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HARMONIZING TECHNOLOGY RESOURCES FOR INTRA-AFRICA TRADE: A DIGITAL TRANSFORMATION PERSPECTIVE.

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Abstract
In today's interconnected world, the framework of ICT infrastructure acts as the bedrock for enabling economic growth, allowing innovation, and furthering sustainable development. This paper undertakes a deep dive into critical components constituting appropriate technology infrastructure and its central role in the digital transformation journey. The paper relates how changing fortunes of digital transformation are bringing efficiency across industries and revolutionizing many sectors, by examining its multi-dimensional impact. A major concern of this research is related to digital transformation implications on intra-African trade. The paper looks into the myriads of challenges faced by the African nations in harmonizing their technological resources, which include gaps in ICT development, regulatory challenges, and the digital divide. Despite these challenges, the paper also highlights some of the opportunities that digital transformation presents for improving trade within the continent. Such opportunities include better supply chain management, improved market access, and the possibility of creating new business models with the use of digital platforms.
The paper also identifies strategic approaches that can easily help to realize such barriers in seamless trade within Africa. It discusses regional cooperation and policy harmonization for the realization of an enabling environment to achieve that growth of ICT. The role of public-private partnership to drive infrastructural development and innovation is further assessed, outlining successful case studies and best practices within and outside the continent. This paper heightens the call for concerted effort in harnessing the full potentials of ICT infrastructure in Africa. The digital transformation, with the challenges and opportunities it presents, needs to be harnessed into a factor for extraordinary intracontinental trade growth that engenders broad-based economic growth and sustainable development of African economies. The ideas in this paper shall help give critical insight to policymakers, industry players, and researchers on steps leading to an integrated and economically buoyant Africa.
Keywords: *Technology Infrastructure; Innovations; Tools and Systems; Enablers and Digital Transformation.*

I. INTRODUCTION

The world is moving at a fast pace to adjust into the 4th Industrial Revolution Era. The utilisation of technology resources will be pivotal role in enhancing trade relationships and economic growth

among African nations. Africa should grow big on digital transformation. The time for growth is now. When the pandemic accelerated, digital adoption showed the importance of connectivity and exposed a growing digital divide. A class of people have been left behind lacking access opportunity and skills. Africa's digital needs for people, businesses and governments became painfully evident today. Only one-third of Africans have access to broadband connectivity, the challenge is huge, and the digital divide is growing together. We should unite for Africa's historic digital transformation. Imagine every individual, business and government in Africa fully online by 2030. We need to invest strategically in the pillars of the digital economy. We can concentrate our efforts and catalyze action to promote inclusive and safe digital innovation, across infrastructure, public platforms, financial services business and individual skills. The work ahead is ambitious and we should transform the way that people, businesses, and governments work to fast-track economic transformation in Africa. What strategies can be implemented to create a digitally advanced Africa for the future? This paper explores the critical components of technology infrastructure, the impact of digital transformation, and its implications on intra-Africa trade. We delve into the challenges, opportunities, and strategies for harmonizing technology resources to facilitate seamless trade within the African continent.

II. PROBLEMATA

This is the fast-evolving Industrial Revolution Era, the 4th Industrial Revolution Era. The use of technology infrastructure is essential for fostering economic growth and enriching trade relationships among African countries. Though the digital transformation landscape in Africa faces challenges such as the widening digital divide, limited access to technology resources, and inadequate connectivity. Trading digitally within Africa is still difficult because of some of these challenges. What strategies can be implemented to create a digital advanced Africa for the future? Imagine everyone in Africa trading digitally without being exposed to scammers. The digital transformation landscape in Africa should be fully protected by regulations and it should be user-friendly.

III. HYPOTHESIS

By 2030, Africa will overcome its digital challenges, leading to a fully connected and digitally empowered continent. This transformation will enable seamless digital interactions, trade, and user-friendly experiences within Africa.

IV. AIM

The Fourth Industrial Revolution is rapidly approaching, with a speed never seen before. The research aims to identify strategies which can be implemented to create a digital advanced Africa for the future.

V. APPROACH

This research is approached from the angle of digital transformation. We delved into the critical components of technology infrastructure, the impact of digital transformation, and the strategies

needed to bridge the digital divide and enhance intra-Africa trade. We used mixed research methods in this paper, qualitative and quantitative.

