public service delivery and democratic processes, enhance the attainment of the Sustainable Development Goals (SDGs) and other international obligations. The framework highlights the goal of the national e-Government programme and spells out its core pillars, critical success factors and an implementation roadmap which will be adopted to achieve it (Fabunmi, Paris & Fabunmi, 2006).

Currently, there are a number of e-Government applications and investments already or being implemented and these include introduction of Blackberry communications services in 2007 by the Ministry of ICT which have made access to information through e- mail easy and quicker (Koutroumpis, 2009). All district local governments in the country have websites developed under the Rural Communication Development Program (RCDP). Government of Uganda web portal to act as a gateway to government services with linkages to the business sector has been developed, establishment of pilot District Business Information Centres in six districts, set up by the Ministry of ICT in collaboration with UNIDO, National Data Centre to facilitate government wide data storage, usage, sharing and security has been built (Meagher, 2016).

A number of Uganda Government institutions have taken on computerization projects such as Integrated Financial Management System (IFMS) by Ministry of Finance Planning and Economic Development (MoFPED), Integrated Resource Management System by Ministry of Defense, Local Governments Information Communication System (LoGICS) by Ministry of Local Government, Uganda Revenue Authority Countrywide Network (URANET) and Electronic Tax (e-Tax) by Uganda Revenue Authority, Electronic Funds Transfer System, Bank of Uganda/MoFPED, Salary and Wage Processing System by MOFPED, Community Information System (CIS) by National Planning Authority and Uganda Bureau of Statistics, Integrated Personnel Payroll System (IPPS) by Ministry of Public Service, Court Case Management System by the Judiciary, Land Information Management System by Ministry of Lands Housing and Urban Development, e-Government Intercom (central government VOIP phones & Video Conferencing facilities) by Ministry of ICT, Health Management Information System (HMIS), Education Management Information System (EMIS) and Rural Information System to provide market information to farmers and other agriculture value chain stakeholders (Ministry of Trade, Tourism and Industry). (Government of Uganda, 2012).

In terms of Legal and Regulatory Framework, the Ministry of ICT in collaboration with the Uganda Law Reform Commission and Ministry of Justice and Constitutional Affairs have developed and drafted ICT related laws (Cyber Laws) i.e. the Electronic Transactions Bill, the Digital Signatures Bill and the Computer Misuse Bill. Other regulatory issues addressed in these laws include; Intellectual Property for software development, privacy and

Integrity laws, policy issues for usage of Internet resources, regulation and standards of Computer hardware equipment and accessories, capacity building and software standards. In addition to the above laws, the following other ICT sector policies, laws do exist; National ICT Policy Framework (2003), Communications Act, 1998, Draft Postal Policy, July 2008, Revised Telecommunications Policy, 2006 and National Information Technology Policy, 2009 (Government of Uganda, 2012).

Kenya

Kenya has put in place strategies that include a fully functional Institutional Framework for e-Government. The implementation actions were operationalized in three phases, namely short term, medium term and long term. This was done to ensure systematic implementation of e-Government that could easily be evaluated using the target set, the achievements and the variance (Ndung'u, 2017a). The Government is undertaking to accomplish the Instituting Structure and Operational Reforms through training and awareness creation to reform and change approach to communication. The Government further aims at accomplishing regulatory and legal framework by reviewing, enacting and enforcing laws related to electronic communication and develop secure and reliable Infrastructure (Ndung'u, 2017b). The Kenyan Government has adopted different modes of reaching different classes of its citizens and other stakeholders on e-Government process. The Kenyan Government approved E-Government strategy in 2004, making the start of e-government journey. In 2006, National ICT policy was approved under the Ministry of Information and Communications (MoICT). The government has since initiated several e-government systems with the aim of enhancing efficiency, transparency and democracy within public administration. Some examples are e-Registry for business registration, passport application and processing system, and G-pay.

The Kenyan Government has also taken and implemented the following initiatives such as the Integrated Financial Management Information System (IFMIS) and Integrated Personnel and Payroll Database (IPPD) which are fully operational in the ministries. Other applications that have been rolled out include the Local Authorities Integrated Financial Operations Management Systems (LAIFOMS), Education Management Information System (EMIS), Integrated Taxation Management Systems (ITMS) currently known as ITAX after making great improvement in design, online Recruitment and Selection System in the public service commission, the Border control System in the Ministry of state for Immigration and Registration of persons, Personnel and Payroll System (IPPS), e-tax, Land Information Analysis (LIS), Education Management Information System (EMIS) and Community Information System (CIS) (Capital Markets Authority, 2017).

The other initiatives include: starting enactment and strategies to build up proper e-government institutional structure; enactment of the Communications Commission of Kenya (CCK) Act in 1998; enactment of the Kenya e-government Strategy in 2004; and the formation of the Ministry of ICT and the ICT Board to give the institutional framework aimed at changing government operations by the use of e-government to enhance performance by guaranteeing efficient and timely conveyance of government services (Republic of Kenya, 2009). The Directorate of e-government has established the Government Data Center (GDC) for storing and processing of government applications and data. The center is connected to the Government Common Core Network (GCCN) that networks all government ministries through enterprise architecture that combines data warehousing, re-engineering processes and virtualized technologies.

The government has recognized e-government as key driver to the provision of effective and accessible services to citizens, business organizations and public agencies. The Kenya Vision 2030 recognizes ICT as a key pillar to development and success. E-government spares citizens travel time to government institutions and permits round-

the-clock access to various services. Commendable efforts have been made on e-applications, capacity building and infrastructural growth.

The foundation for e-government legal framework today is premised in the constitution of Kenya (2010), which has rebuilt the nation's political and managerial structure by devolving a great deal of power to the new county government entities, and which sets out some core principles of administration. Kenya Government is aware that ICT infrastructure is a pre-requisite to e-government. The Kenya public sector has begun a connectivity and e-service provision scheme through a Secure Government Network (SGN) that gives connection, web and email services to government departments.

United Republic of Tanzania

The introduction of e-government in Tanzania, more emphasis has positioned on in what way to support, transform outside effort, develop communication and transaction devices to address external stakeholders by concentrating on applying ICT to all aspects of government business.

With the vision to offer superior services to the citizens and business communities and recognition of the significance of ICT in the public sector, the Government of Tanzania has therefore, prepared the National e-Government Strategy 2013-2018 to deliver the essential guidance on exploiting the ICT opportunities and addressing challenges to add value in public sector services President‘s Office – Public Service Management (2013). In that regard, the key government strategy paper National Vision 2025 noted that —ICT opportunities can be harnessed to meet national development goal.

Meanwhile the medium-term National Strategy for Growth and Reduction of Poverty (MKUKUTA), the Tanzania‘s Mini Tiger Plan, and the Tanzania long Term Perspective Plan 2011/12-2025/26 is also emphasizing the essential to increase the application and usage of technology in accelerating productivity. Furthermore, in recognition of the need to reduce the possibility of Tanzania being further excluded from the global knowledge-based society, as well as the need to harmonize independent ICT-related initiatives, the Government promulgated the National ICT Policy in the 2003 President‘s Office–Public Service Management (2013). Moreover, more efforts the government of Tanzania has taken in recognizing the importance of ICT resulting the revision of the NICTP 2003 in 2016. The National ICT Policy 2016 aim to transform Tanzania into an information rich knowledge-based society and economy, so that to ensure Tanzania and its people fully contribute in the information age and enjoy the social, cultural and economic benefits of the emerging information revolution (NICTP 2016).

Further, ability to identifying potential achievements from e-government is one thing; actually, realizing them is another. In realizing and identifying that the government Tanzania conduct a situational analysis for e-Government readiness by examine the government itself in relation to the following issues: Institutional e-Government services arrangements; human resources; budgetary resources; communication flows between ministries, departments, and agencies (MDAs); ICT infrastructure; ICT capacity levels; ICT related policies; and Public Private Partnerships.

Moreover, for the national development the Government of Tanzania has allowed the Ministries to be liable for developing e-government policy and facilitate its implementation in Government Institutions NICTP (2016). Several policies, statutes, and other initiatives have been undertaken toward this goal).

As a result, the government has succeeded deployment of e-government-wide systems that permits the government to become more efficiently, effectively and reliably achievement of key business processes; these systems include the National Payment System (NPS) which comprises of the Tanzania Interbank Settlement System (TISS), Electronic Clearing House (ECH), Retail Payment System (RPS) (NICTP 2016; MWTC ICT Policy 2016; National e-Government Strategy 2013).

Integrated Financial Management System (IFMS), Human Capital Management Information

System (HCMIS), Land Management System (LMS), Health Information System (eHealth) and Geographical Information System (GIS).

The Government of Tanzania implemented and still planning the following e-Government / ICT Projects; Government Mailing System (GMS), Water Utilities Information System (MajIS, Water Point Mapping System (WPMS), Health Information System (eHealth), Integrated Financial Management System (IFMS), Integrated Land Management System (ILMS),

The implementation of the e-Government in United Republic of Tanzania has got the following challenges; ICT investment remains an ad-hoc affair, with each individual Ministry seeking ICT funding primarily from defined donor project resources to offset the minimal funding available through the governmental budgetary channels; Underutilized of a majority of the implemented systems owing to a series of factors, including a lack of operator training, lack of connectivity, and absence of automated processes; no series of commonly accepted standards is in place, or even informally agreed upon, for equipment, applications, or connectivity, for the current initiatives; A lack of synchronized ICT investment strategy and tracking of ICT investments and performance monitoring within the Government and the key challenge is the lack of awareness of the opportunities, innovative design and implementation and potential impact of introducing an E-government systems in the public sector.

Rwanda

In Rwanda, the contribution of ICT to the GDP is 3% (Ministry of Information Technology and Communications, 2017). The Government of Rwanda (GoR) strongly believes that Information and Communication Technology (ICT) can enable Rwanda leap-frog the key stages of industrialization. As such, GoR has integrated ICTs, through the National Information Communication Infrastructure (NICI) process, as a key driver for socio-economic development to fast track Rwanda's economic transformation, and consistently strives to align the country's development agenda to global trends in order to be competitive.

Since 2000 GoR has established institutions and mechanisms to create an enabling environment for ICT development, deployed critical world-class infrastructure and is continuously developing a skilled human resource base in its quest to become a knowledge-based society and regional ICT hub. Today, the existence of a conducing legal and regulatory framework, availability of good infrastructure and a growing and innovative human resource base are further positioning Rwanda as a regional ICT hub (National ICT Strategy and Plan NICI – 2015).

