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Review Article

A Study on AI Impact of Post Corona-19 in Africa

Dong Hwa Kim [1]

[1]*Adama Science and Technology University, Adama City, Ethiopia*

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Abstract *- This paper deals with the impact of AI after Corona-19. The advanced have been preparing AI and the 4th wave for the future. However, Almost all African Countries do not recognize how those technologies will impact on economy and jobs. This paper suggests the strategy (education, policy, niche approach) of AI implementation after reviewing many materials.*

The author hopes this paper be a good reference and use it usefully.

Keywords *- 4th wave, AI, Start-up, Ethiopia, Africa.*

I. INTRODUCTION

Technology is the key to economic growth and job creation. Especially, the core technology gives an impact on economic growth as well as the quality and quantity of jobs. Therefore, poverty remains unless driving growth by technology that has an important bearing on jobs.

Historically, all economic growth has been following a technology trajectory that can transform economic structure from agriculture (First revolution) to ICT (4th industrial revolution), and currently, its contribution aspects are diversifying such as ICT, service, tourism, manufacturing, platform, and agriculture and fish by high-tech.

That is, these processes have been transforming from agriculture-related jobs in the first industrial revolution (low wage jobs) to high-technology-related jobs (highly productive jobs).

This transformation is also extending a wide variety of regions from the Western world to Asia.

However, this transformation has yet to happen in Africa, and this left African remain poverty.

High-quality and productive jobs are key to reducing poverty, but there are very few 4th wave related jobs and start-ups.

So, because it is not good for the future of work as well as jobs, the policy has to be a key in order that technologies should have the role for the significant driver of economic growth and job.

While technological breakdown has often occurred on a new trajectory of productivity from venture ideas in Western society.

In the past three revolutions, these breakdowns have been referred to as simple technology revolutions.

However, the current world is now at the beginning of a new revolution as the 4th wave.

Recent breakthroughs are a variety such as ICT, biotechnology, knowledge, contents, web services and developer, programmer, computer management, planner, designer, and etc.

Increasingly, AI-related jobs are available to replace or complement workers at all levels.

This paper aims to provide the way for the preparation of the 4th Industrial Revolution through reviewing.

As this paper focuses largely on the impact of AI, it helps to broaden collective understanding of how AI impact economic activity and jobs and touch off the attraction of AI for firms, labor markets, education, policy, and others.

II. REVOLUTION AND JOB PATTERN

Revolution give an influence on economic and job patterns. Figure 1 shows the evolution of technology in our human being life, such as the agriculture revolution (First revolution), industrial revolution (Second revolution), information revolution (Third revolution), and knowledge revolution (Fourth revolution) that will come in the future.

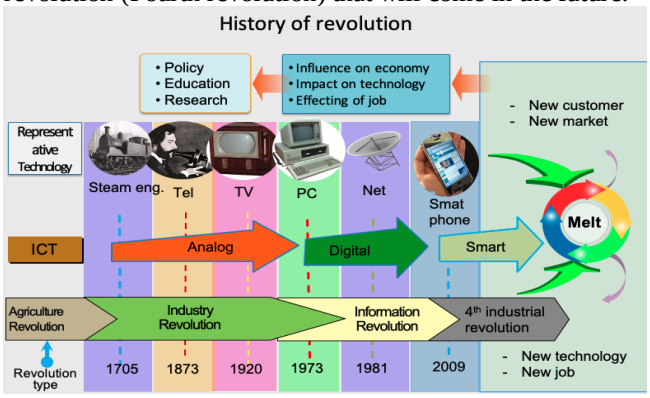


Fig. 1 Revolution and Technology

Three revolutions from the first revolution to the third revolution have already passed. However, the fourth revolution is coming from now, and its impact is bigger than any other revolutions that we had to have experienced in the past.

The problem is that the current economy is built on ICT. Without introducing ICT, we cannot build any economy and social activity.

Bad ICT infra will make more deficiency in everything and in everywhere during the 4th wave.

Therefore, young generations of the future will take this fourth revolution and have to live under this situation.

It means that we have to prepare from primary school to university.

4th revolution can also call a smart revolution because the future revolution will be a smart society with new knowledge, ICT, AI, and etc.

In the 4th wave era, all technologies went in one place and gave influenced each other.

And results will create new technology and job. This pattern also will impact our economy and change social patterns within a short time.

Once a time it happens, it spreads quickly over the world and makes a new paradigm.

We call it a platform, and these platforms lead economy as Facebook or Google, or Air BnB, even they do not have any technology by themselves.

However, they give a big impact on our economy. Its technology is idea and knowledge. Its pattern is speed and creation. So, education and life patterns should be organized again quickly.

ICT's basic philosophy is on time and speed. If we lose exactly on time, we cannot catch up or keep abreast in current technology because of ICT's speed and dynamically changing.

By marketing chart, the top 10 valuable brand technology of 2020 (Table 1) is ICT Company. The top 10 most valuable brand company is almost ICT Company (Table 2).

From these facts, we can see how much the ICT influence is big, and we can see what we must do.

Table 1. Top 10 Valuable Brand Technology Companies

Ranking	Brand	2020 Brand Value	YoY % Change	Country	Sector
#1	Amazon	$220B	17.5%	United States	Retail
#2	Google	$160B	11.9%	United States	Tech
#3	Apple	$140B	-8.5%	United States	Tech
#4	Microsoft	$117B	-2.1%	United States	Tech
#5	Samsung	$94B	3.5%	South Korea	Tech
#6	ICBC	$80B	1.2%	China	Banking
#7	Facebook	$79B	-4.1%	United States	Media
#8	Walmart	$77B	14.2%	United States	Retail
#9	Ping An	$69B	19.8%	China	Insurance
#10	Huawei	$65B	4.5%	China	Tech

Table 2. The 10 Most Valuable Brand Companies

Brand	Brand Value	1-Yr Value Change	Brand Revenue	Company Advertising	Industry	Item
#1	Apple	$205.5 B	12%	$265.8 B	-	Technology
#2	Google	$167.7 B	27%	$136.2 B	$6.4 B	Technology
#3	Microsoft	$125.3 B	20%	$110.2 B	$1.6 B	Technology
#4	Amazon	$97 B	37%	$211.4 B	$8.2 B	Technology
#5	Facebook	$88.9 B	-6%	$48.8 B	$1.1 B	Technology
#6	Coca-Cola	$59.2 B	3%	$23.8 B	$4.1 B	Beverages
#7	Samsung	$53.1 B	11%	$221.6 B	$3.6 B	Technology
#8	Disney	$52.2 B	10%	$33.8 B	$2.8 B	Leisure
#9	Toyota	$44.6 B	0%	$190.8 B	$4.6 B	Automotive
#10	McDonald's	$43.8 B	6%	$96.1 B	$389 M	Restaurants

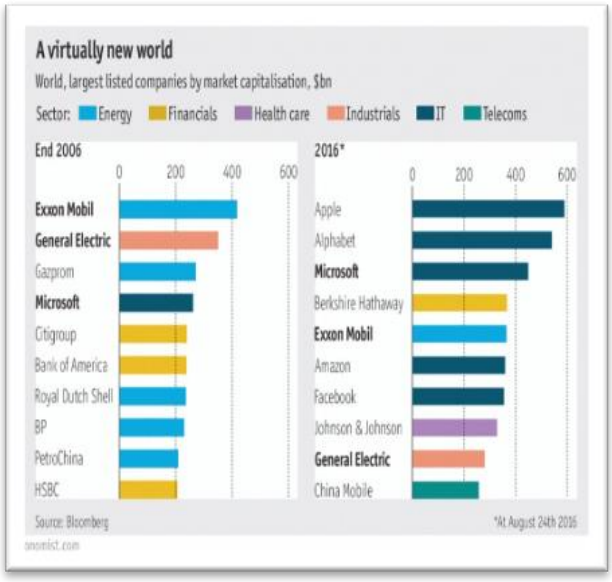


Fig. 2 Virtually New World Company

In Table 1, all brands are ICT companies, and Walmart has already changed to an online shopping mall to survive in 2018. It means they introduced ICT technology.