VI. FINDINGS

A. Digital Education

Trade hasn't changed since colonial times. It remains overly reliant on extractive industries such as fossil fuels, metals, and ores. Although Africa represents 17% of the world's population, it only accounts for 2.3% of global trade extractive industries (Policy Reforms, 2022). It tends to be more capital intensive and less labour intensive; they create fewer local jobs and are more reliant upon foreign capital which needs to be repaid from profits (David Wadley, 2021). The prices of these goods also tend to be volatile making economies that rely on there more susceptible to boom and bust cycles. Policy makers and development partners haven't shown enough motivation to move African economies away from these extractive industries (Agyapong EK, 2022). Even though Africa's total trade has risen in recent decades. Global growth has increased at a faster rate, as a result Africa's share of the World Trade has stagnated, falling from a height of 5% in the 1970s to between 2% and 3% in recent decades (African Export-Import Bank's 2023). Even when African exports soared in the 2000s, they were only keeping pace with the broader worldwide expansion boom led by Chinas accelerating economy (MacLeod, Jamie and Luke, David 2013).

Africa's exports have experienced repeated recent setbacks, most notably in 2009, 2015 and 2020 (Economic Development in Africa Report 2021). These setbacks corresponded with global oil price shocks and illustrated how overly reliant Africa is on exporting petrol (Ahmed H. Elsayed 2023). Five of the top 30 oil producing countries in the world are African.

The continent has provided almost 10% of the world's oil in the last 10 years and fuel is the main export in 12 African countries, for half of these countries it makes up 90% of their exports but an over reliance on a volatile commodity. It doesn't create large numbers of local jobs; it is stunting the growth of Africa's trade and the wider development of African economies in general. African trade was dominated by 6 countries between 2016 and 2020; South Africa, Nigeria, Algeria, Angola, Egypt, and Morocco exported more than the rest of the continent combined. In total 26% of Africa's exports go to the EU, 18% go to other African countries and 15% goes to China. In terms of imports 26% come from the EU, 16% from China and 15% from elsewhere in Africa (J. William Carpenter 2021). The EU and China are vital for Africa's trade, but it is an unbalanced partnership (Tofe Ayeni 2022).

Africa only accounts for 3.9% of China's imports and only 2.2% of the EU's (Arnoldi 202). Although the continent's biggest exports are the extractive industries, mentioned above. Within

Africa the story is different. Inter African trade is dominated by manufacturing, which makes on 45% of the total fuels are second with 21% and foodstuffs third with 19%. These are only the formal numbers; recent estimates suggest that informal trade flows account for between 7% and 16% of intra African trade (African Trade Statistics 2020). Educational Technology is quite critical for the preparation of our young people to the future of market. Africa should introduce digital training. It should look at how to ensure that skills can easily come to the educational technology in place and the youth that would be part of such training should deliver their services over the IT platform. It should be on record that Africa should make it a must to prepare the youth for the market (Kim, S., Raza, M., & Seidman, E., 2019).

Technology companies should initiate their own programs to break the gap in educational technology from what is offered at the university and to the job market (Daniel Rodriguez-Segura 2019). Tech firms should do programs like skills for Africa initiatives. Governments should also do a digital talent program which aims to break the curve between the university and the market. We need strong foundational training for young people. Life skills and employability skills, young people need to prepare for the world of work (OECD 2021). Communication, creative thinking, problem solving, and all these are life skills that add up to the technical skills such as having the digital ability, but they also need to know what it takes to be a young person in the workplace (University of the People, “Why is Critical Thinking Important? A Survival Guide 2013). They need to know time management, interpersonal relationships, and entrepreneurial mindset all these combined and support the technical digital skills (Moren Lévesque 2019).

There's a quite need to address soft skills because the nature of work is changing. Look at Kenyan skill the market requires ready people to work, yet how are the training institutions at times to keep the foundation on that training? So, to address this, there is need to further enhance the linkage between the industry and the academia and this can be breached by education technology stakeholders to ensure that there is a continuous linkage for students in their training, in their institutions to collaborate and work closer with the universities. As mentioned above, the example of the digital talent program which can provide students to be connected and attached to industry provided. We have to transform how people prepare talents for the market, and this is now beyond ICT because it's touching all the other professional careers (Deborah Lovich, Sebastian Ullrich, Nick South, Ádám Kotsis, and Katie Lavoie 2013).