Rwanda strives to leverage ICTs in all sectors of the economy and is registering tremendous progress. In 2010, Rwanda was the top global reformer in the World Bank Doing Business report and second global reformer out of 183 countries in 2011. Rwanda is also the 9th easiest place to start a business in the world and the 6th most competitive economy in Sub-Saharan Africa according to the 2010 World Economic Forum global competitiveness report.

The third plan, NICI III (NICI-2015 Plan), focuses on the development of services by leveraging ICTs to improve service delivery to citizens, as Rwanda approaches the fourth and final phase of the NICI process that will propel Rwanda to achieve Vision 2020 goals (National ICT Strategy and Plan NICI – 2015).

The Government of Rwanda has implemented E-Government that aims to integrate all government processes such that government operates under a "ONE government" system in order to improve service delivery to citizens/businesses. This has ensured sustained improvements in government service provision and delivery by simplifying Government-to-Citizen (G2C) services to continuously improve the social and governance

clusters; Government-to-Business (G2B) services to continuously improve the economic cluster, and Government-to-Government (G2G) processes to continuously improve government efficiency. The scope of the Rwanda e-Government (e-Gov) is three-fold. First is to improve both government business processes and communication. Second is to increase citizen participation in the country's socio-economic development and third is to improve the legal and regulatory environment that enables Rwanda to adapt to emerging technologies (Republic of Rwanda, 2000).

Numerous e-Government initiatives such as the modern and secure National ID and driving license; e-Cabinet; e-Parliament, document tracking and workflow management system; financial management system (FMS) and human resource management system (HRMS) have been or are in the process of being deployed to improve government operations and service delivery to citizens. One of the key tools introduced by the GoR in 2006 to reinforce participation and accountability of local government is performance-based contracts. Furthermore, hundreds of local government officials and citizens have been trained in ICTs to promote ICT literacy and citizen participation in the country's development. These initiatives will most certainly improve government-to-citizen (G2C) services and facilitate more development in the governance cluster (Republic of Rwanda, 2000).

The main objectives of the Rwanda e-Government strategy is to improve communication and reduce barriers to government transactions through ICT, streamline government business processes using ICT Government can be efficient and effective when all business processes are streamlined, foster a conducive legal and regulatory environment to allow easy adaptation to emerging technologies (NICI-2010 Plan)

Since the beginning of NICI process, Rwanda has made significant progress towards becoming a knowledge-based economy and is now well positioned to become a regional ICT hub that can offer a wide range of competitive ICT products and services. The following are the initiatives that have been registered in the country's priority clusters i.e. economic, social and governance: online trade information portals; business incubators; online tax calculators; credit reference bureau; a land administration and management information system; electronic case management system; and improvements in online banking, e-transaction regulatory system, Management Information System (AMIS), Land Use Management and Information System, The national fibre optic backbone network that is connecting Rwanda to international sea cables, Communication, Navigation Surveillance and Air traffic management system (CNS-ATM), wireless broadband (WIBRO); National Data Centre; Broadcasting infrastructure, implementation of numerous ICT in education initiatives including ICT training for teachers and One Laptop Per Child, open-source medical records system and telemedicine system.

There are challenges that hinder Rwanda's ICT development such as Energy access and high costs are a major impediment to Rwanda's industry and services sectors, limited access to finance, inadequate international bandwidth, inadequate ICT skills, low ICT awareness and usage, Rwanda's private sector, particularly the ICT sector, is relatively small, inadequate information security and limited interoperability of government systems.

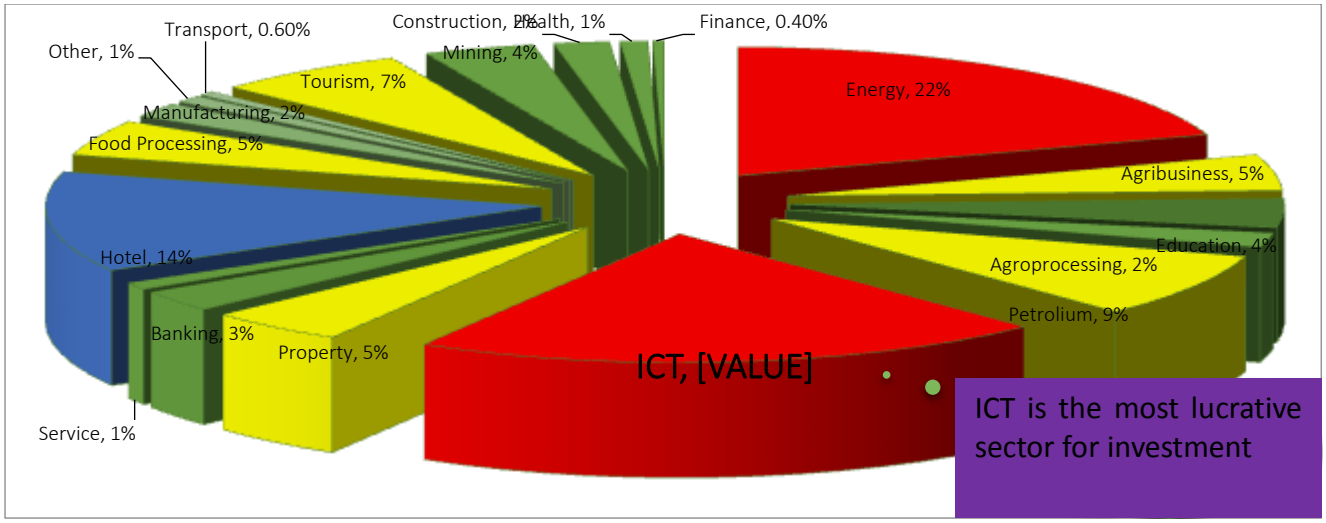

Figure 3: ICT as a tool for Foreign Direct Investment
EAC Investment by sub-sector, 2019

From the above figure ICT remains the most attractive area for Foreign Direct Investment. Digital transformation can be a game-changer for inclusive growth. We are confident Africa's growth will continue to improve, and growth prospects remain robust for long-term. Many countries will grow at 3 per cent or above per annum, with a big number of high-growth economies expanding by more than 5 per cent annually. Between 2001 and 2015, there were 14 such countries, and this number is expected to rise to 19 by 2030. However, it is important to understand that Africa's uneven FDI picture reflects the current global uncertainty.

There were 9.37 million mobile connections in Rwanda in January 2020. The number of mobile connections in Rwanda decreased by 153 thousand (-1.6%) between January 2019 and January 2020. The number of mobile connections in Rwanda in January 2020 was equivalent to 73% of the total population.

Burundi

Burundi will soon be equipped with a reviewed ICT development strategy that will enable the country to make it a tool for economic growth. Currently Burundi Government is carrying out an institutional reform of ICT. Burundi's Digital Agenda and ICT framework will be soon in place for the appropriate and innovative regulatory framework that will help to the rise of the digital economy. This more appropriate legal environment will also contribute to improving the socio-economic conditions of the population, especially young people and women, through greater attention given to access, new uses and security (UN, 2019).

Burundi adopted a national ICT development policy late in February 2007 as an update to the national ICT strategy adopted in 2004, but it has not been implemented due to the government's focus on the post-war cease-fire issues and lack of funding. The national ICT development policy identifies six strategic objectives: capacity-building, enhancement of a legal and regulatory environment, promotion of a base infrastructure, promotion of good governance, promotion and encouragement of private investment and promotion of the development of content and applications (World Bank Group, 2016).

The National ICT Policy was revised and adopted in 2011, the National Policy for Science, Technology and Innovation (STI) adopted in 2011 with an implementation framework for 2014 - 2018 and the decree to establish the National Commission for Science, Technology and Innovation was signed in July 2014 (Ntareme & Issa, 2012).

ICT Initiatives in Burundi are primarily focused on e-Infrastructure and e-Government. A metropolitan area network has been set up in Bujumbura, Gitega Province and Ngozi Province. Telecentre is facilitating Internet access within secondary schools. ITU implemented the Broadband Wireless Network Project with main outputs being the deployment of wireless broadband infrastructure in Burundi; development of ICT applications; training local experts on the operation of deployed wireless communication networks; development of national ICT broadband network plans (UNCTAD, 2012b).

Burundi Government has established the National Computer Incident Response Team (CIRT) to assist the Government of Burundi in building and deploying the technical capabilities and training required to establish the national CIRT. This has assisted in developing national cybersecurity capacity (UNESCO, 2019). The Burundi Government has also invested in communications infrastructure that has supported the enabling environment, connectivity and preparation for e-Government.

South Sudan

South Sudan is one of the growing African countries in ICT following her independence on July 2011 after civil war that disrupted in the country for a number of decades. For South Sudan, the expansion of the ICT sector is essential for the promotion and modernization of public and private activities and to better integrate the economy (UNESCO, 2019).

The country is still in the process of building its economy, there is already a significant amount of activity within the country's ICT sector, particularly efforts to expand broadband connectivity and mobile services. The ongoing construction of the National ICT broadband backbone (NICTBB) is a practical demonstration of the South Sudan government's commitment to promote ICT and enforce e-government in public delivery systems.

Today South Sudan has about 11 licensed ISPs in the country. They might not have expanded very well into the rural areas, but there is a good semblance of that. There is a clear policy, the Communications Act (2012), in place and the country is working on the regulator, the National Communications Authority (NCA), which will help the country regulate the system and create a good environment for operators and those doing business in in the country. The South Sudan Government has also established an ICT institute in order to train and increase the capacity of the people. The country is also working on VAS and national fibre optic.

The country has planned e-government that will improve the network and connect institutions with computers to increase efficiency. With e-government implementation, the country will better manage time and reduce the paperwork. The government is also planning technology improvement in the Ministry of education, and customs system. In the hospitals, the country has implemented mini-telemedicine and local community hub centres equipped with computers and a network that have promoted cultures and health services. In the country 2030 agenda, the country had planned for technology services to penetrate schools, hospitals, banking, and monetary systems.

The country has invested in ICT and Telecom Sector in the following areas; broadband services, ICT training facilities, software and hardware development, high-speed internet for which the market is still unexploited, the ability to develop ICT in enterprises and schools for better competitiveness, e–technology for all government and other public institutions, database management centres and installation of fibre optic (UNSC, 2016).

