Case Studies on AI Skills Capacity-building and AI in Workforce Development in Africa

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Executive Summary

Background

The Mapping AI for Development in Africa (AI4D) project is a response to the research agenda for the ethical and equitable application of Artificial Intelligence (AI) in the Global South proposed in the IDRC whitepaper, "Artificial Intelligence and Human Development". The project conducted case studies on AI deployment across the African continent, and the associated policy and governance implications. It explored AI in relation to four thematic areas – biometric identity, computer vision and surveillance, skills capacity and workforce development, and gender. This report covers the Skills Capacity-building and Workforce Development theme. Research for each thematic area began with a broad mapping exercise to search for examples of AI initiatives across Africa, followed by deeper analysis of a selection of the identified examples. The themes were examined in terms of the potential contribution of AI systems to public service delivery specifically and socio-economic development generally, the challenges AI systems present for African countries, and the role of both public and private sector actors.

In the context of Research ICT Africa's (RIA's) ongoing work on digital and social inequalities, the research was framed by concerns about whether the appropriate systems and mechanisms are in place to deliver benefits and safeguard against the harms and risks associated with AI, especially for the most marginalised populations. The potential positive impacts of AI technologies were examined against the social, economic, political, and historical realities within case study countries as well as in a global context; with particular attention to the interplay amongst the state, markets, and citizens in the delivery of public services, especially those that are partially or fully provided by private sector actors. Social justice and human rights lenses were applied to reflect on the legal and ethical frameworks required to safeguard human rights and ensure data and privacy protection as well as data justice. These perspectives feed into recommendations for the design of policies that enable beneficial, inclusive, and rights-based AI in Africa.

AI skills capacity-building and AI in workforce development

It is generally accepted that the deployment of AI in Africa will generate new employment opportunities (through new types of jobs), accelerate organisational efficiency (through automated processes and decision-making) and improve public service delivery (through more responsive and personalised attention) in well-prepared settings (Pillay, 2018). However, existing infrastructure and skills gaps inhibit the ability of African countries to leverage the potential of AI, in terms of scientific contributions to AI development, local production of AI-based goods and services, and use of AI to deliver public services. For example, in the context of an already unequal society in which employment opportunities tend to be less readily accessible to people in resource-constrained environments, the efficiency-related benefits of integrating AI into existing systems will also bypass these populations. Furthermore, as is occurring in other parts of the world, the introduction of AI is likely to lead to critical challenges such as misuse or uncritical acceptance of biased automated decision-making (Gwagwa Arthur et al., 2020; Trajtenberg, 2018). The ability to face these challenges will largely be influenced by the extent to which nations have nurtured an appropriately skilled workforce, not only with technical skills but also with the knowledge and training to govern the deployment of AI. However, in spite of a growing community of Africa-based AI enthusiasts (Snow, 2019), developing a home-grown talent base to execute this vision remains a challenge due to infrastructural and educational system limitations. A recent review of AI capacity in

Africa (Butcher et al., 2021) identified numerous capacity challenges including lack of AI experts and lecturers; limited capacity of educational institutions; poor funding for AI research, infrastructure and entrepreneurship; and male dominance in the AI community. Diversity challenges are also evident, especially gender-related but also in terms of other groups such as people with disabilities (Butcher et al., 2021; Centre for Intellectual Property and Information Technology Law, n.d.).

Despite the recognition of a skills gap in Africa, knowledge about the actual state of AI skills across the continent is quite thin, as is knowledge about institutions and initiatives working to fill the gap (apart from a few notably well-publicised programmes such as the African Masters of Machine Intelligence in Rwanda). Few measures of capacity exist, with current tools often depending on proxy indicators (e.g., Government AI Readiness index) or having limited data on Africa (e.g., the AI Index, AI Talent Report). Equally unclear is the extent to which and how AI technology itself is being utilised within programmes aimed at boosting employment or building workforce capacity across economic sectors. The two case studies presented in this report contribute to narrowing the knowledge gap on AI skills capacity building and AI use in workforce development in Africa, especially as it relates to the public sector.