In Table 2, almost company show the most valuable brand except Coca-Cola, Disney, and Macdonald. Here, also Toyota has already announced to change for cooperation with the electronic company.

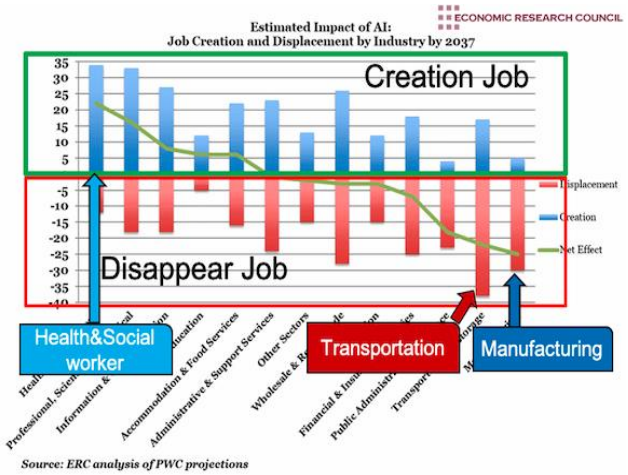


Fig. 3 Job Creation and Disappear. The Young Generation and Policymakers Must Know

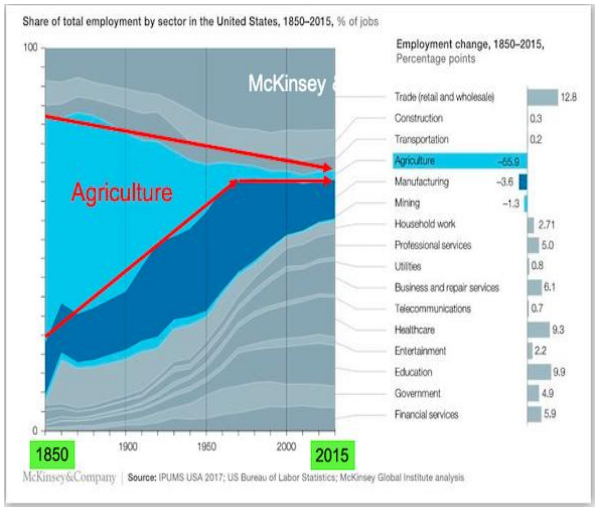


Fig. 4 Economic Pattern: The Economy Was Done Almost Agriculture in 1850 But Only 5% In 2015 (165years). It Will Be Done Faster in The 4th Wave Era

Fig .2 illustrates a virtually new world company, and only one company was in 2006 but almost are ICT company after 10 years in 2016. We must recognize this paradigm.

Fig .3 and 4 express job patterns depending on the revolution from the 1st revolution to so far. In figure 3, manufacturing and transportation jobs almost disappear, and instead of those, health and social jobs are created.

Rapid advances in artificial intelligence (AI) and automation technologies have the potential to significantly disrupt labor markets.

This report[1] gives so much technological and wide topic about 4th wave (4IR).

They illustrate that the 4IR takes place in areas as diverse as robotics, sensors, big data, automation, and artificial intelligence (AI) together as well as digital and biological.

Because 5G connectivity enables the harnessing of data at high speeds and low latency regardless of location, 4IR speeds up and stronger soon.

This report mentions the 4IR impact on many areas of industry, as shown in Fig .4.

III. REVIEW OF LITERATURE FOR STRATEGY

A. Review on Impact of AI on Economy

To build a strategy, we must know the prospect of agency about AI[2, 3, 4, 5]. From these prospects, we can see why AI is important to the economy and job and why the government has to make policy and education system.

Basically, the artificial intelligence (AI) related technology (H/W, S/W, Algorithm, Policy, Planning, Management, Education, Strategy planning, Seminar, Workshop) is to give an impact on many technologies and businesses of the global economy as well as raise nation's status to a higher level.

This is not surprising news given recent progress because there have been doing breakthrough results, and demonstrations of AI, as well as the increasingly pervasive products and services already in wide use.

The United Nations' Sustainable Development Goals (SDGs)[6] and ITU[7], USA[8] have mentioned on how AI will influence on arguably unprecedented changes in all of these of live and work.

Some research papers offer a framework for thinking about how to model the economic impact of AI [9], technologies on the dynamically changing automation[10], and the increasing use and potential of AI[11].

[1] Fitch Solutions, The Fourth Industrial Revolution: how ready are you? 2019.

[2] Sherouk Zakaria, Artificial Intelligence for Africa: An Opportunity for Growth, Development, and democratization, 2017.

[3] Morgan R. Frank, toward understanding the impact of artificial intelligence on labor, 2019.

[4] Horizon 2020, Work program 2018-2020, Future and Emerging Technologies, 2019.

[5] Fourth Industrial Revolution: Opportunities, Challenges, and Proposed Policies DOI: http://dx.doi.org/10.5772/intechopen.90412.

[6] International panel of the UN commission on S&T for develop, 2019.

[7] ITU, Assessing the Economic Impact of Artificial Intelligence, 2018.

[8] U.S. government to define "emerging technologies," impacting CFIUS and expert controls.

[9] Electronic copy available at: https://ssrn.com/abstract=3123798 Modeling Automation, Daron Acemoglu Pascual Restrepo, February 4, 2018.

[10] International Federation of Robotics Frankfurt, Germany, The Impact of Robots on Productivity,
Employment and Jobs, April 2017.

[11] U.S. government to define "emerging technologies, 2018.

All research papers and reports have been mentioning that AI has large potential to contribute to global economic activity. AI is not a single technology but a fusion technology that can drive manufacturing, computer vision, natural language, AR/VR, robotic and process automation, IoT, a sensor device, and others.

By 2030, some simulation results reveal that 70 percent of companies may have adopted at least one type of AI technology, but less than half may have fully absorbed the five categories [ITU].

AI could potentially deliver additional global economic activity of around $13 trillion globally by 2030, or about 16 percent higher cumulative GDP compared with today[12].

The rapid development of AI influence technological breakthrough as well as impacts human society and economic growth. Research on AI economics is growing fast on the productivity and employment effects of AI.

This paper reviews recent literature in order to answer three key questions. Our review is to reveal what studies express and how AI would have a different and broader impact such as ICT, social pattern, job wage, manufacturing system, and education paradigm than previous technologies.

Firstly, what approaches are being used to represent the role of AI in economic growth and job?

Secondly, will AI technology have a different impact on economic growth than previous new technologies? Through this question, we can pose the question of whether AI can be an important fact to introduce in our education.