However, the Government of South Sudan faces the following challenges in regard to e-government implementation; lack of ICT equipment, electric power supply is not widely available to facilitate use of ICT, the costs of radio and TV broadcasts are currently too high, increased taxes especially for telecom companies that has been increased from 20% to 30%, lack of awareness among Policy and Decision Makers, insufficient ICT Infrastructure,

insufficient number of ICT Experts at all levels and sectors, institutional Networks yet to be setup for most of the sectors, awareness in the importance of ICT and all the related services among potential users, very low Connectivity if not totally inexistent, high illiteracy in ICT and weak sector regulation.

Process of technology diffusion

Another aspect is that trade unions need to fight against the trend of deregulation and the efforts to bypass social and working legislation when it comes to digital service platforms. Workers who provide the offered services often work in parallel and insecure labor structures that do not always have policy and regulations that provide legal, protective and encouraging working environment (Kunming, 2019).

Digital transformation is not a one-time event. It proceeds in waves driven by technological progress and diffusion of innovations. The first wave of digitization is associated with the introduction and adoption of what today are considered “mature” technologies, such as management information systems aimed at automating data processing and applied to monitoring and reporting of business performance, telecommunications technologies such as broadband (fixed and mobile) and voice telecommunications (fixed and mobile) which allow the remote access of information (McKinsey Global Institute, 2018). The second wave of digitization entails the diffusion of the Internet and its corresponding platforms (search engines, marketplaces), which enable the networking of enterprises to consumers and enterprises among themselves for purchasing of supplies, and distribution of output. The third wave of digitization entails the adoption of a range of advanced technologies, such as big data/analytics, Internet of Things, robotics, sensors, and artificial intelligence, and is aimed at enhancing information processing and the quality of decision making, while further automating routine tasks within business enterprises and governments (Organisation for Economic Co-operation and Development (OECD) (2017). These technologies are not typically adopted in a stand-alone fashion but are integrated with the mature technologies’ characteristic of the first and second waves.

Each digitization wave has a specific set of social and economic impacts. Computing, broadband and mobile telephony networks have been instrumental in relaxing industry scalability constraints, thereby allowing traditional sectors of the economy to grow more rapidly. The alleviation of the resource constraint has led to increased demand for labor in service industries, (e.g., financial services, education, health care, etc.) although it also had a positive effect in manufacturing. Finally, the first wave appears to have had an impact on the growth of household income, and the facilitation of social inclusion (access to information, government services, and entertainment content) (Evangelista, et al. 2012)

The second wave of digitization has led to the introduction of new services and applications such as Internet information searches, electronic commerce, distance education and a whole range of collaborative businesses that characterize the digital economy (Uber, airbnb, etc.). This “innovation effect” has yielded enhanced demand for labor in certain occupations linked to the development of digital services or the emergence of collaborative business models, coupled with the disappearance of repetitive low and middle-skilled jobs resulting from task automation.

The third wave of digitization has significant implications for productivity improvements. It also promises to have significant benefits on social welfare, more particularly on several Sustainable Development Goals, associated with the delivery of public services. The evidence so far with regards to the disruptive labor effects of the third wave are quite speculative, unless once believes that third wave disruption is merely an extrapolation of the second digitization wave effects. However, there is almost universal agreement that, similarly to the prior waves of innovation, automation will tend to favour those workers with more education and training. In this context, it is relevant to consider

the policy remedies that could propel the benefits of automation and limit the negative outcomes:

- Implement labor market policies focused on workers being able to either retain their current jobs or move to the new areas of demand. These policies comprise job placement services, special labor market programs and wage subsidies to lessen the transition cost;
- Deploy policies focused on increasing geographic mobility, which would allow workers residing in areas affected by automation to move to high job creation cities.
- Accelerate the creation of clusters of industries and universities around high quality of life locations that stimulate high-skilled labor demand in under- developed areas.
- In particular, emerging countries need to actively promote the digitization of production and digital transformation. This requires emphasizing policies focused on accelerating the digitization of production of small and medium enterprises, by reducing the cost of technology acquisition, training of employees, and the provision of consultancy services to support companies in their process of digital transformation.
- Launch changes in educational and training systems to address the human capital gap (implement tracking systems aimed at sorting out top performers; introduce short term technology careers; structure two-tier university systems);
- If ICT deployment leads to job destruction in certain areas or sectors, governments should be ready to implement retraining programs and temporary safety net mitigation initiatives.

The policy challenge going forward is that the digital transformation resulting from all three waves of digitization is so all-encompassing that sector-specific strategies developed within institutional silos are not applicable any more. Governments need to build cross-institutional links fostering the collaboration among education, ICT, industrial promotion, science and technology to devise and jointly implement policies. In addition, the future public policy scope has to be significantly expanded beyond traditional domains such as taxation, competition, and digital literacy to include new areas such as privacy protection, cyber security, and the fostering of digital adoption such as trust and enhanced customer experience. As it is clear, the challenges for policy makers are significant, but so are the benefits for citizens and the need to mitigate any potential disruptions.

Digitization technology waves

The same way earlier waves of technological change, such as the steam engine, railroads, telegraph and automobiles have transformed society, technological innovation linked to digitization proceeds along “waves”

Process of digitalization of technology waves

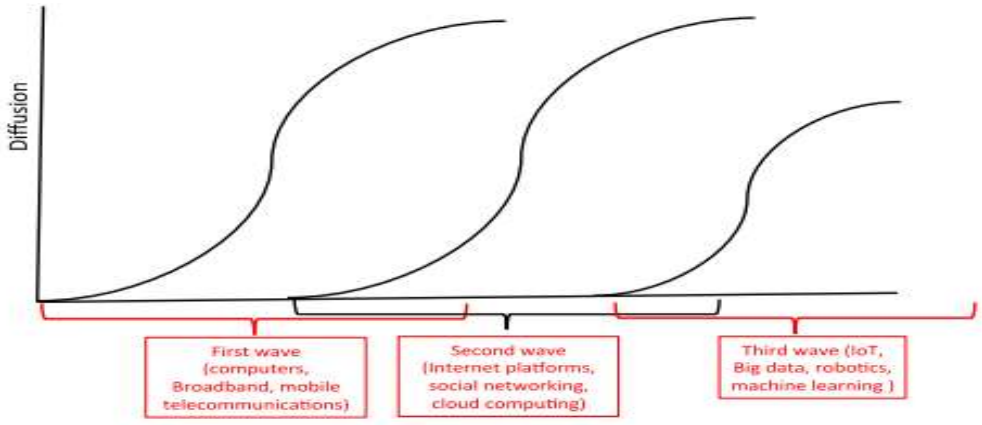

Figure 4: Digitization technology waves
(Wamda, 2013)

The first wave of digitization is associated with the introduction and adoption of what today are considered "mature" technologies, such as management information systems aimed at automating data processing and applied to monitoring and reporting of business performance, telecommunications technologies such as broadband (fixed and mobile) and voice telecommunications (fixed and mobile) which allow the remote access of information. Computers were introduced in business environments in the 1960s and reached 92.61% penetration among businesses in OECD countries only in 2014 (Katz, et al 2014). Mobile telephony was launched in 1985 and achieved 99% worldwide penetration by 2015. Personal computers, introduced in 1982, were adopted by 80.29% of OECD households in 2015. Similarly, fixed broadband was introduced approximately in 1995 and has reached 80.07% adoption within the same universe, while mobile broadband networks (3G and above) reached 84% of the global population in 2016.

The second wave of digitization entails the diffusion of the Internet and its corresponding platforms (search engines, marketplaces), which enable the networking of enterprises to consumers and enterprises among themselves for purchasing of supplies, and distribution of output. In addition to adoption of the Internet, this wave led to the diffusion of cloud computing. These technologies are supported by equipment, ranging from servers and routers to mainframes and switches. Despite its early development in the late 1960s through 1980s, the popular introduction of the Internet can be situated in 1995. By 2015, 77.2% of the OECD population accesses the Internet in a regular fashion, while 45% of the emerging world population has reached the same level (Irniger, 2017).

Diffusion cycles of digital technologies are becoming faster with each generation. For example, while Facebook, the dominant worldwide social networks, was launched in 2005, by 2015, 48.05% of the OECD population accesses the dominant social network in each country on a regular basis. In emerging countries Facebook penetration has reached even higher levels (Argentina: 62.19%, Malaysia: 59.35%, United Arab Emirates: 68.80%). (DIODE, 2018).

The third wave of digitization, whose diffusion start point can be somewhat arbitrarily placed around 2010, entails the adoption of a range of technologies aimed at enhancing information processing and the quality of decision making, while further automating routine tasks within business enterprises and governments. They comprise:

Big data/analytics: This is defined as the capability of processing extremely large data sets to identify patterns of relationships (correlation, causality) among data to be used in detecting market trends, consumer behaviour and preferences. Most common applications range from epidemiological and climate change research (in the public domain), as well as marketing and business process design (within the private sector).

Internet of things: It entails platforms that link multiple sensors and data devices in order to generate a complete vision of the behaviour of an organization, a system, a business operation, or a phenomenon. The most common applications are precision agriculture (which controls fertilizers, monitors rain and determines the most appropriate harvest), smart cities (which allow the control of traffic flows or manage energy use in public places), and telemedicine (which monitor hospital patients health). The adoption of Internet of Things is directly linked to vertical applications, and while these platforms are different from machine to machine applications, they are based on common components. Machine to machine applications are generally conceived as point solutions that link similar devices, such as thermostats, connected via a cellular network, a flow sensor in a refinery, a vehicle location system for fleet management, or home appliances monitoring. On the other hand, an Internet of Things system is a platform that

interconnects a variety of discrete devices (including Machine to Machine sensors) to provide a holistic vision of certain phenomena. In that sense, M2M devices are a component of an Internet of Things network.

Robotics: This entails the application of digital technology to the performance of repetitive manual tasks, such as those required in car assembly, agricultural harvesting, and exploration in dangerous environments.