The Africa AI Accelerator provides a case of AI as an output of capacity-building activities (developing a workforce able to create, deploy and govern AI products and systems), while the Harambee Youth Accelerator is a case study of AI as an input to development agendas (using AI to improve general labour force participation or educational outcomes). The cases address skills and capacity challenges from the perspectives of entrepreneurship and employment – two critical components of most national economic development plans – and formulated with some degree of collaboration between the public and private sector.

Case study 1: Africa AI Accelerator

This case study set out to examine the contribution of the Africa AI Accelerator (AAIA) to building AI skills in Ghana, to assess whether this approach to entrepreneurship development represents a new model of human development, and on that basis, to consider the likelihood that the programme would lead to the production of beneficial and inclusive AI products and services.

Overall, the programme appears to help fill an existing need for capacity-building in both AI skills and business development by providing opportunities to access technical training, business mentorship and start-up funding. Broader impact on the growth of a skilled AI workforce at the national level remains to be seen as the programme has only just turned out its first cohort of 11 start-ups—arguably a mere drop in the ocean considering the overall AI skills deficiency. In the longer term, investment in more foundational skills building through tertiary institutions might be more impactful as such training will produce larger cohorts on a yearly basis, and likely build a broader range of capacities – e.g., for basic AI research, work-ready skills, governance abilities, and AI entrepreneurship.

The AAIA facilitates the distribution of resources (and power) to particular activities and organisations within the local and global AI ecosystem. In terms of the extent to which the Accelerator's approach conforms to or disrupts existing development models, the programme largely maintains an orientation towards neoliberal models of development, essentially contributing to the government's commitment to technology entrepreneurship as the engine of national growth. The capacity-building focuses on technical and business skills, buttressing the assumption that successful business performance will translate into delivering human development.

The business incubator approach is becoming more entrenched and receives more media attention compared to the relatively low-key investment in university education and research and development –

possibly a result of more resources being put into publicity, the global fascination with the language of the Sustainable Development Goals (SDGs) and social impact, the longer timeframes of university education and research, and possibly academia's more cautious approach towards technology advancements. Long-term sustainability of this model as an approach to development, however, remains questionable considering its high dependence on venture and donor capital, and the lower capacity of entrepreneurs in developing countries to sustain the shocks of experimentation characteristic of technology hubs in more advanced economies.

While it is too early to assess the impacts of the AAIA on the production of beneficial, inclusive and rights-respecting AI, the results so far demonstrate that such programmes do contribute to AI technical and entrepreneurship capacity-building through training and mentorship. Start-ups have a focus on local problems and solutions, concentrated around fintech, agriculture and health. However, the programme criteria will likely attract relatively high socio-economic status applicants; and is also likely to foster innovating for high-income consumers. This will only repeat trends already seen with older technologies such as computers, mobile phones and the internet.

Being primarily dependent on government and donor funding, the scalability and long-term sustainability of the programme is uncertain. Critically, there is no direct connection to public sector service delivery—such connections could potentially augment the ability of the programme to reach less affluent populations. Policy and legal frameworks are also not in place to ensure that AI is ethically deployed. These all suggest that as far as the goals of AI for development are concerned, the social and economic impacts of these types of programmes might turn out to be less dramatic than advocates hope, and the risks and potential harms remain high.

Programmes like the AAIA that seek to accelerate technological development may represent more opportunity than risk and might not directly cause harm; however, they could launch the country on yet another technological trajectory for which its population and leadership are unprepared. Learning from experiences with mobile and internet technology, relatively slow progress may be a good thing to enable appropriate capacity and governance frameworks to be established.

Case study 2: Harambee Youth Employment Accelerator

This case study explored the Harambee Youth Accelerator programme in terms of whether the programme mitigates or exacerbates social inequalities, whether the programme might have any human rights implications, and whether the South African environment is equipped to support successful outcomes of the programme's use of AI. It discussed a variety of legislation and human rights-related issues (such as algorithmic transparency, unfairness, bias, discrimination, accountability, negative effects on employees, privacy and data protection, and liability for damage) and how they are or are not addressed by Harambee. The case study concludes that despite existing gaps in the South African education system, skills deficit in the labour market, and continuing human rights and governance uncertainties, there are still opportunities resulting from AI-based technologies. Because of the large reduction in capital costs brought about by AI applications, as well as the fact that the direction of technological change is, at least in part, driven by the relative supply of low- versus high-skilled labour, Harambee stands to benefit from AI automation for its job-matching efforts, provided it is implemented at a small-scale and with a risk-based assessment approach.