Third, in which aspects will AI have an impact, and what is the empirical evidence of these effects of AI?

Namely, studies on the labor market seem to have reached a consensus on the fact that AI may increase unemployment within sectors but almost worry about an opinion that may create employment gains at the aggregate level.

AI also increases the income gap between underdeveloped countries, advanced countries or low-skilled workers, and high-skilled workers[13].

Many believe that AI impacts international trade and education.

The adoption of AI gives widen gaps between countries, companies, and workers[14].

[12] EU commission, Future and Emerging Technologies, 2020.
[13] Morgan R, Toward understanding the impact of artificial intelligence on labor, 2019.

B. Impact on Countries and Policy

AI may impact widen gaps between countries or reinforce the current digital divide because AI encompasses fields as diverse as robotics, autonomous vehicles, 3D printing, and nanotechnology and quantum computing as the core of the 4th industrial revolution[1516].

It is important to think about how AI introduce and developed in its areas. For that, education and skills should be done again. For instance, entrepreneurship training to develop job creators as well as job seekers, adult education, life-long learning for AI.

It is reskilling to deal with current and future technological transitions.

So, countries need different strategies (niche strategy for the country) and policies because AI adoption levels vary. AI leading countries can give an influence others in AI-related technology over developing countries.

Leading countries will capture an additional advantage in net economic benefits compared with today, while developing countries may capture only a very small percent.

Many developed countries have no choice anymore but to push AI to capture higher productivity growth as their GDP growth momentum slows, in many cases partly reflecting the challenges related to aging populations[17].

Moreover, wage rates in these economies are high, which means that there is more incentive than in low wage, developing countries to substitute labor with machines[18,19].

Developing or underdeveloped countries tend to have other ways to improve their productivity by using the existing method and the traditional technology, including catching up with the best practices. So, they have more incentive to restructure their industries instead of AI or advanced technologies in policy and investment to push.

However, this does not necessarily mean that developed economies are set to use AI and high technologies better, and developing economies are

[15] President office of USA, Artificial Intelligence, preparing for the future of AI Automation, and the Economy, 2016.
[16] David H´emous, The Rise of the Machines: Automation, Horizontal Innovation and Income Inequality, 2016.

[17] The Fourth Industrial Revolution (4IR) is upending the nature of work as we know it. Policymakers are struggling to grapple with this future in the West, but for African countries—and developing countries generally—the outlook appears even more bleak, 2019.
[18] Morgan R, toward understanding the impact of artificial intelligence on labor, 2019.
[19] AUS University of Adelaide, The Impact of AI on the Future of Work and Workers, 2018.

destined to lose the technology megatrend environment of the world.

Because advanced countries believe that the economy depends on the choices of AI-related technologies, they make to strengthen their AI-related foundation and enable their capabilities to manage proactively and transit their economic path.

Some countries are already trying to shape bold paths for the future. For instance, Swiss has a national strategy in place to become a global leader in the AI supply chain and Blockchain and is investing heavily.

Table 3. National AI Strategy

Argentina [https://futureolife.org/ai-policy-argentina/]: The Argentinian ministry of education, culture, science, and technology is developing a national AI plan.
Australia [https://futureolife.org/ai-policy-australia/]: Australia has dedicated $29.9 million in the country's annual budget to promote and guide the development of AI.
Austria [https://futureolife.org/ai-policy-austria/]: Austria has an advisory Robot Council that is developing a national AI strategy.
Brazil [https://futureolife.org/ai-policy-brazil/]: Brazil is creating eight AI laboratories and has adopted the OECD AI Principles.
Canada [https://futureolife.org/ai-policy-canada/]: Canada has a national AI strategy called the Pan-Canadian Artificial Intelligence Strategy.
Chile [https://futureolife.org/ai-policy-chile/]: Chile created an expert committee that is developing a National AI Policy.
China [https://futureolife.org/ai-policy-china/]: China has a national AI strategy, denied under the "New Generation Artificial Intelligence Development Plan."
Denmark [https://futureolife.org/ai-policy-denmark/]: Denmark has a digital strategy that includes a focus on AI along with other technologies.
Estonia [https://futureolife.org/ai-policy-estonia/]: Estonia is developing a legal framework for the use of AI in its country, including a bill on AI liability.
Finland [https://futureolife.org/ai-policy-Finland/]: Finland has an Artificial Intelligence Programme guided by a steering group under the Ministry of Economic Affairs and Employment.
France [https://futureolife.org/ai-policy-france/]: France has a national strategy for AI called "AI for Humanity," which is outlined in the "Villani Report".
Germany [https://futureolife.org/ai-policy-germany/]: The German Government adopted its Artificial Intelligence Strategy in November 2018.
India [https://futureolife.org/ai-policy-india/]: India denied a national policy on AI in a working paper titled, "National Strategy for Artificial Intelligence #AIforAll."
Ireland [https://futureolife.org/ai-policy-ireland/]: The Irish government has hosted AI workshops and launched a national AI Masters program.
Italy [https://futureolife.org/ai-policy-italy/]: Italy has an interdisciplinary AI Task Force launched by the Agency for Digital Italy.
Japan [https://futureolife.org/ai-policy-japan/]: Japan has an "Artificial Intelligence Technology Strategy" and has also included AI in its integrated innovation strategy."
Kenya [https://futureolife.org/ai-policy-kenya/]: The Kenyan government created a Blockchain & Artificial Intelligence task force.
Lithuania [https://futureolife.org/ai-policy-lithuania/]: The Lithuanian Artificial Intelligence Strategy was released in April 2019.
Malaysia [https://futureolife.org/ai-policy-malaysia/]: The Malaysian government is developing a National Artificial Intelligence Framework and establishing Digital Transformation Labs.
Mexico [https://futureolife.org/ai-policy-mexico/]: The Mexican government supported the creation of the white paper, "Towards an AI Strategy in Mexico: Harnessing the AI Revolution."
Netherlands [https://futureolife.org/ai-policy-netherlands/]: The Netherlands launched the Strategic Action Plan for Artificial Intelligence in October 2019.
New Zealand [https://futureolife.org/ai-policy-new-zealand/]: New Zealand has an AI Forum to connect and advance the country's AI ecosystem.
Norway [https://futureolife.org/ai-policy-norway/]: Norway published a National Strategy for Artificial Intelligence in January 2020.
Poland [https://futureolife.org/ai-policy-poland/]: Poland launched the Artificial Intelligence Development Policy in Poland for 2019–2027.
Russia [https://futureolife.org/ai-policy-russia/]: The President of the Russian Federation released a national AI strategy in October 2019.
Saudi Arabia [https://futureolife.org/ai-policy-saudi-arabia/]: Saudi Arabia established a government agency called the Saudi Data and Artificial Intelligence Authority in August 2019.
Serbia: [https://futureollife.org/ai-policy-serbia/] The Government of the Republic of Serbia adopted the Strategy for the Development of Arti cial Intelligence in the Republic of Serbia.
Singapore [https://futureolife.org/ai-policy-singapore/]: Singapore launched a National AI Strategy in November 2019 and has a national AI program called AI Singapore.
South Korea [https://futureolife.org/ai-policy-

south-korea/]: South Korea has an Artificial Intelligence Information Industry Development Strategy.
Spain [https://futureolife.org/ai-policy-spain/]: Spain published an AI RDI strategy in March 2019.
Sweden [https://futureolife.org/ai-policy-sweden/]: The Swedish government has released a "National Approach for Artificial Intelligence."
Tunisia [https://futureolife.org/ai-policy-tunisia/]: Tunisia has created an AI Task Force and Steering Committee to develop a national AI strategy.
United Arab Emirates [https://futureolife.org/ai-policy-united-arab-emirates/]: The UAE has a national strategy for AI and was the rst country to name an AI Minister.
United States of America [https://futureolife.org/ai-policy-united-states/]: The US launched the American AI Initiative in February 2019.
United Kingdom [https://futureolife.org/ai-policy-united-kingdom/]: The UK government launched a Sector Deal for AI to advance the UK's ambitions in AI consistent with its Industrial Strategy, and taking into account the advice of the Parliament's Select Committee on AI.
Uruguay [https://futureolife.org/ai-policy-uruguay/]: Uruguay's industry, mining, and energy ministry launched a public consultation of Artificial Intelligence for the Digital Government in April 2019 and is developing a strategy based upon its findings.