3D printing: It is a technology that allows the creation of objects by means of successive printing of adhesive materials such as polymers. While applications of 3D printing are widespread, its use is fairly common in product design (medicinal prosthetics, architectural models, textile design) as well development of spare parts (in consumer electronics and industrial products)

Artificial intelligence/machine learning: these two technologies are not equivalent, although they share some common concepts. Machine learning is an artificial intelligence application consisting in the development of programs that allow a computer to learn routines without being necessarily pre-programmed. In that sense, the machine learning program transforms itself once it starts processing information. The most common machine learning applications are self-driving cars, product recommendations, Internet platforms like Amazon and Netflix, fraud detection in credit card usage, and calculation of consumer credit profile. These technologies are not typically adopted in a stand-alone fashion. In order to be incorporated within an industry 4.0 digitization context, they are integrated with the mature technology's characteristic of the first and second waves. Along those lines, industry 4.0 represents the assembly of mature and advanced technologies to respond to new requirements in the configuration of value chains in order to yield higher efficiencies and new capabilities in product development and delivery (which naturally leads to an increase in consumers' willingness to pay). As an example of changes in business operations:

- Collaborative development of products and services among different firms;
- Optimization of production chains in order to reduce transactions costs between functions;
- Reduction in production sizes and decrease in response time to allow for higher product personalization;
- Optimization of logistics chains to reduce supply intervals;
- End to end multidimensional traceability in order to increase monitoring and management of the production chain;
- Flexibilization and efficiency in the management of production means; and Transformation of distribution in order to optimize market reach

Digitalization and Agriculture

The African agriculture sector could benefit from digitalization to improve production and food security. In the face of global climate change and high population growth, digitalization can offer broad solutions needed by African farmers. Digital technology can enable automation processes to increase production and to create learning communities for farmers through mobile technology. Small holders learned how to restore soils using crop rotation, though in some countries this is a traditional method, but with new technology, farmers learn types of crops to alternate. Digital Green Organization transformed agriculture in India and Ethiopia using technology. Smallholder farmers have been integrated in digitalization using mobile phones and videos for training and education in local languages (Annan, Conway and Dryden 2016).

Like in any other sector, digitalization makes it easier for farmers to connect, to access and share information. Through special designed apps, farmers can create a knowledge-based community in which they share information and learn from each other. In order to increase farmers´ productivity, other apps have been developed to measure and analyze soil data like temperature, nutrients and vegetative health by images taken

from satellites or drones. Weather forecasts and soil sensors make it possible to manage crop growth in real time and provide information on how to use the right fertilizer and optimally irrigate farms (Annan, Conway and Dryden 2016); (Trendov, Varas and Zeng 2019).

In a long-term perspective, this might also be able to help to consolidate interests and form a common voice that can express issues towards other actors such as national governments. Youth have the opportunity to learn from the past and initiate agri-preneurs to play a role in transformation of agriculture, related investment and agribusiness (Trendov, Varas and Zeng 2019).

Similarly, farmers can benefit from new digital services with access to the information about market, price, products, distribution and sell of crops using mobile phones. Access to information could also remove price asymmetry between farmers and buyers; digital payment opens new markets to farmers who could not participate before. Other start-ups offer banking opportunities and credits to farmers who don't have access to the classic banking system. Digital technology can even allow smaller players to be integrated into the value chain, for instance through e-commerce platforms.

Digitalization and Information

Digitalization could have an equalizing effect on societies. The valuable good of accessing and creating knowledge that has been available only to the privileged for centuries, is now widely offered to everyone with a web-enabled device. Never have so many people had access to general and specific information. In spite of different cultural or economic backgrounds, education or geography, everyone can gain information if they have access to a device that can provide an Internet connection.

The www (world wide web) is an inclusive place that provides the same services to anyone. However, inclusive Internet Index 2019 pointed out that for internet to be relevant to all and to contribute to the socio-economic development, the following factors should be measured: "Availability: quality and breadth of available infrastructure required for access and levels of Internet usage. Affordability: cost of access relative to income and the level of competition in the Internet marketplace. Relevance: existence and extent of local language content and relevant content. Readiness: capacity to access the Internet, including skills, cultural acceptance, and supporting policy" The Inclusive Internet Index 2018 listed Tanzania, Rwanda and Uganda as part of the top 5 of low-income countries regarding their Internet inclusivity. Especially for Rwanda, access to the Internet has increased unprecedentedly.

Digitalization and Gender

Digitalization can bridge the gender gap and establish inclusive ways of access and creating knowledge and information sharing. Looking at the status quo, the current access to ICT shows the discrepancies between men and women in the digital world. Systemic inequalities based on gender are mirrored in the digital sphere and leave many women, especially the poor and the rural behind in Africa's tech transformation. In Sub-Saharan Africa, women only make up 13% of owners of a smartphone

Women are 50 percent less likely to use the Internet than men, which makes Africa the continent with the widest gap internet use between men and women, which is referred as the Digital Gender Divide. Reasons include gender inequality associated with power relations, politics, and socio-economic and cultural norms. Women often have less control over their household´s finances; girls do not receive the same education as boys including the digital sphere (Mariscal, et al. 2019). As a result, the United Nations want to tackle this problem until 2030 and to make it part of their Sustainable Development Goals and increase access to technology by women (UTU 2017).

There are several areas where women can benefit from digitalization using for instance mobile phones, mobile money and platforms. One of them is healthcare. Through text messages, mothers can be educated on what to expect when they are

pregnant or how to make health decisions for their children. Other apps help to educate young women about their reproductive health, issues of family planning which otherwise might be hard to obtain due to cultural reasons. Many women and girls still do not have access to ICTs, and there is an ongoing challenge to offer these services to all those in need.

Security in the Digital Age

In the digitalized world, personal data has become the most valuable good. It is impossible to see or to count it and is extremely hard to protect. Cyber security has become an essential subject of digital development. Access to sensitive information through hacking and digital related crimes is becoming an increasingly relevant threat and concern for governments, companies, organizations and individuals. Everybody is affected. Therefore, there is need to invest in cyber security (Clive 2016). There are several ways of accessing consumers´ data. Big tech companies and service providers collect private data and can use them for different purposes. Even though this process is legal, it has several hidden consequences that many users of these mostly free services are not aware of since it is mostly not clear what the provided data is used for and how much of it is being collected.

Private data needs to be protected. Unlike the European Union or the USA, most African states do not have any updated data privacy laws. Even though the continent has the fastest growth of Internet use, personal data is often not protected from data breaches and hacking e.g. on social media websites, which can leave the consumer exposed. Currently, only 23 out of 55 African nations have passed or drafted personal privacy laws, and only nine of them have data protection authorities. Even though, awareness of the issue is rising, many African countries view data protection as a priority in their digital development strategies due to the restriction measures of European data policy about sharing data with third party, which include Africa countries (Makulilo 2012). It should also be in the interest of governments to protect individual data, as breaches and hacking can also have political consequences (Toward a Social Compact for Digital Privacy and Security 2015).

- (better signalling, better prices, improved segment coverage).

Rationale for the implementation of the EAC regional digital agenda

In accordance with the article 103 of the EAC Treaty, the partner States established the East African Science and Technology Commission with a general mandate to coordinate and facilitate the development, management and application of science, technology and innovation in EAC Partner States. To pursue the achievement of the EAC objectives for Science, Technology and Innovation, and the regional integration agenda the EASTECO Strategic Plan, 2017-2022, includes ICT among strategic priorities, with the aim to the development of regional capacity in ICT for the promotion of efficient productive and social sectors, through i) the establishment of collaborative linkages and partnerships between technologists, researchers and entrepreneurs, ii) the development and establishment of a regional catalogue and record on ICT capacity (needs, available Institutions, human capital and technology solutions), iii) the support for training and R&D in software development and ICT applications; iv) support and commercialization of ICT innovation through ICT incubation centers; and v) the coordination of ICT initiatives to enhance access to ICT.

The East African region has generally invested a lot in national backbone networks and have implemented e-government strategies and policies. To complement on the infrastructure development in ICTs, digitalization is very important as it strengthens the benefits of connectivity, and is expected to make an enormous impact on the East African development and influence it to be more inclusive, efficient and innovative. Digital transformation drives growth, generates jobs and opens up for delivery of a vast array of services. A large and growing young population in the East

African region is expected to fuel the digital development in the region.

The EASTECO in collaboration with EAC Secretariat will ensure the national e-government strategies are harmonized and all public and private services are easily accessible across the region. There will be more focus on Promotion of local digital content production relevant to East African people's needs.

In this regard, the 13th Ordinary Meeting of the EAC Council of Ministers and the 8th Summit of the EAC Heads of States held in November 2006 approved the EAC Regional e-Government Framework that identifies seven focus areas in the implementation EAC Regional Digital Agenda as per the Regional e-Government Programme.

The EAC identified focus areas for regional E-Government that include i) Customs and Immigration controls; ii) e-Parliament; iii) e-Health; iv) e-Banking; v) e-Procurement; vi) e-Commerce and e-Tourism; vii) Meteorological and tidal information.

The implementation of these above e-Government applications faced a number of challenges such as i) National Policy Frameworks (development and implementation); ii) Infrastructure development (national/regional backbone, connectivity, power fluctuations, computers); iii) human resource and skills gaps; iv) data security centers; v) harmonization of laws, legal and regulatory frameworks; vi) development of information systems; vii) funding.

The EAC 5th development strategy is targeting to "Support integration of Information and Communication Technology (ICT) into regional development initiatives" to achieve the EAC strategic Development objective number 2; "Investing in enhancement of the stock and quality of multi-dimensional strategic infrastructure and related services, to support and accelerate sustainable regional integration and competitiveness".

On the national level, EAC Partner States developed and are implementing national policies and strategies on ICT and e-Government Strategies though they may be at different stages. EAC recognized the need for a harmonized EAC Regional Digital Agenda to Partner States' common digital priorities and ensure an efficient regional cooperation to build a competitive EAC digital economy.

EAC Partner States are embracing e-Government initiatives to enhance their efficiency and effectiveness in service delivery to the citizens, businesses, and other arms of government through the use of ICT. It is a strong belief by the EAC Partner States that ICT has the potential not only to revolutionize the way governments are operating at the moment, but also to enhance the relationship between Government and Citizens (G2C), Government and Business Community (G2B), Government-to-Employee (G2E) and within Government to Government departments (G2G).

At the moment, EAC partner States are implementing e-Government initiatives that require harmonization and standardization under a common regional framework. Therefore, the need for drawing up a Regional e-Government Framework to be used by EAC Partner States to either adopt or adapt to their own environments with minimum alterations.

Generally, EAC Partner States are aware of the e-Government and they have a substantial amount of investment in e-Government / Telecommunications Infrastructure, however, the application or usage of e-Government infrastructure is still limited. There is inadequate legal and regulatory framework to support the effective implementation of the e-Government program but even where the laws exist, the enforcement is very weak. More importantly, the planning, monitoring and evaluation of ICT activities are weak with the institutional capacity equally weak demonstrated by low levels of qualified ICT staff and non-existence of ICT units in most government Ministries, Department and Agencies (MDAs).