The potential risks are linked with widening wealth inequalities. Harambee uses various proxies such as geographical location, educational background and household size to determine qualified candidates; and has outsourced the task of identifying suitable candidates to AI algorithms that search through the

programme's database based on these features. The use of AI/ML to gain new insights into the attributes of candidates and predict their success in certain types of jobs has the potential to reinforce social inequities. Indeed, AI algorithms and machine learning (ML) systems have frequently failed to ensure equality, most notably by generating biased decisions against people of colour. South Africa has a dark history of using apartheid spatial planning to deliberately place marginalised people in remote areas where access to economic, social, and educational opportunities was impossible, and to this day, these problems persist. Therefore, Harambee's proxies could be built on historical data that results in biased decisions; hence the possibility to either exclude certain groups of people from their dataset, or systematically find them to be unsuitable candidates for attractive job opportunities in urban centres. Harambee has committed to addressing this issue by developing better proxies using their internal data. For instance, they have included personalised testing, learning ability and cumulative experience rather than depending solely on conventional proxies.

With regards to having a supportive ecosystem for the implementation of AI systems, the government is proposing reskilling and investing in curriculum development in addition to adopting intersectoral approaches to AI in education planning and governance. In the long term, this should help to address some of the skills deficit challenges that organisations like Harambee are facing.

The development, deployment, and use of AI/ML technology by Harambee provides an example of organisations trying to build the structure and frameworks to advance responsible and accountable AI technology practices, combining ethical and human rights approaches in a deliberate way. Harambee is aware of the potential harms of using ML in their work; the fact that they have deployed it primarily in test cases shows their careful consideration of possible effects. While noting Harambee's positive efforts in attempting to mitigate these issues (such as establishing an ethics council that checks its AI algorithms), this area requires ongoing examination and adaptability, given the gravity of the potential effects of AI technologies, particularly on vulnerable individuals and groups.

Key Conclusions

Public sector, public-private partnerships and social impact agendas

The two case studies illustrate efforts by governments to leverage AI and data technologies for national development, but with no direct application to the delivery of public services. In the case of the Africa AI Accelerator, despite falling under a government initiative expressly intended to transform the delivery of government services, the initiative does not actively seek to generate AI innovations for the public sector. Likewise, all indications are that Harambee's partner employers do not include public sector agencies, although such a partnership seems like a natural fit. The apparently loose links that the two cases have with the public sector also raises questions about what types of public-private partnership (PPP) models are at play. PPPs can be beneficial for workforce growth and re-skilling. But the political economy of PPPs could result in clashing or competing agendas and power dynamics that prioritize the interests and motives of some partners over others (Boardman & Vining, 2012). As Razzano (2020, p.2) notes, "the question of public obligations with private actors is a fundamental one for considering the future of the AI-enabled economy". Without strong public sector involvement, especially with a new and fast-evolving technology, the behaviour of PPPs is likely to err on the side of private sector partners.

However, this is not a foregone conclusion—as seen in the case of Harambee, the organisation appears to be consciously attempting to maintain a social impact agenda, e.g., by ensuring that multiple stakeholders contribute to shaping its use of AI/ML. Although it is unclear who the most influential stakeholders in this partnership are, the strong social impact overtones of Harambee could be linked to

the source of its funding and the more obvious association it has with youth employment goals. The AAIA, on the other hand, driven as it is by the goal of promoting business prosperity, is understandably more likely to prioritise advancing private sector success criteria. Again, with this initiative, it is unclear who the most influential stakeholders are but, by all appearances, key partners such as the Ghana government and GIZ see the business accelerator model as a way of indirectly achieving social goals by facilitating business interests. Thus, it is not surprising that there does not appear to be any specific expectation or pressure around how social impact is defined or achieved.