Fig. 5 AI Strategy Map (Green: Strategy, White: No Strategy, Africa Country Has No Strategy With Table 3, Source: Future Of Life: Https://Futureoflife.Org/Ai-Policy/?Cn-Reloaded=1).

This example illustrates well that policy needs to support the development of emerging technologies (Table 3 and Figure 5).

C. Impact on Business and Companies

AI technologies may lead to a performance gap between front-runners on one side and slow adopters and non-adopters on the other.

At one end of the business or project over the next five to seven years, revenue or benefits may be disproportionate. Of course, the traditional technology with its highly disruptive technologies and integration of the digital and physical worlds presents significant challenges and opportunities for businesses too because of price, productivity.

In order to obtain business benefit from the opportunities, global companies have been preparing from the ground, and this is awaking to the possibilities and actively planning for the wider application of AI.

That is why such an application is already planning on many businesses' agendas. Front-runners tend to have a strong starting digital base or turnover, a higher propensity to invest in AI, and positive views of the business case for AI.

Some current AI innovators and creators have been preparing big data computing power and specialized talent of manpower. Of course, we can think laggards at the other end of the spectrum that do not adopt AI technologies at all, but this group may decline in their levels, revenue, and others.

One important driver of this profit is the existence of strong competitive dynamics among firms, and this develops the market and the benefits of AI (Figure 6).

D. Impact on Workers.

A gap by AI is widening at the level of individual workers. Demand for jobs is shifting away from repetitive tasks toward those that are socially and cognitively driven tasks by the robot.

Job profiles characterized by repetitive tasks and activities that require low digital skills may experience the largest decline as a share of total employment, from some 40 percent to near 30 percent.

The largest gain in share may be in non-repetitive activities and those that require high digital skills, rising from some 40 percent to more than 50 percent.

These shifts in employment would have an impact on wages. The share of the total wage bill of the latter group declined and direct consequences of this widening gap in employment (Figure 7-10).

Fig. 6 Makeup Selection By AI And Bigdata: Lotte Mart In Seoul (Source, Daily Electronic News, Feb. 29, 2019). New Business by AI: They Analyze Customers' Skin, Color, Situation, Age, And Others By AI and Big Data. Then They Immediately Advise The Best Makeup Whenever Customers Visit.

Fig. 7 Pizza Delivery Robot (372 Pizza Plates Produce Per Day: Source, Daily Electronic News, Jan. 28, 2019).

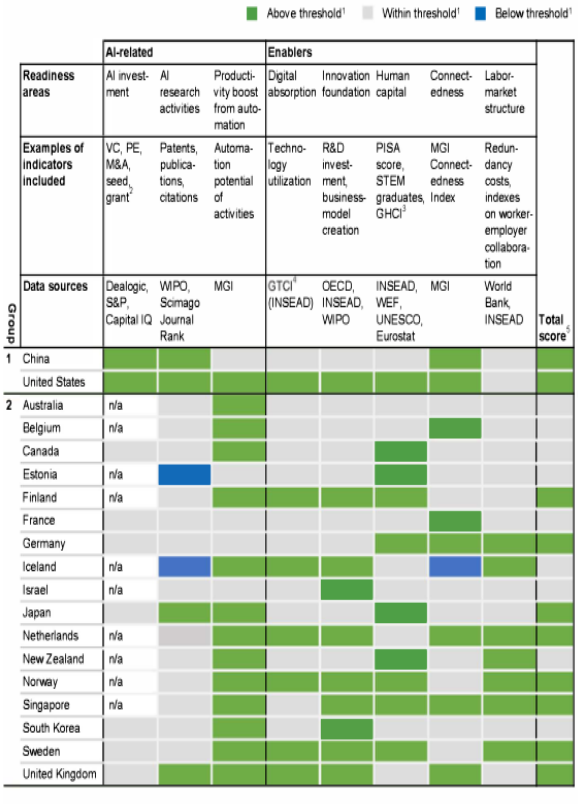


Fig. 8 (a) AI Readiness In The Country

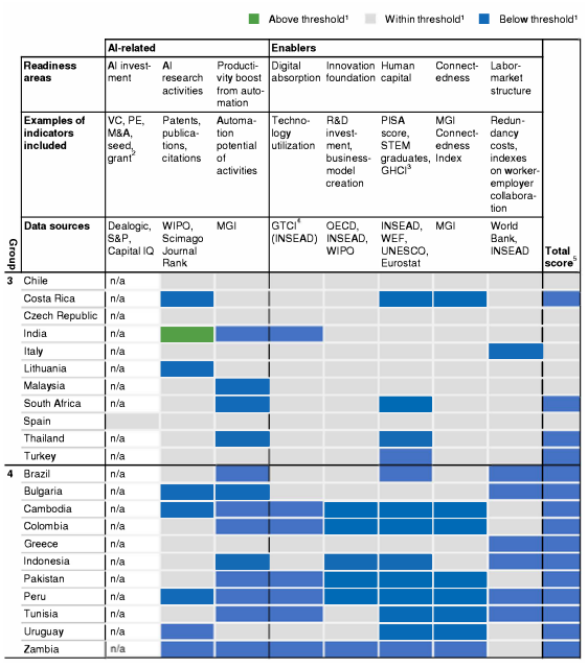


Fig. 8 (B) AI Readiness in The Country

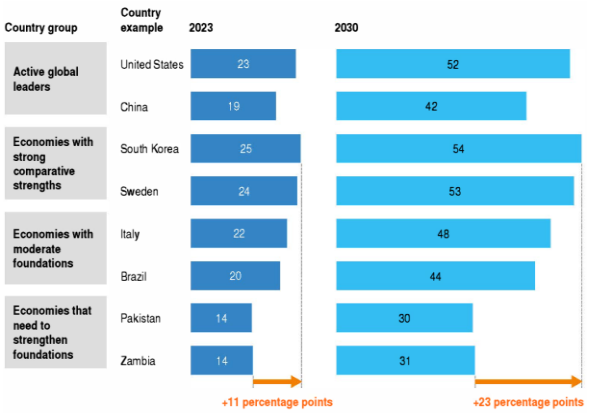


Fig. 9 Simulated AI Absorption Levels Per Country Group Share of Firms (%). Source: Mckinsey Global Institute Analysis.