We should not only focus on digital skills, but also more importantly skills that help one to be innovative, to be able to start your own business from a tech ecosystem. Where we are, we have various skill sets that are critical, that change from basic intermediate to advanced and all these are very in varying proportions important in one way or the other. There are skills that can be skilled but there are skills that really can be applied across the border because they don't require you to have prior technical skill training in ICT, but just the general skills in ICT.

B. Harmonization of data governance and data formulation, harmonization for interoperability of soft and hard ICT infrastructure, Interoperability of data, harmonization of regional and cross

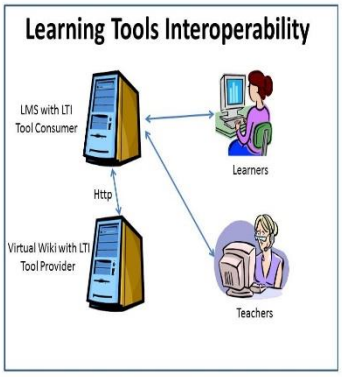
regional.

In terms of the regional integration initiatives, having a regional integrate in regional integration in terms of payment subscript it is important for ecommerce and digital trading general. For example, initiatives like the single euro payments area that would help digital trade in Africa. There are already small pilots in Africa at regional economic community level for example, through the southern African Development Community and the recently launched Pan African payment and settlement system. Africa should consider some of the digital trade challenges or issues. Africa should have a look out on legal and regulatory frameworks or harmonization contractual aspects and certain back-end arrangements (Busani Moyo 2023). For example, commitments in the world trade organizations guilds in terms of payments. Electronic payments services or cross-border payments as well or even regulation under the Bank of International settlements that might be helpful just from like regional integration, from the payment aspects of digital trade (FIS 2021).

In terms of foreign investments and sectors relevant for digital trade, there are quite a few digital services, tax laws that have popped up in Africa and these are like indirect taxes that cover digital services (Franziska Sucker 2024). Internally within a country and a few countries have some form of direct digital services tax that applies to nonresidents with no physical presence in their respective countries (Favourate Sebele and Tankiso Moloi 2022). These will be helpful to Africa because it effects impact restrictiveness in terms of foreign investments and such as relevant for digital trade.

Africa should include things like electrification and energy access deficits and what is needed for meaningful connectivity to participate in digital trade in a digital trade landscape (Manfred Hafner 2018). Africa needs to look at access to appropriate devices, affordable data, fast high-quality Internet connection. Africa needs to have meaningful connectivity and electricity if it doesn't have these then countries can't even participate fully in the data economy and in digital trade. Just adding to the payment aspects of digital trade it also overlaps with the connectivity issues in terms of people using a mobile phone for entrepreneurship or for business activity, the digital divide and digital identity issues (Dr. Amani Abou-Zeid 2023).

One need to have a digital identity and financial inclusion in order to interact in a digital payment system and therefore have an inclusive great ecosystem in different African countries. So, Africa needs to have regulatory convergence and a payment system that complements connectivity issues. It’s the needs to be overlapping, considerations. You cannot just be digital trade in isolation especially in the context of African countries, where we don’t have the enablers to have an efficient digital trade system (Kingsley Ighobor 2020). African Union is in the process of finalizing a data governance, a framework that could be extremely useful, of course as it will be continent wide and help to provide a guidance and framework for data content, it will



deal with the IPR rules including data restrictions of privacy, the issues around nationalizing data and whether that can be used or accessed outside countries (Mercy King'ori, Ulric Quee, Hunter Dorwart 2023).

The also,rate initiative also from the African Union on interoperability primarily focuses on digital, but also more broadly on interoperability. These two initiatives of course along with the e-commerce protocol which is much anticipated from the African continental free trade area, which was part of phase three with a target for the end of 2020 but clearly is delayed (Dr Alastair Tempest 2020). Are we very relevant going forward in the next couple of years? It is high time to also focus on developing usages and developing more importantly the digital, so that Africa does not become just a simple kind of consumer digital, but also an active actor in terms of usage and in terms of pages. If you look at the main key facts today in terms of the digital video traffic, the mobile data has grown by 20 times in the last five years. Even if the access to the Internet to the Africans is still less than 30%, to the precise it's 27% (Laura Ceci 2024).