"Acceleration" as the new leapfrog development thesis?

Notions of accelerated development are not new in Africa. For several decades, the leapfrog thesis has imbued information and communication technologies (ICTs) with visions of enabling countries in the global south to jump over or bypass stages of development and emerge as equal or competitive partners in the global economy and secure higher standards of living for citizens. On balance, this vision has not been achieved with technologies such as computers, the internet or mobile phones (Gillwald & Onkokame, 2019). Yet this imaginary does not die and in the rise of business incubation and accelerator models, we are arguably seeing a revisioning of the leapfrog thesis in an even more targeted context. In both case studies, the use of AI is seen as a way to accelerate outcomes, whether directly by making operations more efficient and effective (Harambee) or indirectly by enabling business organisations to come up with innovations to solve social and economic problems (Africa AI Accelerator). However, in the absence of the requisite talent pool and governance framework, the impulse to accelerate AI development itself, as well as the application of AI for human development is questionable (see Gillwald, 2020a; Gillwald, 2020b; Gillwald et al., 2019; for examples of Research ICT Africa's critique of 4IR ambitions in Africa).

As the case of the AAIA in Ghana has shown, even attempts to establish the prerequisites (such as a trained workforce) for successful AI deployment should be approached with care lest it result in widening social inequalities. Rapid skills development can produce short-term boosts in expertise; however, in the long-term, the result might be a work-ready, but narrowly tooled workforce with primarily entry-level job capabilities (Garrido & Sey, 2016). In contrast, the slower (e.g., formal education system) route may produce less work-ready graduates, but with a broader knowledge base, critical thinking preparation and more readiness for management-level positions. African governments and other entities working on AI in Africa should consider that sometimes AI for development might mean "slow AI" (Kozlowska, 2021). Regarding the use of AI in workforce development, the Harambee Youth Accelerator is an example of a programme that has chosen the slow AI route by limiting the integration of AI into its operations; opting not to institute automated decision-making, but rather to use AI to inform decision-making by humans.

Inclusions and exclusions

In terms of social inclusion, the case studies illustrate both encouraging and concerning trends. On the positive side, AI analysis is enabling Harambee to make advances in labour force inclusion. The workforce development applications of AI are being integrated with human input and more diverse employability criteria to counteract the effects of the status quo and bring normally excluded youth into the labour market. On the other hand, the challenges of inclusive business development and social impact are becoming evident in the commercial model of the AAIA, where the people benefiting from the capacity-building investment are not likely to come from relatively disadvantaged areas.

Implications for investment in AI skills capacity building

It is noteworthy that the capacity-building efforts of tech hubs, accelerator programs and similar initiatives tend to grab the public imagination so much more than traditional pathways such as formal

education or vocational training. The flashiness of private sector-led social impact and accelerator initiatives stand in contrast to the more low-key activities of other actors. Yet few assessments have been able to concretely demonstrate long-term impact on economic growth, much less on social development or poverty reduction, in low and middle-income regions. It is also unclear the balance of resources going into different institutions for the purpose of building AI skills or employing AI systems and what the cost-benefit ratio is. For every unit that goes into supporting AI entrepreneurs through accelerator programmes, how much goes to basic AI research and development, for example? How are these investments being monitored and evaluated to determine whether programmes and incubated enterprises are functioning beyond pilot stage, whether the outputs or outcomes are worth the investment, how resilient the outcomes are, and what would be the most productive avenues to which to channel investments?

Recommendations

Align state-funded initiatives to public sector and public administration capacity building goals. Considering the overlap of social impact ambitions underlying the AI initiatives and national development plans, as well as the increasing pressure on governments to support (both policy-wise and with direct funding) these types of private sector activities, there are opportunities for renewed experimentation with public-private partnerships. Such experimentation could explore ways to co-opt the relative agility of private enterprise more intentionally for targeted public sector goals related not only to general workforce development, but also to specifically building the public sector workforce and enhancing its ability to utilise (and govern) AI for the public good in areas such as provision of basic utilities, education, health, agriculture and finance. This will, however, also require separate capacity-building of public sector officials to expose them to non-private-sector-driven considerations around AI.