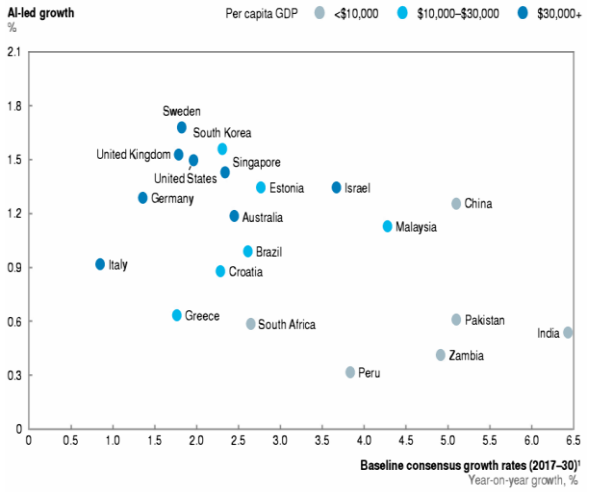


Fig. 10 AI Adoption and Absorption Could Make A Large Contribution To Growth in Slow-Growing Developed Economies. Source: IHS Markit; Economist Intelligence Unit; Oxford Economics; Mckinsey Global Institute Analysis

E. Impact on Education

Educational application of AI was done at the beginning of the 1980s by the knowledge-based approach [20].Current AI technologies are used for combining complex and varied sources of data and for real-time pattern recognition.

For example, student homework can relatively easily be checked and diagnosed by an AI system that has data on both individual student history and peer responses. As another example, UC Berkeley students can get course recommendations using a system that relies on neural AI technologies originally developed for natural language processing and machine translation[21].

Supporting for learning by AI is increasing to measure individual development than average performance in standardized tests[22].

Classroom Watson, developed by IBM, can help educators by providing insights into the learning styles, preferences, and aptitudes of each student. It can analyze personalized learning to a whole new level[23].

In order that we think about how AI can most effectively be used in the current educational context, it is important to understand the impact of AI in the context of future learning and education.

The impact of AI on teaching will increase on the future of learning. A key of the intelligent tutoring system is to analyze the current state of the learner and try to support understanding a domain that she or he is learning.

AI will have a profound impact on education systems. This is not because of any specific characteristics of AI, but AI is one expression of a broader transformation that results from digitalization, global real-time networking of communication and production, and automation of production processes[24].

IV. STRATEGY FOR AI IMPLEMENTATION

A. Policy

The policy is a key milestone of AI development and application in the Country. AI-related technology and direction can contribute to countries' economies and expand into societies, and public persons attract or are unkerned with AI and high technology, depending on government actions.

Therefore, the role of policymakers is quite important in the direction of technology.

Of course, many stakeholders can play different roles because the government is not uniquely capable of taking a broad view of only AI. However, its impact on economic growth is determined by policymakers' the legal, regulatory, and it gives an influence on the business environment that can encourage innovation, investment, and technology-based development.

Many policymakers of Africa recognize that how AI and the 4th wave is the important digital economy[25][26].

However, their implementations and activities are very low for run national education systems and research institutes.

The policy of governments is a quite important platform for information and bringing directions together stakeholders. They can create important research activities and share information between the public sector, the private sector, and academia.

Discussions with these parties are also important to identify and design effective researches that will arise from AI. For that, an advanced country such USA[27], UK[28], Japan[29], Australia[30] including S. Korea[31] was operating Agency long time ago. I strongly suggest African countries establish an agency to promote science and technology for the public sector.

The government of Nigeria[32] has announced the formation of a National Agency for Research in Robotics and Artificial Intelligence in March 2018.

Kenya was also the first African country to launch an open data portal to make information on education, energy, health, population, poverty, and water and sanitation[33].

Application development in Kenya is high, and the government wanted to support the industry's growth.

The South African Department of Trade and Industry formed for Future Industrial Production and Technologies in 2017 to examine the impacts of emerging digital technologies, including the Internet of Things, big data, AI, robotics, and new materials.

South Africa's government aims to boost its investment in the research industry to enhance South Africa's readiness and development, support for entrepreneurs, and skills development.

Usually, almost government says that the budget is not enough. However, they should invest in niche areas to have initiative with small money. AI is one of the best areas.

B. The role of University

Universities and research institutions are the most important for AI ecosystems and offer fertile ground or must nurture manpower (scientists and engineers) who lead experiments and try out their new ideas.

Faculties of universities can support the idea for policy, and the current megatrend of technology is important as an invaluable source of reference for policymaking.

[20] For an early example, see Sleeman and Brown (1982).
[21] E.g., Pardos et al. (2018).
[22] Mislevy (2018), Gane et al. (2018).
[23] https://www.ibm.com/watson/education
[24] EU commission, The Impact of Artificial intelligence on learning, teaching, and education, 2018.
[25] The 2nd African Science, Technology and Innovation; and the 6th African Sustainable Development Forums are being held in Victoria Falls, Zimbabwe, Feb. 24, 2020.
[26] Africa should not be too quick to embrace the fourth industrial revolution, Sept. 24, 2019.
[27] https://www.aaas.org/
[28] https://royalsociety.org/
[29] https://www.jst.go.jp/EN/
[30] https://www.csiro.au/
[31] https://kofac.re.kr/eng/main/index.do#main
[32] https://research.google/pubs/pub48985/
[33] https://kenya.ai/

For example, in African University about AI, the University of Pretoria (UP) in South Africa created the Intelligent Systems Group (ISG) for the theory and application of systems[34]. They invite some research groups and institutes around the world, including Cambridge University Engineering Department, the United States Office of Naval Research, and the United States Space and Naval Warfare Center, as the members of the ISG collaborate.

The University of Pretoria has also established the Institute of big data and data science in September 2017.

The Centre for AI Research (CAIR) in South Africa aims to contribute to South Africa's digital transformation and economic competitiveness[35].

It is cooperating with five South African universities: The University of Cape Town, University of KwaZulu-Natal, North-West University, University of Pretoria, and Stellenbosch University.

Strathmore University (Strathmore) of Nairobi has established the @iLabAfrica Research Centre for emerging technologies such as big data, artificial intelligence (AI), Blockchain technology, Internet of Things (IoT)[36].

Dedan Kimathi University of Technology (DeKUT)[37] in Nyeri, Kenya, focuses on research, innovation, technology transfer, entrepreneurship, and quality education to contribute to the attainment of national development goals.

The University of Lagos recently launched the first AI Hub in Nigeria. This Hub serves for developing AI in the country by focusing on deep learning and encouraging young talent discovery within the innovation and data analytics space.

C. Manpower Education

To do the fast growth of AI technology and to reap the benefit through AI, the education and skills systems should be prepared.

Applications and development of AI can only be poised to prepare the nature of work in ways of education systems.

AI-driven processes and jobs will be more productive, and jobs of the future will be different.

Because economic transformation can happen in different sectors, we should recognize what types of jobs and what specific skills will be needed is.

That is, education reformation is needed:

First, the level of primary and secondary education needs to refocus on core skills or specific AI-related technical skills through improved STEM (science, technology, engineering, and math) skills, including coding. It is important to allow people to assume high technology jobs through this coding and a workforce.

It is also important to build a workforce that is an effective curriculum of AI tools. STEM and coding subjects are needed compulsory requirements, and the gap can be filled through collaboration between industry and academia.