There is a need for developing and implementing a

regional e-Government programme aimed at the efficient use of ICT in public administration in order to improve public service delivery and democratic processes and also to enhance the attainment of the Sustainable Development Goals (SDGs). A new United Nations report has found that e-government is an effective tool for facilitating integrated policies and public service by promoting accountable and transparent institutions, such as through open data and participatory decision-making, and therefore it has the potential to help support the implementation of the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs). (IMF (2019a).

The e-Government ensures online accessibility of all government services and opportunities for community participation in a friendly, transparent and efficient manner for all sections of the society and enhances and promote the efficiency and transparency in the functioning of government through the increased use of ICT for online service delivery to citizens and business.

Implementation of regional e-government agenda in the EAC region will have benefits such as improved services and convenience to citizens, improved the productivity (and efficiency) of government agencies, create a more accountable government, increased transparency and fight corruption, empower public access to information/records in possession of the state or public body, so as to effectively scrutinize and participate in government decisions that affect them, improve the quality of life for disadvantaged communities, promote gender equality and minimize the national digital divide, strengthen good governance, broaden public participation and promote democracy, strengthen the legal system and law enforcement, facilitate commerce and services for businesses online and make private sector more competitive by reducing the cost of transacting with the Government e.g. in tax collection and e-procurement. For the EAC, e-government will enhance the use of opportunities and capabilities for digital and information revolution, accelerate economic development and deepen regional integration and fast track the implementation of common market objectives

There also advantages of e-government implementation for the EAC partner States which include; improved efficiency of government agencies in processing of data, improved services through better understanding of users' requirements, thus aiming for seamless online services, sharing of information and ideas between all government agencies and department to build one mega database, assists a government's economic policy objectives by promoting productivity gains inherent in ICT and e-commerce, improving transparency, accuracy and facilitating information transforming between government and customers, helps in building trust between governments and citizens, an essential factor in good governance by using internet-based strategies to involve citizens in the policy process, illustrating government transparency and accountability.

To conclude, it is clear that implementation of e-government not only saves resources, effort and money but it can also extensively increase service quality levels and reducing time spent in government departments. It's against this background that the East African Science and Technology Commission in collaboration with the East African Community Secretariat are jointly carrying out the review of the EAC regional digital agenda policy framework and implementation of the EAC e-Government framework.

Digital transformation impacts society at several levels. On the production side of the economy, digital transformation enables the automation of business operations, yielding operational efficiencies, such as reduction of transaction costs, with an impact on productivity. Similarly, digital transformation provides new business opportunities, impacting employment and entrepreneurship. Regarding the delivery of public services, digital transformation enhances the

provision of health and education, while improving the way citizens interact with their governments. Digital transformation has an impact on human relationships and individual behaviour, facilitating social inclusion and communication. Digital foundations include; Digital Ecosystem (laws, regulations, policy, institutions, skills), Expanding Digital Connectivity and Digital Public Services Infrastructure & essential platforms (IMF (2019a).

Digital technologies have been useful with campaigns and voting, relaying information to citizens easily. Politics is one of the most important aspects of modern-day society, and technology is already having a huge impact on the way we view political affairs. Staying current with new technological advances is proving to be critical for both the masses and politicians striving to represent themselves as leaders.

METHODOLOGY

This paper adopted an econometric model.

Econometrics Analysis

Econometrics means economic measurement and may be understood as the critical social science in which the tools of economic theory, mathematics statistical inference are applied to the analysis of economic phenomena. Although quantitative measurement of economic concepts such as the Gross Domestic Product (GDP), unemployment, inflation, imports and exports is very important and the scope of econometric is much broader.

Dybczak, Flek, Hájková and Hurník (2006) (herein after referred to as "DFHH") used this assumption of constant labor share and discussed the consequences of raising the labor share on estimation of potential output growth only briefly. DFHH basically follow Giorno et al. (1995) and model the potential output using the two factor Cobb-Douglas production function with Hicks-neutral technology:

$$Y_t = A_t \ . \ L_t^{\alpha} \ . \ K_t^{\beta} \quad \ldots\ldots\ldots \text{Equation}-(1)$$

Where Y, L, K and A are real GDP, labor input, capital input and the Total Factor Productivity (TFP) level respectively. There are two methodological advances used by DFHH that are worth mentioning. First, they incorporate the concept of a time - varying non-accelerating inflation rate of unemployment (NAIRU) into the production function approach, to derive "potential labor", and second, they newly introduce the concept of "capital services" to adjust the aggregate capital stock with respect to the real productive impact of this factor input.

The parameter A_t is an index of technological efficiency, which is neutral in Hicks sense i.e., in the sense that it has no eeffect on the ratio of marginal products for a given capital-labor ratio. Profit maximization by frms in a competitive framework delivers two optimality conditions equalizing factor prices with their marginal products. Combining these conditions delivers

$$\frac{r_t K_t}{w_t L_t} = \frac{\frac{f`(k_t)k_t}{f(k_t)}}{1 - \frac{f`(k_t)k_t}{f(k_t)}} \ldots\ldots\ldots\ldots \text{Equation}-(2)$$

where f(k) is output per unit of labor, k is the capital-labor ratio, and r and w are the rental prices of capital and labor, respectively. As is well-known, in the United States, the value of the left-hand side of this expression has been remarkably stable throughout the post-WWII period, while the capital-labor ratio has steadily increased. It follows that this equation can be consistent with

The specification of the production function is a special case of the Constant-Elasticity-Of-Substitution production function (CES), with the elasticity of substitution equal to one and with the usual theoretical assumptions used in the empirical literature. As mentioned earlier, positive and diminishing marginal products of each input (L, K) are assumed. This restricts both a and β to values between 0 and 1. Second, returns to scale are assumed to be constant, i.e. β = (1- a).

Arrow et al. (1961) showed that the assumption of a constant elasticity of substitution implied the following functional form for the production function:

$$Y_t = A_t[\delta K_t^{\frac{\sigma-1}{\sigma}} + (1 - \sigma)L_t^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma-1}{\sigma}} \ldots\ldots\ldots \text{Equation–(3)}$$

where Y_t is real output, K_t is the flow of services from the real capital stock, L_t is the flow of services from production and nonproduction workers, A_t is a Hicks-neutral technological shifter, δ is a distribution parameter, and the constant σ is the elasticity of substitution between capital and labor. Following Berndt (1976), it is useful to the one the aggregate input function $F_t \equiv Yt/At$, which given the assumption of Hicks-neutral technological change is independent of A_t. Profit maximization by firms in a competitive framework implies two First-order conditions, equating real factor prices to the real value of their marginal products. These conditions can be rewritten and expanded with an error term to obtain:

$$\log\left(\frac{F_t}{K_t}\right) = \alpha_1 + \sigma \log\left(\frac{R_t}{P_t}\right) + \in_1 t \ldots\ldots \text{Equation–(i)}$$

$$\log\left(\frac{F_t}{L_t}\right) = \alpha_2 + \sigma \log\left(\frac{W_t}{P_t}\right) + \in_2 t \ldots\ldots \text{Equation–(ii)}$$

where R_t, W_t , and P_t are the prices of capital services, labor services, and aggregate input F_t , respectively, and $\alpha_1$and α_2 are constants that depends δ. A third alternative specification can be obtained by subtracting (i) from (ii)

$$\log\left(\frac{K_t}{L_t}\right) = \alpha_3 + \sigma \log\left(\frac{W_t}{R_t}\right) + \in_3 t \ldots\ldots\ldots \text{Equation–(iii)}$$

Following Berndt (1976) one can also rearrange equations (i) through (iii) to obtain the following three reverse regressions:

$$\log\left(\frac{R_t}{P_t}\right) = \alpha_4 + \left(\frac{1}{\sigma}\right) \log\left(\frac{F_t}{K_t}\right) + \in_4 t \ldots\ldots \text{Equation–(iV)}$$

$$\log\left(\frac{W_t}{P_t}\right) = \alpha_5 + \left(\frac{1}{\sigma}\right) \log\left(\frac{F_t}{L_t}\right) + \in_5 t \ldots\ldots \text{Equation–(V)}$$

$$\log\left(\frac{W_t}{R_t}\right) = \alpha_6 + \left(\frac{1}{\sigma}\right) \log\left(\frac{K_t}{L_t}\right) + \in_6 t \ldots\ldots \text{Equation–(Vi)}$$

I hereafter denote the estimates of σ based on equations (i) through (vi) by $\alpha_i, i = 1 - 6$.

As pointed out by Berndt (1976), in this bivariate set the following equalities will necessarily hold for the OLS estimates:

$$\frac{\sigma_1}{\sigma_4} = R_2^1 = R_4^2; \frac{\sigma_2}{\sigma_5} = R_2^2 = R_5^2; \frac{\sigma_3}{\sigma_6} = R_3^2 = R_6^2 \ldots\ldots \text{Equation–(Vii)}$$

Where R_i^1 refers to the R-square in equation. These equalities in turn imply the inequalities

$$\sigma_1 \lesseqgtr \sigma_4, \ \sigma_2 \lesseqgtr \sigma_5 \ and \ \sigma_3 \lesseqgtr \sigma_6$$

More importantly, it follows from (vii) that the larger the R-square in the OLS regressions, the closer will the standard and reverse estimates be. It should be emphasized, however, that these results hold only for the OLS estimates. On the other hand, nothing can be predicted on statistical grounds about the relative size of the estimates

$$lny = lnC + alnk_t + \beta lnh_t + \mu_t \ldots\ldots \text{Equation–(3)}$$

Equation (3) appears suitable for estimation. However, some problems may arise since most macroeconomic time-series contain unit roots and that regression of one-stationary series on another is likely to yield spurious results. A well-known difficulty with estimating aggregative production functions is the possibility of a correlation between the error term and the regressors which would yield biased coefficient estimates. For example, a stochastic shock to the production function would typically be expected to result in the faster growth of accumulated inputs in that period. If shocks are also persistent, this will induce a positive correlation between future shocks and future levels of physical and human capital. By transforming the time series to stationarity by first differencing, the estimation bias can be removed. However, in any case this will create its own problems, notably because of the risk in losing information on the long run relationships of the variables.