If we look at the entrepreneurship ecosystem and developing of the digital and innovation industry and look at the ecosystem it has grown by more than 10 times also in the last five years in terms of incubators accelerators all kinds of tech hubs any front, we still have all policies (Eristian Wibisono 2022). The framework is still not flexible enough, still not adapted to this new sort of economic shiprock. It is something very specific to Africa, so we see the defragging in many kinds of services, the most common one is about the mobile money which is a typical example in terms of the infrastructure installed (Fatema Huzefa 2020).

One should remember that we are not around the classical financing resistance. We need to have a venture financing system, but it's not very spread out around the continent. Digital finance is becoming really a clear driver of social and financial inclusion in Africa. Digital adoption in businesses and more importantly the government levels is still very slow, especially the government when you're talking about the digital growth across Africa. Only a few governments at the end have implemented digital strategies and this is really a factor. Phones are a major tool for social inclusion. Mobile money accounts have more than doubled over the last five years in Africa. Most importantly, we have more mobile accounts that bank accounts with a very low penetration of the banking traditional sector.

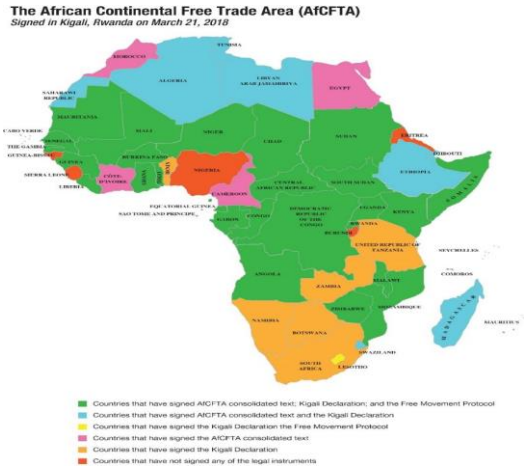
A lot of countries today in Africa don't have the full identification of their population and this is quite a major barrier since if you don't have an IT income taxes to complex services, so it has an impact on social inclusion (Africa Digital Identity Landscape 2022). The digital ID can be a major tool or major way to try to reach this gap and to make again kind of leapfrog. Moving directly to the digital ID which can be a much easier way to have the full identification of the population, which is a major point for moving into the digital economy. Modernizing the policies, is important and some people say no we have policies on that entry and then we want to move to the economy of the next century so there is a huge gap hereon today policies. In terms of digital goal services, many countries digital data and digital document is not recognized as legal document (Africa

Digital Identity Landscape 2022).

Digital ID does not have the same value as a physical document, it is kind of a showstopper. This is to move sweet the government level, and the number of countries are making this move in terms of policies. All the policies related to entrepreneurship, innovation environment and how to stimulate. Several experiences around the continent also are put in place. Things to be addressed at the very early stages, population with a different education approach and kind of traditional approach. Three types of population we have users, the business leaders and the tech experts. Therefore, three times this should be covered, these are really the key enablers to moving to the next level. Regional collaboration in digital economy is extremely important. Staying kind of fragmented in the markets will not help to move to the next level.

The region collaboration is important in terms of developing all kind of infrastructure, to make it to have all kind of economies of scale, to make it faster when you have the cooperation at the sweater regional level, but most importantly in terms of markets the regional market is huge in Africa. As long as we have a home all the barriers between the countries are put down and as long as we have a seamless market across the different countries. This is a major point if we want to have larger and bigger digital champions in Africa, we need to have access to and this is the way to attract venture capital. For example, Africa focuses on the region that they know that the market is so fragmented. We have a lot of very innovative startups. Our local markets are small, they don't have the ability to draw or to attract venture funds. The Erasmus program, in Europe which was a way to develop the European more citizens. Why not do digital kind of restaurants in Africa to have an exchange between the students that can really enable this regional market for the future? During covid Ethiopia’s objectives was to ensure Internet access for all, being defined as both a function of affordability and conductivity.