D. Research Centre of Company

A research center of industry is the core to the application of the AI ecosystem everywhere from entrepreneurs, start-ups, and SMEs.

As an example, SyeComp [38] of Ghana focuses on enhancing agriculture through ICT and advanced geospatial solutions.

DataProphet [39] is a South African start-up that has focused on the finance and insurance sector through machine learning solutions.

Kudi of Nigeria has developed a chatbot for the financial sector. It allows users to make payments and send money.

Microsoft started for the Research Ph.D. Scholarship Programme to support research collaborations between academics in Europe, Middle East, and Africa (EMEA) region (Kenya and Nigeria) [40] with researchers at the Microsoft Research Cambridge Lab. Projects accepted to the program involve research on AI, infrastructure for the cloud, the future of work, and biological.

IBM Research Africa (IBM-RA) center in Kenya and South Africa [41] is also the first commercial technology research center in Africa conducting both applied and far-reaching exploratory research.

Google recently announced the opening of a Google AI Research Centre in Accra, Ghana [42], Africa, to collaborate with local universities and research centers.

It will be helping to bridge the gap between technologies as a catalyst for African growth.

E. Start-up for S/W and AI

To encourage and give some motivations for AI and 4th wave related industry as well as education, business and start-up building should be done easily.

Of course, if there are some abundant funds, you can build industrial infra by using the existing based or H/W based industry because those can bring many jobs such as worker, cleaner, seamster, and etc. However, there are several risks at this point.

First, those need lots of budget because of H/W.

Second, there is no vision for the future. It means those jobs are low-wage jobs.

Third, after corona-19, many companies and countries are considering returning to their country.

Fourth, AI and robotics will penetrate faster into the manufacturing system and repeat work. Many global manufacturing companies such as smartphones, the sewing industry, and chemical processes were built in China

[34] https://www.up.ac.za/intelligent-systems
[35] http://www.cair.za.net/people
[36] http://www.ilabafrica.ac.ke/index.php/ilabafrica/
[37] https://csit.dkut.ac.ke/

[38] https://syecomp.com/
[39] https://dataprophet.com/partners/#
[40] https://news.microsoft.com/en-xm/features/furthering-our-investment-in-africa-microsoft-opens-first-africa-development-centre-in-kenya-and-nigeria/
[41] http://www.research.ibm.com/labs/africa/#visiting-the-lab

[42] https://en.wikipedia.org/wiki/Google_AI_Centre_in_Ghana

because of cheap labor costs. But a few years ago, they have been moving to Vietnam.

Currently, they are coming back to their home country because of collapsing unstable global manufacturing chain, home government's suggestion, easier application of strong robot and AI technology, logistic system, and high quality and cheaper by a robot.

This progress of global companies will come fast and faster after C-19.

As an example, to avoid these difficult situations, I would like to strongly suggest Ethiopia must encourage and give the motivation to build S/W based start-ups. In that case, there are many advantages:

Firstly, there are young and smart students in Adama Science and Technology University (ASTU) and Addis Ababa S&T University (AASTU).

As far as we can focus on teaching entrepreneurship and S/W for AI and 4th related technologies, they can develop new ideas and survive through global competition. I had already mentioned at previous by MS, Google, and other examples in S. Africa and Nigeria, Kenya.

Secondly, S/W-based investment is cheaper than H/W-based industry and can build within shorter terms.

We can establish using only PC and S/W, and there is also a vision for the 4th wave. In that case, we must consider why it is not a success [43] and not many companies[44] [45].

Thirdly, all students can speak English. That is one of the strongest powers in the world.

Fourthly, the curriculum should be operated intensively. As an example, we can consider concepts like UoA in Japan[46]. This University focused on only S/W established by Fukushima province in 1992.

They also have BS and Ph. D course and had ever joined the team together with 10 Universities such as MIT, Carnegie Mellon University when MS developed Window NT in 1995.

The Ethiopian government has a human resource requirement plan for the Ethiopian Industry Roadmap[47] (Fig .11). The projection for the priority manufacturing sectors was built up from three major areas. Figure 11 and Table 4 show the HRD road of Ethiopia. When ICT and the 4th wave are added, it can be better. We can also use it as references to Fig .12, 13, 14, and Table 5 for building curriculum in University and HRD road map.

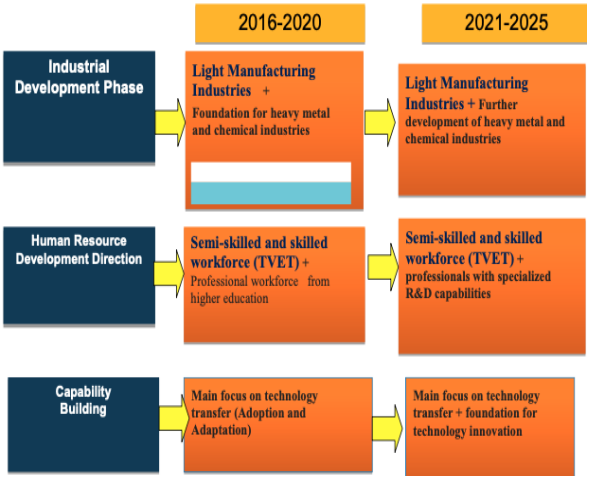


Fig. 11 HRD Load Map of Ethiopia

Table 4. HRD Road Sector

Manufacturing Sectors	Ratio	Manufacturing sectors employment opportunities at industrial parks for the year (2017-2025)								
		2017	2018	2019	2020	2021	2022	2023	2024	2025
Leather	10%	24937	60341	103450	154273	234077	313931	388782	473907	554122
Textile	15%	37406	90511	155175	231409	351115	470897	583173	710860	831183
Metal & Engineering	1%	4987	12068	20690	30855	46815	62786	77756	94781	110824
Chemical & construction inputs	1%	2494	6034	10345	15427	23408	31393	38878	47391	55412
Pharmaceutical	1%	2494	6034	10345	15427	23408	31393	38878	47391	55412
Food and Beverage	61%	152116	368079	631046	941063	1427868	1914982	2371571	2890830	3380144
Total	90%	249371	603408	1034501	1542727	2340767	3139314	3887821	4739065	5541219

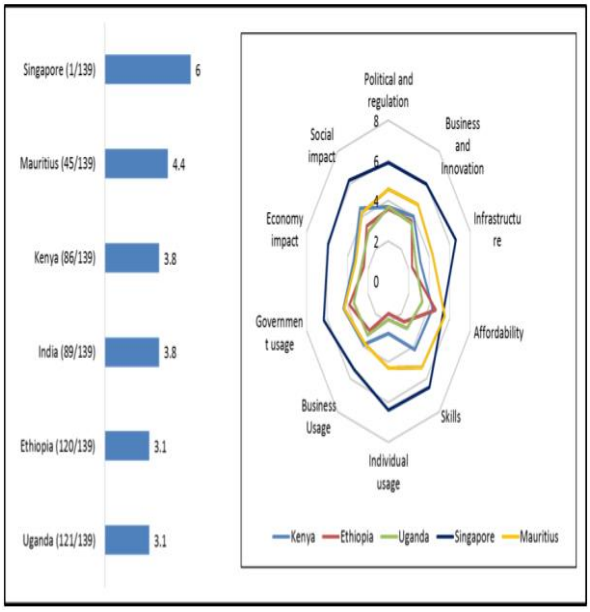


Fig. 12 Network Readiness Index (Nri): Source, Wef (2016)

[43] Why Ethiopia's Software Industry Falters, https://addisfortune.news/

[44] https://addisbiz.com/business-directory/information-technology

[45] http://www.ethyp.com/category/Information_technology

[46] https://www.u-aizu.ac.jp/en/curriculum/course-introduction/

[47] Human Resource Requirement Plan for Ethiopian Manufacturing Industries (2016-2025), 2015.