One approach in dealing with this dilemma is to employ an error correction model which combines long run information with a short-run adjustment mechanism. The error-correction model may be estimated in two ways. The generalized "one-step" error correction model is a transformation of an autoregressive distributed lag model. As such, it can be used to estimate relationships among non-stationary processes. In order to estimate the human capital augmented production function, the error-correction model may be written as follows:

$$\Delta lny_t = y_1 \Delta lnk_t + y_2 \Delta lnh_t - y_3 (lny_{t-1} - \alpha lnk_{t-1} - \beta lnh_{t-1} - \ln C + \mu_t) \ldots \text{Equation}-(4)$$

Since we do not have information on α and β, the equation can be transformed as follows:

$$\Delta lny_t = \ln C + y_1 \Delta lnk_t + y_2 \Delta lnh_t - y_3 lny_{t-1} - y_4 lnk_{t-1} - y_5 lnh_{t-1} + \mu_t) .. \text{Equation}-(5)$$

Estimates of the parameter 3 variable y can be used to calculate the required elasticities α and β. The coefficient 3 variable y contains additional information because it can be interpreted as a measure of the speed of adjustment in which the system moves towards its equilibrium on the average. Once the overall model has been found satisfactory, equation (3) is reformulated in order to incorporate an error-correction term. This "two-step" procedure, in which the error-correction term EC_{t-1} is derived from the lagged residuals t u of the level's regression in equation (2) and can be used to estimate the following model:

$$\Delta lny_t = \ln C + y_1 \Delta lnk_t + y_2 \Delta lnh_t + y_3 EC_{t-1} + \mu_t) .. \text{Equation}-(6)$$

Where

$$EC_{t-1} = lny_{t-1} - alnk_t - \beta lnh_t - LnC + \mu_t$$

Equation 5 and 6 should in principle produce similar results as one equation has been obtained from the other. The data used in this paper has been obtained from the central statistical office in Mauritius and The Bank of Mauritius reports for the period 1990 to 2006. In the model, Y has been used as a proxy for real Gross Domestic Product (GDP) while K has been taken as the proxy for capital stock. Human capital stock is represented by H and L is a proxy for labour. In our analysis, we have used real GDP as a proxy for output. The gross domestic product (GDP) or gross domestic income (GDI) is one of the measures of national income and output for a given country's economy. GDP is defined as the total market value of all final goods and services produced within the country in a given period of time (usually a calendar year). It is also considered the sum of value added at every stage of production (the intermediate stages) of all final goods and services produced within a country in a given period of time, and it is given a money value. The most common approach in measuring and understanding GDP is the expenditure method: GDP = consumption + gross investment + government spending + (exports − imports).

Gross fixed capital formation (GFCF) is a macroeconomic concept used in official national accounts. The statistical aggregate of GDFCF is a measure of the net new investment by enterprises in the domestic economy in fixed capital assets during an accounting period. While it is not possible to measure the value of the total fixed capital stock very accurately, it is possible to obtain a fairly reliable measure of the trend in new fixed investment. GFCF is a flow value. It is usually defined as the total value of additions to fixed assets by resident producer enterprises, less disposals of fixed assets during the quarter or year, plus additions to the value of non-produced assets (such as discoveries of mineral deposits, or land improvements).

Normalising the full utilisation of factor inputs as one, potential output can be represented as follows trends:

Total Factor Productivity (TFP):

The TFP trend is estimated from the Solow residual by using a bivariate Kalman filter method that exploits the link between the TFP cycle and capacity utilization. The Solow residual employed in the estimation process is calculated until the end of the short-term forecast horizon using forecasts for GDP,

labour input and the capital stock, which permits the extension of the TFP series by two additional observations. Since there are no forecasts of the degree of capacity utilization in the economy, this means that the Kalman filter model is estimated with two missing values. During the estimation process, these missing values for capacity utilization are, however, not problematic since the operation of the Kalman filter is not dependent on the availability of a forecast extension. The filter can in fact compute linear projections through a recursive procedure which yields the expected value of the TFP cycle on the basis of only the available observations. The Kalman filter in turn produces trend TFP forecasts by simply running the Kalman filter out of sample, over the required medium-term forecast horizon.

NAWRU'S:

The trend specification chosen for the NAWRU implies that the best prediction for the change in the NAWRU in future periods is the current estimate of the intercept. This basically implies that the slope of the NAWRU in the last year of the short-term forecasts should be used for the medium-term projection. Such a specification seems problematic for longer-term projections since it will eventually violate economic constraints (such as non-negativity of the NAWRU, for example, or balancing forces in the economy). An alternative specification which is more consistent with the common notion of the NAWRU as a stable long run level of the unemployment rate would be a random walk without drift. This specification would imply a flat extrapolation of the last NAWRU value. Although this specification does not work well in estimation for European data where persistent trend changes of the unemployment rate can be observed, it may be a more plausible specification for the projections. The projections in practice constitute a compromise between these two concepts, with the medium-term NAWRU estimated according to the following rule.

The paper took the structure of the index we created from the paper by Raul F. Katz et al. (2014) "Using a digitization index to measure the economic and social impact of digital agendas". Our index spans an interval of 9 years and includes statistics from different sources for various subcategories. For weighting the indicators, the paper has chosen to use the methodology from the German Digitalization report (Deutschland-Index Der Digitalisierung 2017), where digital indicators were weighted in the following manner: Digital Life 20%, Economy and Research 20%, Infrastructure 25%, Citizen services 10%, Digital community 25%. Each subcategory was measured following its own methodology, and these were all converted to a percentage for the purpose of consolidation. We have chosen these variables as sub-indexes for digitalization: eGovernment index (EGDI), PC penetration, math performance, internet usage, fixed broadband and mobile broadband. In order to consolidate the measurements, we rescaled all variables as percentages. For a detailed description of the data and ID scores.

Table 1: Information about the structure of the index and the data

Category	Sub-category	Weight	Source	Measurement
Ubiquity (Infrastructure)	fixed broadband penetration	20%	WB	per 100
	mobile broadband penetration	15%	OECD	per 100
	PC population penetration	15%	OECD	percentage of all households
	E-government	20%	UN	EGDI Index scores
	percentage of individuals using the internet	10%	WB	percentage of all households
Education	Mathematics education	10%	OECD(PISA)	Scores, max 600
Skills	ICT workers per 100	10%	OECD	percentage of business sector employment

To confirm that our ID (Index of Digitalization) has some amount of influence, we have implemented it in the GDP payback model using prices from the previous year. We have used the basic Cobb-Douglas model based on two classical components – investment, which represents capital path, and the percentage of the employed aged 15+ as the labour force. In addition, we have added our synthetic index as a third independent variable.

We based this evaluation on OECD countries because they are homogenous and the probability of having significant outliers is relatively low. We did not achieve either the "breadth" of the paper by Katz et al. (2014) nor the "depth" of German Digital index (2017). In our dynamic case, we found on a global scale, including the OECD countries, that not all of the indicators could be found. Moreover, the data is quite heterogeneous. Therefore, we had to leave only 6 indicators. Furthermore, there is not only direct connections but also indirect connections between digitalisation and the performance of the economy, and these are quite hard to evaluate, at least when using a quantitative approach.

Once we collected our data for the time interval that we created our Digitalization Index (DI) for, we decided to use a dynamic panel data model with fixed effects since our dependent variable GDP (PVP) is closely related to its past realisations (to be further discussed in the Results section). Deciding on the correct model for our data involved a process of elimination; for example, we eliminated the pooled OLS (Ordinary Least Squares) model from the very beginning because this model ignores the country specific characteristics and idiosyncratic error term (uit), which in turn leads to an overestimation of the lag term (yit-1) and an upward bias since uit and yit-1 are positively correlated (Wooldridge 2015). The main problem with the only other alternative – the Random Effects (RE) model was its strong exogeneity assumption that residuals are uncorrelated with the independent variables (Bell & Jones 2015)

Interpretation of Results and analysis

Index

Looking at the first and the second level of internet connectivity 3G, 4G and currently the 5G. In the electronic digital setting, metadata also allows digital information to travel and to establish digital communication in the first place. For example, Internet Protocol (IP) enables the transfer of information as it logs the time, the size, as well as the source and the destination of the digital information and identifies different routes from sender to receiver. Similarly, Hypertext Transfer Protocol (HTTP) was developed to send information, tailor contents, track information and capture any activity on a website through query strings. Through the development of metadata and respective protocols, digital information has become transferable.

Table 2: Mobile, Internet, and fixed broadband subscription penetration

	Mobile cellular penetration Percent	Internet users Per 100 inhabitants	Fixed broadband subscriptions Per 100 inhabitants	Mobile subscribers 2009 Millions
World	67.00	26.00	7.00	
Sub-Saharan Africa	38.00	9.00	0.1	
Kenya	49.00	10.00	0.02	18.5
Rwanda	24.00	3.00	0.08	2.0
Tanzania	40.00	1.60	0.00	17.3
Uganda	29.00	10.00	0.02	11.8

TREND EFFICIENCY:

Within the production function framework, potential output refers to the level of output which can be produced with a "normal" level of efficiency of factor inputs, with this trend efficiency level being measured as the HP filtered Solow Residual. TFP is regarded an exogenous in our framework and is assumed to follow a stochastic trend. The growth rate of TFP is specified as an AR process.

Table 3: Decomposition of Potential Output Growth (average of q-t-q annualised growth)

		Contribution to growth		
	Potential output (%)	TFP (A*) (%, p.p)	Potential labor (L*) (p.p.)	Capital services (K) (p.p.)
2000	**2.2**	**0.6**	**0.2**	**1.6**
2001	**2.0**	**0.3**	**-0.1**	**1.7**
2002	**1.8**	**0.0**	**0.0**	**1.8**
2003	**1.3**	**-0.2**	**0.0**	**1.4**
2004	**1.3**	**0.0**	**-0.2**	**1.4**
2005	**1.6**	**1.1**	**-0.7**	**1.2**
2006	**2.2**	**1.6**	**-0.5**	**1.2**
2007	**3.6**	**2.0**	**0.2**	**1.4**
2008	**3.4**	**2.5**	**-0.4**	**1.3**
2009	**4.6**	**2.6**	**0.1**	**1.9**
2010	**5.1**	**2.2**	**0.6**	**2.2**
2011	**3.4**	**2.5**	**-0.4**	**1.3**
2012	**3.6**	**2.0**	**0.2**	**1.4**
2013	**3.4**	**2.5**	**-0.4**	**1.3**
2014	**4.6**	**2.6**	**0.1**	**1.9**
2015	**5.1**	**2.2**	**0.6**	**2.2**
2016	**1.6**	**1.1**	**-0.7**	**1.2**
2017	**1.8**	**0.0**	**0.0**	**1.8**
2018	**1.3**	**-0.2**	**0.0**	**1.4**
2019	**3.4**	**2.5**	**-0.4**	**1.3**
2000-2019	**2.7**	**1.2**	**-0.1**	**1.6**

In terms of a decomposition of the various components of growth, Table above gave the cumulative contributions to potential growth over the period 2000-2019 from labour (hours), capital accumulation and total factor productivity (TFP). Regarding the East Africa countries, the graph shows the degree of heterogeneity amongst the Member States, with respect to the individual inputs. In terms of labour, the contributions range from a positive growth impulse of 9 ½ % in Uganda to a negative contribution of 1% in the case of Kenya. A similar picture emerges with regard to capital accumulation, with Rwanda again joint lowest (with Tanzania) with a contribution of 1.8% points compared with gains of 8-9% points for Uganda, Rwanda and Tanzania.