Ethiopia telecom being government owned and the single player in the in the telecom space in Ethiopia was able to move quite quickly. They were able to slash the cost of services introducing price cuts above 65% tariff reduction for residents on broadband and 69% for enterprises (Reuters 2024). They also introduced anything to stay at home. The urgency to develop Ethiopians digital foundation in Ethiopia is increased. Ethiopia didn't have a foot lockdown but students, schools closed so making more bandwidth available for students was crucial. Helping promotes online working and learning was fundamental in the last three years. The Ethiopian government took bold decisions, one of these decisions where to liberalize and partially privatize the telecom sector. This is a major milestone for a country where telecom services are provided to over 100 million people by a sole government state owned enterprise (Behailu Shiferaw Mihirete 2022). Huawei is an organization worldwide; it has what we call in place a global collaboration infrastructure. Huawei let its global workforce who were forced at one point by government ruling or by lockdowns to work from home to increase the capacity of global infrastructure. To increase the capabilities of this global infrastructure, to allow its staff to work at home and from home share information across teams and departments as they go forward in their daily work.



Huawei opened global infrastructure that they work with to their partners and customers worldwide to be able to also work on similar and same global infrastructure for their daily needs. Not so much in communication with the employers but also in communication and collaboration with their partners. Sometimes in some home offices it's not just daddy or mommy working from home, but it's also children not going to school. Sometimes also the children are at home and have to learn from home, so remote office turns into remote learning solution. This global infrastructure becomes not only a remote learning infrastructure for children in their collaboration with school, curriculum, teachers, but also from perhaps a Medical University medical student (Shenzhen 2021). Retired medical specialists needed the infrastructure to be a medical specialist remotely. Clinical collaboration infrastructure telehealth services are other examples of how Huawei system and services are being worked on worldwide. This is so because its global infrastructure is built on the latest and greatest of technology.

C. African Trade Profile

Madagascar is a country supplies 80% of global vanilla. Requirements of all the vanilla that is consumed in the world, 80% of it originates from Madagascar. Madagascar is quite key to industries that require this commodity, however what is curious is that Madagascar exports the majority if not all the vanilla pots that it grows all the way to Europe (David Pilling 2018). The parts exported to Europe when they get there, they are further processed, and they are then integrated into different industries, the perfume industry, and the confectionery industry. Then find their way back to the African continent and revise them at a premium, because they've got higher values that has been added to them. Madagascar vanilla story is the quintessential story of the way the African continent trades with the world.

For example, copper from Zambia that will be exported to China and come back to the continent in the form of copper cables and copper wire. Companies of all sizes use big queries to uncover new insights from their data like cost savings operation and we buy it at a premium. Cocoa from West Africa coast avoid Ghana. They will be exported to Europe and come back to the continent, and we buy it as delicious Belgian chocolate. This is the story of the African trade interface. I want this to begin to get to the grips with the reason why our structure of trade in the continent is the way it's been mentioned previously that the level of trade within the African continent is very low 16%. If we compare this level of intricate trade to for example how Europe trade with itself 60% of European trade happens amongst European countries 60% of trade in North America happens amongst the North American countries.

Similarly with Asian it's over 30% so there's a lot of room for growth in this space and there's an

agency that Africa needs to begin to trade more with itself. Precisely because of the value and the benefit that trade brings to economic prosperity. If the continent is going to grow, if we're going to create the jobs that we need to create particularly as part of our post COVID reconstruction we have to make sure that we use trade as a key instrument for transformation of the African economy. Madagascar still remains one of the poorest countries in the world. This country that exports 80% of vanilla to the world, still has a per capital income of 1700 US dollars.

Compare that to US pickup better income of 63,000US Dollar, compare that to even South Africa of 13,000US Dollar, that means that this profile of Africa of continuing to trade with the rest of the world sending primary commodities whether they're agricultural or mineral and buying back value-added commodities it's keeping us in the perpetual poverty cycle. This is an issue that we need to confront and to address as Africa. Why is the African trade profile like this? It's important that we embed our current trade profile as a continent in our history, because we would be remiss. If you do not acknowledge the fact that we are still perpetuating colonial patterns of production colonial patterns of consumption and colonial patterns of distribution on this continent in the 1800s, when colonial masters from different parts of the world Europe and everywhere else landed on the African continent as part of the extension of the imperialist agenda.