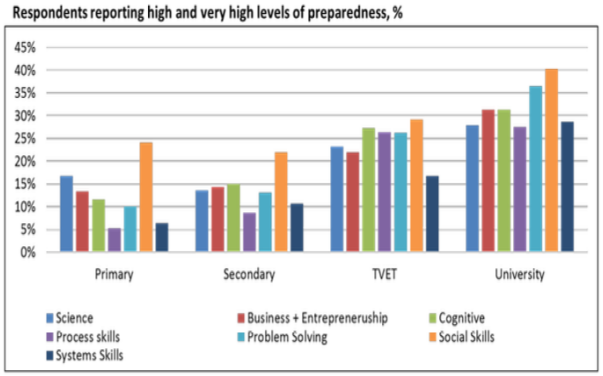


Fig .13 Education Systems Preparedness for 4IR (TVET: Technical and Vocational Education and Training): Source, Gatune and Brown (2018a) Based Quantitative Data From Field Surveys And Qualitative Data From Focus Group Discussions in 11 Countries: Cameroon Côte d'Ivoire, Egypt, Gabon, Ghana, Kenya, Morocco, Rwanda, Senegal, South Africa, and Tunisia.

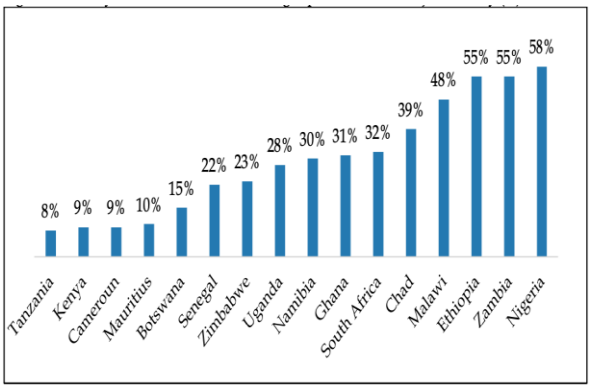


Figure 14. Primary School Children not Reaching the Expected Level of Subject Mastery (%) Reference. Though Enrollment In Primary Education has Rapidly Improved, An Important Thing is Not Good Learning Outcomes for Building Higher-Level Skills. For Example, In Ethiopia, 55% Of Students are not Mastering The Materials Required at Their Grade Level (*Source: ACET 2018*)

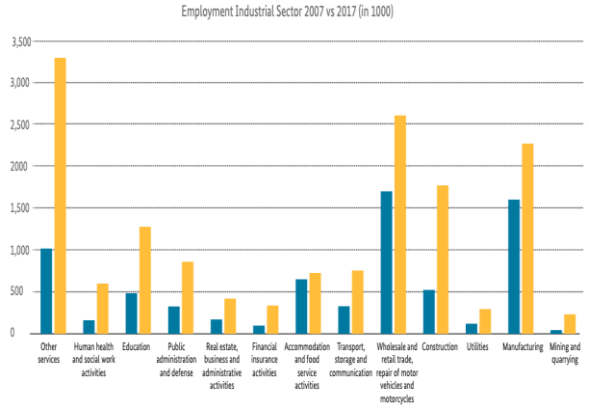


Fig. 15 Employment Industrial Sector 2007 vs. 2017. (*Source: ILO*).

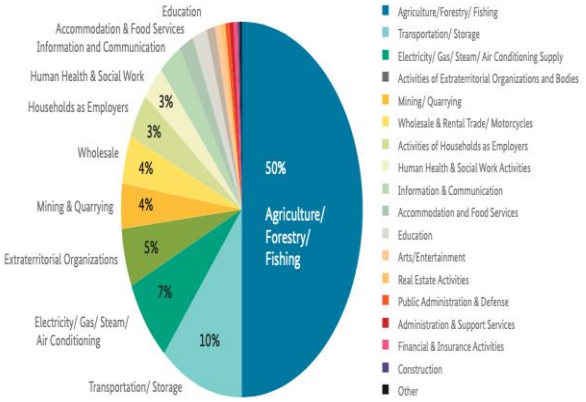
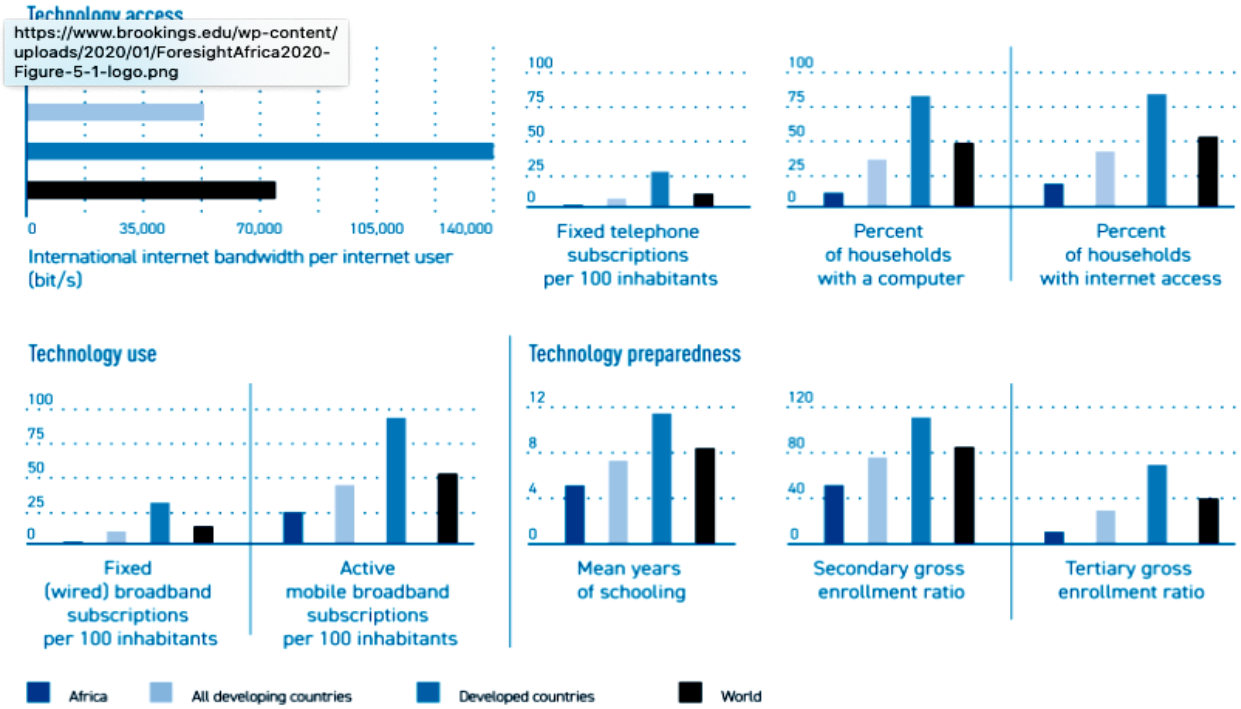


Fig. 16 GDP Contribution Ratio of Ethiopia: *Source [7].*



A number of persons engaged and employed in manufacturing. (Source: CSA, Survey reports 2016)

Sub-sector	Size of enterprise		
	Medium & large	Small scale	Total
Food, beverages and Tobacco	131,200	120,013	251,213
Grain milling	-	212,444	212,444
Textiles and wearing apparels	38,880	132,724	171,604
Leather and leather products	17,122	5,786	22,908
Wood and paper	13,190	4,742	17,932
Chemicals and allied products	36,260	2,213	38,473
Non-metallic minerals	28,198	29,851	58,049
Iron and steel	23,822	81,176	104.998
Furniture	43,019	112,972	155,991
Total	331,691	701,921	1,033,612

Fig. 17 Africa's ICT Readiness: Africa Lags in Several Indicators for the 4th Wave Infra, Technologies Access, And Education (*Source, ITU2018*).