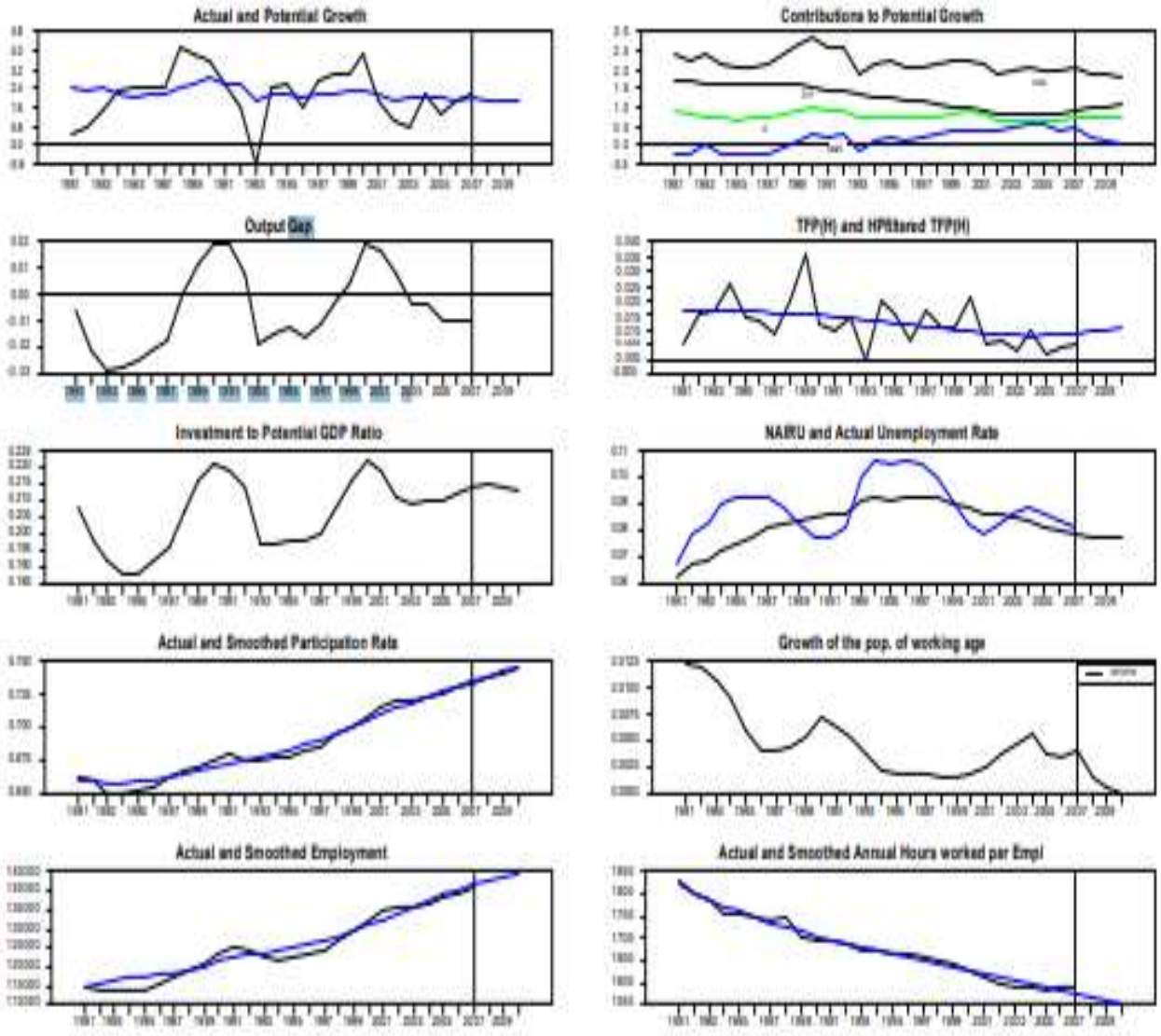

Figure 5: Graph showing Potential Growth and its components in East Africa Community region

The above graph allows the following observations. First, since the beginning of the 90s the employment contribution to growth has become positive, due to rising participation rates and a fall in structural unemployment since the mid-90s. These two labour market trends dominate the negative contributions arising from a continuous decline in average hours worked and of the growth of population of working age. Second, the contribution of capital to growth has been fairly stable and third, TFP growth shows a slight tendency to decline over time.

The outlook for the next five years until 2010 is characterised by some mean reverting properties of the model. First, concerning the Non-accelerating inflation rate of unemployment (NAIRU) it is mechanically assumed that structural unemployment will stabilise over a period of five years. The stable investment rate is projected forward. Concerning TFP, a recovery to historic trends is implied by the time series specification of the TFP series.

Panel data

The first column shows the results from the fixed effects model (FE), whereas the second shows the results from the first difference model (FD). Our dependent variable is GDP in past value prices, because it is a more robust approach for omitting the influence of inflation. Our independent variables are: lagged value – because this is the case

for a dynamic model; our synthetic index – which was created in the last section; Investment in logarithmic (normalised) form as K from the growth model; Lpr – which means percentage of employed in overall labour force (we have used this form because it is already normalised and may reflect shocks in the economy like the effect of crises on the labour market); then we have used time dummies to show differences in time.

According to our findings we may conclude the following results: model fits the data well, adjusted R^2 is 0.949; Labour is neither economically nor statistically significant because our time interval is not long enough; time dummies are significant and show positive growth over time, Investment is statistically significant at the 1% level. A 1% change in Investment causes a 0.228% change in GDP in the short run and a 0.389% change in the long run; time lag is significant statistically; our Digitalization index is statistically significant at the 10% level. A 1% change in the level of the Digitalization index causes a 0.09% change in GDP in the short run and a 0.154% change in the long run.

Table 4: Results of the panel data model

	log (GDP_PVP)
lag (log (GDP_PVP), 1)	0.414*
	(0.046)
log (ID)	0.099*
	(0.051)
Log (I)	0.228***
	(0.007)
Lpr	0.0017*
	(0.0001)
factor (TIME) 2000	0.044***
	(0.010)
factor (TIME) 2019	0.048***
	(0.012)
R^2	0.959
Adjusted R^2	0.949
F-Statistics	4.535
Durbin-Watson	1.95254
N 2000-2019)	17
t-statistics in parenthesis	0.975

Notes: ***Significant at the 1 percent level; **Significant at the 5 percent level; *Significant at the 10 percent level.

CONCLUSION

This paper has presented the current methodology used in determining the relevance of digital technology in regard to political, social and economic transformation. The paper identifies declining TFP growth trends in the majority of East Africa member states which are not fully compensated by an increasing digitization of growth as the major reason for the recent slowdown in growth. It also discusses the medium-term projections which currently extend to the year 2010. Given past trends and the history of downward potential growth revisions, the projections are on the optimistic side.

The main aim of the paper is to show the intricate nature of digitalization. First, we wanted to make a synthetic index, which may be used as a metric measure for the process. Identifying and quantifying digitization is not enough to understand the whole process, and so we wanted to validate the results using a panel data model. We assume that digitization has a direct and indirect effect on the economy. Panel regression analysis using GDP

as the dependent variable provided us with the intuitive notion that our index has a feasible effect on economic processes. Considering that we used a simple economic growth model, just for verification, there is obviously room for further research. Therefore, using modern models, this connection could be altered. Nevertheless, we may conclude that digitization may contribute to innovation or even be the main component in understanding how technology transforms the economy.

Looking at the complexity of digitalization; as Parviainen, et al said in their paper: "digital transformation is a monumental and multi-dimensional concept. There is no silver bullet for tackling digitalization". Therefore, combined efforts, commitment and collaboration and partnership among digital actors would be a key to ensure that Africa benefits from digitalization. The collaborative efforts would address challenges such as lack of investment, knowledge and skills development, infrastructure and material such as strong internet coverage, cyber security measures, adoption of policy and other regulation that not only improve digitalization but also give room to digital incentives to improve digital services and innovation and entrepreneurship in e-commerce for inclusive economic growth. All those strategies will improve governance in the digital arena, social protection, and inclusive economic development.

The real meaning of proclaimed people-centred region in East Africa is thus evolving and deepening. It is the creative and steadfast determination of East African people and their leaders in boldly venturing and overcoming the challenges and removing the bottlenecks that will deliver the benefits of ICT for all.

RECOMMENDATIONS

It is necessary to understand how, in a fast-moving technological environment, effective frameworks may be developed at the EAC level to fully leverage the opportunities created by rapid technological changes. There is therefore an urgent need for a new EAC legislative and regulatory paradigm. It is even more meaningful in the EAC as a developing region due to the opportunities to leapfrog technology and short-cut regulatory change. This new legislative and regulatory framework would ideally aim at facilitating the deployment of different technology options based on the establishment of an open, level playing field for all the ICT industry operators.

In addition, the following recommendations should be taken into consideration:

- Understanding these important roles played by ICT in national economies, policy measures of facilitating the expansion of telecommunications infrastructures through private and public investment should be pursued vigorously.
- Capacity building and training: ICT Skills, Training and Awareness
- Partner States should extensively develop sustainable ICT infrastructure in satellite towns more so in rural areas.
- Partner States should foster investment in terms of software's production and their commercialisation to enhance more job creation within the youth.
- Further researches needed to examine the role of ICT through telecommunications sector revenues, taxes and employments.
- Partner States should propagate any ICT information and research they are carrying to avoid replication and hence maximize experiences.

Lessons for future digitization

First, digitization has pushed the retail electronic payments system to cover virtually the whole economy, including government services, pushing the government to accept an electronic payments ecosystem. One spill-over effect has been the formalization of most informal transactions, raising hopes that informal markets in Kenya, and indeed Africa, will one day shift towards formality. M-Pesa-type products have led to a vibrancy of financial markets cutting across all sectors and improved

transactions at all levels from the formal to informal markets in Kenya and the East African region.