Although the priority was one and one alone to exploit Africa’s natural and human resources for the betterment and the growth of countries outside of the continent. That's exactly how then the trade profile of Africa was set up. It was about extracting natural resources and sending them to other countries to help with their development and industrialization. It's a pity that we still have somewhat similar profile that we've had since colonial times and that is why it becomes urgent that we address this fundamental challenge. The fundamental challenge of reversing the colonial patterns of production consumption and distribution from the African continent. One of the key things that we need to look at when it comes to production is the fact that we, as Africa we represent 17% of the global population but we only contribute 2% to global manufacturing and we only have a say of 3% of global trade. This confirms the fact that our paternal production is still very much in the manner in which it was set a long time ago. Africa remained still largely exporters of raw materials and Africa still remain importers of value-added products.

Let's look at Africa’s patterns of consumption, similarly there's still a fundamental preference for products that are coming from outside of the continent. This is reflected in the fact that African countries are not trading too much with one another. 84% of Africa’s trade is with the rest of the world. Even if Africa move beyond the trade realm levels of intra African investments. Infrastructure still structured in a way that it leads from a natural resource point out to the nearest exit port, even today it's a very extractive plan of infrastructure. There’s very little infrastructure that countries and functional viable infrastructure take trade fronted with issues of gauges that the gauges don't match. The interconnectivity interrupted some of the roles. So, in terms of our all pending, there's still a lot to be done. To make sure that we cross infrastructure, start to build end to create on the African continent. What are the implications of all of this to us if we continue to not focus on adding value to our primary commodities? We are costing ourselves as Africans,

critical jobs we're costing ourselves, critical skills we're costing ourselves, ability to move up the value chain, and become a viable player in the global economy. We cannot even begin to start talking about the participation of Africa in the fourth industrial revolution if we are still struggling with the second industrial revolution matters. It is therefore very urgent that all of us as the African citizenry begin to address the issue, redress, correct the colonial patterns of production consumption and distribution on the African continent now. How can we work together as governments, as citizens, as the global community even to address this matter and to contribute to increasing our levels of intricate trade?

VII. RECOMMENDATIONS

Emphasize the importance of inclusive digital transformation that addresses the digital divide and ensures that all segments of the population have access to technology resources and skills development. Highlight the significance of intra-Africa trade and the role of harmonizing technology resources in facilitating seamless trade within the continent. Propose strategies to enhance trade relationships among African nations. Advocate for investments in digital education to prepare the youth for the future job market. Encourage collaboration between educational institutions, industry stakeholders, and governments to bridge the gap between academic training and market demands. Stress the importance of developing soft skills alongside technical skills to prepare individuals for the evolving nature of work. Recommend initiatives that focus on communication, problem-solving, creativity, and entrepreneurial mindset. Suggest the harmonization of data governance and formulation to ensure interoperability of soft and hard ICT infrastructure. Propose initiatives that promote regional integration in digital trade and address legal and regulatory frameworks for cross-border transactions. Advocate for the adoption of digital finance to drive social and financial inclusion in Africa. Highlight the role of mobile technology in expanding access to financial services and recommend policies that support digital payment systems. It is crucial to modernize policies related to digital services, data governance, and digital documents to keep pace with the evolving digital landscape. This includes recognizing digital documents as legal equivalents, promoting digital identity systems, and creating an enabling regulatory framework for digital trade and commerce.

VIII. CONCLUSION

This research paper examines the importance of technology infrastructure in the 4th Industrial Revolution Era and its impact on intra-Africa trade. The COVID-19 pandemic highlighted the digital divide, with only one-third of Africans having broadband access. The goal is to have every individual, business, and government in Africa fully online by 2030. This requires strategic investment in the digital economy, promoting inclusive and safe digital innovation. This involves leveraging technology across infrastructure, public platforms, financial services, and individual skills. Robust regulations are necessary to protect users and foster trust. A user-friendly digital landscape should protect Africans from scammers and ensure secure transactions. Governments, businesses, and individuals must work together to harmonize technology resources, facilitating seamless trade within the African continent.

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XI. CONFLICTS OF INTEREST

The author declares no conflicts of interest.

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