Fig. 18 The Top Program Language 2019, Source, IEEE Spectrum

If we teach and develop knowledge by using language, they can have a competition in the global situation and Africa.

Figure 18 also shows the ranking of S/W, and next comes Java, C, and C++. Matlab language developed by MathWorks ranks 8th, but it simply reflects the language's prominence in hardware engineering, especially for those interested in running simulations or creating control systems via MathWorks' graphical Simulink package.

In any case, the intention is the most important. Without intention is no chance.

V. CONCLUSION

This paper deals with the impact of AI in Ethiopia and suggests strategies and methods after reviewing the paper.

The advanced countries have been preparing for core technology, AI of 4th wave from a long time ago. So, they are going to have an initiative for the economy and technology in the future.

Of course, global competition is so high to invite smart students and researchers.

However, unfortunately, African Countries are so quiet, as we can see from Figure 12-17, 19. It means the African economy will be strongly depending on other continents in the future as far as no preparation. We had better prepare now. Earlier is better.

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Region	Country	Structure of Production Score	Structure of Production Rank	Drivers of Production Score	Drivers of Production Rank
Leading Countries					
●	Austria	7.46	9	6.79	18
●	Belgium	6.51	24	6.80	17
●	Canada	5.81	33	7.54	7
●	China	8.25	5	6.14	25
●	Czech Republic	7.94	6	6.01	26
●	Denmark	6.29	27	7.20	10
●	Estonia	5.75	34	6.00	27
●	Finland	7.00	14	7.16	11
●	France	6.87	18	6.89	14
●	Germany	8.68	3	7.56	6
●	Ireland	7.34	10	6.85	15
●	Israel	6.43	25	6.24	23
●	Italy	6.99	15	5.90	30
●	Japan	8.99	1	6.82	16
●	Korea, Rep.	8.85	2	6.51	21
●	Malaysia	6.81	20	6.51	22
●	Netherlands	6.32	26	7.75	5
●	Poland	6.83	19	5.83	31
●	Singapore	7.26	11	7.96	2
●	Slovenia	6.80	21	5.71	32
●	Spain	6.05	29	6.23	24
●	Sweden	7.46	8	7.40	9
●	Switzerland	8.39	4	7.92	3
●	United Kingdom	7.05	13	7.84	4
●	United States	7.78	7	8.16	1
Legacy Countries					
●	Hungary	6.96	17	5.30	42
●	India	5.99	30	5.24	44
●	Lithuania	5.92	31	5.42	37
●	Mexico	6.74	22	5.04	46
●	Philippines	6.12	28	4.51	66
●	Romania	6.61	23	4.93	52
●	Russian Federation	5.71	35	5.30	43
●	Slovak Republic	6.98	16	5.33	40
●	Thailand	7.13	12	5.45	35
●	Turkey	5.87	32	4.90	57
High-Potential Countries/Economies					
●	Australia	4.26	61	7.14	12
●	Hong Kong SAR	4.52	58	7.45	8
●	New Zealand	4.79	53	6.73	20
●	Norway	5.65	36	7.07	13
●	Portugal	5.36	39	5.99	28
●	Qatar	3.89	72	5.96	29
●	United Arab Emirates	4.53	57	6.76	19
Nascent Countries					
●	Albania	2.73	91	4.07	78
●	Algeria	2.83	90	3.70	87
●	Argentina	4.91	50	4.25	75
●	Armenia	4.10	65	4.43	70
●	Azerbaijan	2.16	95	4.69	62
●	Bahrain	4.78	54	5.31	41
●	Bangladesh	3.59	80	3.67	89
●	Bosnia and Herzegovina	4.66	55	4.04	79
●	Botswana	3.17	86	4.43	69
●	Brazil	5.22	41	5.03	47
●	Bulgaria	5.23	40	5.02	48
●	Cambodia	3.56	81	3.63	91
●	Cameroon	1.84	98	3.24	100
●	Chile	4.18	63	5.60	34
●	Colombia	4.61	56	4.53	65
●	Costa Rica	4.97	47	4.90	56
●	Croatia	5.50	37	4.93	51
●	Cyprus	4.11	64	5.65	33
●	Dominican Republic	3.99	71	4.02	80
●	Ecuador	2.85	89	3.66	90
●	Egypt	4.99	46	4.46	68
●	El Salvador	4.81	52	3.55	94
●	Ethiopia	2.01	96	3.29	98
●	Georgia	3.61	79	4.92	54
●	Ghana	1.96	97	4.14	77
●	Greece	4.44	60	4.96	50
●	Guatemala	4.05	67	3.71	86
●	Honduras	3.43	83	3.61	92
●	Indonesia	5.41	38	4.89	59
●	Jordan	4.00	69	4.91	55
●	Kazakhstan	4.19	62	4.74	61
●	Kenya	2.97	88	3.83	83
●	Kuwait	3.56	82	4.65	63
●	Kyrgyz Republic	3.73	76	3.43	96
●	Latvia	4.91	49	5.39	38
●	Lebanon	4.02	68	4.43	71
●	Mauritius	3.84	73	5.37	39
●	Moldova	3.36	84	4.02	81
●	Mongolia	1.81	99	3.82	84
●	Morocco	3.67	77	4.35	73
●	Nigeria	1.66	100	3.68	88
●	Oman	4.00	70	5.13	45
●	Pakistan	3.82	74	3.60	93
●	Panama	3.82	75	4.89	58
●	Paraguay	3.24	85	3.84	82
●	Peru	3.67	78	4.18	76
●	Saudi Arabia	5.16	44	5.44	36
●	Senegal	3.11	87	3.74	85
●	Serbia	5.18	42	4.59	64
●	South Africa	5.03	45	5.02	49
●	Sri Lanka	4.10	66	4.26	74
●	Tanzania	2.39	93	3.28	99
●	Tunisia	4.83	51	4.41	72
●	Uganda	2.25	94	3.31	97
●	Ukraine	5.17	43	4.47	67
●	Uruguay	4.52	59	4.75	60
●	Viet Nam	4.96	48	4.93	53
●	Zambia	2.39	92	3.54	95

● East Asia and the Pacific ● Eurasia ● Europe ● Latin America and the Caribbean ● Middle East and North Africa ● North America ● South Asia ● Sub-Saharan Africa

Fig. 19 Readiness of Each Country (*Source, WEF2018*)