Second, Kenya shows how digitization can enable financial inclusion. The digital financial services platform has worked as a transactions platform, bringing the unbanked into the banking system. The platform supported the evolution of national retail payments; positioned banks as a platform to manage micro accounts through virtual savings products; enabled the evolution of virtual credit markets; micro insurance; and investments in government securities. It has also been useful in tracking fraudulent flows into personal accounts.

Finally, digitization is now driving fiscal policy designs, revenue administration, and public finance management. It is reducing leakages in revenue administration, but more importantly, the digital tax payment platform is an important innovation for efficiency and transparency. Indeed, the digital platforms have revolutionized the way payments to and from the government are made. In addition, government services are being digitized across ministries and government agencies.

REFERENCES

Annan, Koffi, Gordon Conway, and Sam Dryden. 2016."African Farmers in the Digital Age: How Digital Solutions Can Enable Rural Development." Special Issue (Magazine Article),

Arntz, M., Gregory, T. and Zierahn, U. (2019). “Digitalization and the future of work: macroeconomic consequences”, in Klaus, F. (Ed.) Handbook of Labor, Human Resources and Population Economics, Zimmermann (Editor-in-Chief), pp. 19-24.

Ayodeji,A. F.,Michae, L. B. & Thomas, N. S. (2013). Is the One Laptop Per Child Enough? Viewpoints from Classroom Teachers in Rwanda. *Journal of Information Technologies & International Development, Vol.9(3), PP.29–42.*

Banga, Karishma, and Dirk Willem te Velde. (2018). "Digitalisation and the future of manufacturing in Africa." supporting economic transformation, March 2018.

Blix, Marten. "The Economy of digitalization: Opportunities and Challenges." Confederation of Swedish Enterprise, 2015.

Bridges, Sarah, Louise Fox, Alessio Gaggero, and Trudy Owens. (2013). “Labour Market Entry and Earnings: Evidence from Tanzanian Retrospective Data.” Background paper presented at the CSAE Conference on Economic Development in Africa, Oxford University, March.

Capital Markets Authority. (2017). Stakeholders’ Consultative Paper on Policy Framework for Implementation of a Regulatory Sandbox to Support Financial Technology (Fintech) Innovation in the Capital Markets in Kenya.

Christian Bührer, Christian D. Hagist. (2017). "The Effect of Digitalization on the Labor Market." In the Palgrave Handbook of Managing Continuous Business Transformation, 115-137.

Clive, James. 2016. "Cybersecurity, Threats, Challenges, Opportunities." ACS,

Committee, Trade Union Adversary. 2017. "Digitalization and the digital economy: Trade Unions Key Messages."

Dean, Williams, Wolfe Trenton, Marcus Wolfe, and Holger Patzelt. 2016. "Learning from Entrepreneurial Failure: Emotions, Cognitions and Actions."

Degryse, Christophe. Digitalisation of the economy and its impact on labour markets. Brussels: European Trade Union Institute,

Degryse, Christophe. 2018. "Digitalization of the economy and its impact on labor markets." European Trade Unions Institute, February 2016. Economist, The Interagency Unit. "The inclusive Internet Index 20018."

DIODE (2018). Digital Economy Policy in Developing Countries. Strategy Brief. Development Implications of Digital Economies. Manchester

EAC Facts and Figures 2014

Evangelista, R., Guerrieri, P. and Meliciani, V. (2014), "The economic impact of digital technologies in Europe", Economics of Innovation and New Technology, Vol. 23 No. 8, pp. 802-824

Finger, G. (2007). Digital Convergence and Its Economic Implications, Development Bank of Southern Africa

Fossen, F.M. and Sorgner, A. (2018). "The effects of digitalization on employment and entrepreneurship", conference proceeding paper, IZA – Institute of Labor Economics

Freddi, D. (2018). "The employment effects of digitalisation – a literature review".

Fabunmi, B.A., Paris, M. & Fabunmi, M. (2006). Digitization of library resources: challenges and implications for policy and planning. International journal of African & African American studies, 5(2), 23-36.

Gigineishvili N, P Mauro and K Wang (2014). "How Solid Is Economic Growth in the East African Community?" IMF Working Paper No. 14/150.

Government of Uganda (2011), National Information Security Strategy, available at: www.sicurezzacibernetica. it/it/[Uganda]%20National%20Cyber%20Security%20 Strategy%20-%202011%20-%20EN.pdf (accessed 7 September 2020)

Ibrahim, Gamal, Witness Simbanegari, Anita Prakash, William Davis, Wilson Waseke, and Ashraf Patel Wasike 2019. "Industrial development in Africa: Opportunities, Challenges and Way Forward." Cooperation with Africa,

IMF (2019a). World Economic Outlook, Spring 2019. Washington, DC

Irniger, A., (2017). Difference between Digitization, Digitalization and Digital Transformation.

Katz, R. (2017). Social and Economic Impact of Digital Transformation on the Economy, International Telecommunication Union (ITU)

Katz, R., Koutroumpis, P., & Martin Callorda, F. (2014). Using a digitization index to measure the economic and social impact of digital agendas. info, 16(1), 32-44.

Koutroumpis, P. (2009). "The Economic Impact of Broadband on Growth: A Simultaneous Approach." Telecommunications Policy 33 (9): 471–85. Available at http://www.sciencedirect.com/science/article/pii/ S0308596109000767

Kunming, H.W.I. (2019). "Digital industry plays a bigger role in economic growth | China daily"

Laura Schelenz, Kerstin Schopp. (2018). "Digitalization in Africa: Interdisciplinary Perspectives on Technology, Development, and Justice." International Journal of Digital Society (IJDS), Volume 9, Issue 4, December 2018.

Mahaldar, O., & Bhadra, K. (2015). ICT: A Magic Wand for Social Change in Rural India. In Handbook of research on cultural and economic impacts of the information society (pp. 501- 525). IGI Global.

Makulilo, Alex Boniface. 2012. "Privacy and Data protection in Africa: A state of the art." International Data Privacy Law,

Mariscal, Judith, Gloria Mayne, Urvashi Aneja, and Alina Sorngер. 2019. Bridging the Gender Digital Gap. Economics E-journal,

Master Card. 2019. "Digital Commerce and Youth employment in Africa." White Paper, Master Card Foundation, 2019.

McKinsey Global Institute (2018). "Notes from the AI frontier – modelling the impact of AI on the world economy", Discussion Paper

Meagher K (2016). The scramble for Africans: Demography, globalisation and Africa's informal labour markets. The Journal of Development Studies, 52(4): 483–497.

Ministry of Finance and Economic Planning. (2014). Shaping Our Development" A Journey to Middle Income Status". Kigali - Rwanda: Government of Rwanda.

Ministry of Information Technology and Communications. (2017). ICT Sector Strategic Plan (2018-2024) "Towards digital enabled economy"

Moavenzadeh, John. 2015. The 4th Industrial Revolution: Reshaping the Future of Production. Amsterdam: World Economic Forum, 2015.

Ndung'u, N. (2017a). M-Pesa – a success story of digital financial inclusion. Practitioner's Insight, Blavatnik School of Government, University of Oxford.

Ndung'u, N. (2017b). Digitization in Kenya: Revolutionizing Tax Design and Revenue Administration. In Gupta, S., Keen, M., Shah, A. and Verdier, G. (eds.), Digital

Njuguna, Ndung'u. 2018. Harnessing Africa's digital potential: New tools for a new age.

Ntareme, H. and M. Issa. (2012). "Case Study: Academic Networking in Burundi." Royal Institute of Technology, KTH

Organisation for Economic Co-operation and Development (OECD) (2017), "Going digital: the future of work for women", Policy brief on the future of work.

Park, H. and Choi, S.O. (2019). "Digital innovation adoption and its economic impact focused on path analysis at national level", Journal of Open Innovation: Technology, Market, and Complexity, Vol. 5 No. 3, p. 56

Parviainen, Päivi, Maarit Tihinen, Jukka Kääriäinen, and Susanna Teppola. 2017. "Tackling the digitalization challenge: how to benefit from digitalization in practice." (International Journal of In formation Syst ems and Project Management) 2017: 2-3.

Perci, Okay, and Gyasi Kojo. 2013. "Internet Penetration in Africa Compared to the Rest of the World." Scientific and Academic Publishing, 2013.

Prakash, Anita. .2019. "Industrialization and Growth in Digital Age: Disruptions and Opportunities for Employment Led Growth in Asia and Africa." G20 Japan 2019.

Spigel B (2017). The relational organization of entrepreneurial ecosystems. Entrepreneurship Theory and Practice, 41(1): 49–72.

Stiglitz, E.J., 'East Asia's lessons for Africa', The Independent, 14 June 2013, http://www.independent.co.ug

Svensson, Mans, Calle Rosengren, and Fredrik Astrom. 2016. "Digitalization and privacy: A Systematic Literature Review." Lund University, 2016.

"Toward a Social Compact for Digital Privacy and Security." 2015.

Trendov, Niclos M, Samuel Varas, and Meng Zeng. "Digital Technologies in Agriculture and Rural Areas." FAO, 2019.

UNIDO & UNCTAD, (2011). Economic Development in Africa: Fostering industrial development in Africa in the new global environment, Report.

UN (2019). World Economic Situation and Prospects, UN, New York, NY

UNCTAD (2012b). Trade and Development Report 2012: Policies for Inclusive and Balanced Growth (United Nations publication, Sales No. E.12. II. D.6. New York and Geneva).

UNESCO (2019). UNESCO's Internet Universality Indicators: A Framework for Assessing Internet Development. Paris

UNSC (2016). Report of the Partnership on Measuring Information and Communications Technology for Development: Information and Communications Technology Statistics. United Nations Statistical Commission. E/CN.3/2016/13. New York, NY.

UTU. "ICT Facts and Figures." 2017.

Wamda. (2013). How digitization spurs economic growth and job creation around the world. Retrieved September, 13, 2013,

World Trade Report 2010: Trade in natural resources

World Bank Group (2016). World Development Report 2016: digital Dividends, World Bank Publications.

Velde, Karishma Banga and Dirk Willem te. Digitalisation and the Future of Manufacturing in Africa. Supporting Economic transformation, 2018.

Vries, Peer. "The Industrial Revolution." 158-161. Oxford University Press, 2008.

Xu, Min, Jeanne McDavid, and Hi Kim. (2018.) "The Fourth industrial Revolution: Opportunities and Challenges." *International Journal of Financial Research (Online Publication).*