Improve data availability. There is an urgent need for open data on the deployment of AI, especially in the public sector. Transparency is needed to enable understanding of whether and how AI is being used across sectors and what measures are in place to mitigate risks and harms.

Perform social and economic risk assessments prior to AI. Where decisions have been made to deploy or promote the deployment of AI, it should be preceded by social and economic risk assessments to ensure that there is an appropriate awareness of the associated implications. This includes considering the appropriateness of applying accelerator models to socio-economic development and innovation for the poor, and determining what tweaks, if any, would be needed to make the model more successful for social impact goals. While private sector firms could police themselves, public policy should also institute rules and regulations to establish benchmarks or expectations around firm behaviour and acceptable risk levels, for example.

Develop AI governance skills. AI capacity-building programmes tend to focus on technical skills with only passing (if any) attention to governance issues. To ensure AI is developed or implemented with due considerations of its potential risks and harms, capacity-building organisations should include AI governance, ethics and cybersecurity training as central components of their curriculum.

Invest public resources in reducing socio-economic inequalities. Addressing social and economic inequalities would also lessen the likelihood of AI-powered systems exacerbating existing inequalities. For example, states should invest in improving the quality of education for all, to lay the foundation for integrating AI and any subsequent technologies into the economy more seamlessly. This would be a critical requirement to ensure that existing imbalances in general and technology-specific skills do not

continue to act as barriers for disadvantaged populations to join the formal or informal AI workforce. Countries should not expect the private sector to drive their national development agendas.

Future research. One limitation of the AI4D project is that it had a relatively narrow goal of conducting a high-level assessment of the state of AI deployment in the public sector across Africa. This was done largely through desk research, meaning a high dependence on publicly available information. The finding of limited public sector AI capacity-building and workforce development applications could be a function of this research methodology, which might have led to easier identification of private sector initiatives that have an interest in promoting their activities publicly. Even with the selected methodology, direct access to public officials could also have assisted in obtaining greater insights; however, this was not achieved within the schedule of the study. Follow-up studies with an expanded methodology will enable deeper analysis of the issues uncovered by the desk research and limited interviews. These could include getting a clearer picture of public sector use of AI, examining the nature of AI4D public-private partnerships, obtaining concrete measures of the amount and types of AI talent, measuring the short-, medium- and long-term outcomes of business accelerator programmes along with their cost-benefit, evaluating investment in different types of AI capacity-building models, and identifying concrete examples of workforce-related human rights impacts of AI in Africa.

Part A: Introduction

1. Project Background

The Mapping AI for Development in Africa (AI4D) project is a response to the research agenda for the ethical and equitable application of Artificial Intelligence (AI) in the Global South proposed in the IDRC whitepaper, "Artificial Intelligence and Human Development". The project conducted case studies on AI deployment across the African continent and the associated policy and governance implications. It explored AI in relation to four thematic areas – biometric identity, computer vision and surveillance, skills capacity and workforce development, and gender. This report covers the Skills Capacity and Workforce Development theme. Research for each thematic area began with a broad mapping exercise to search for examples of AI initiatives across Africa, followed by deeper analysis of a selection of the identified examples. The themes were examined in terms of the potential contribution of AI systems to public service delivery specifically and socio-economic development generally, the challenges AI systems present for African countries, and the role of both public and private sector actors.

In the context of Research ICT Africa's ongoing work on digital and social inequalities, the research was framed by concerns about whether the appropriate systems and mechanisms are in place to deliver benefits and safeguard against the harms and risks associated with AI, especially for the most marginalised populations. The potential positive impacts of AI technologies were examined against the social, economic, political, and historical realities within case study countries and in global context; with particular attention to the interplay amongst the state, markets, and citizens in the delivery of public services, especially those that are partially or fully provided by private sector actors. Social justice and human rights lenses were applied to reflect on the legal and ethical frameworks required to safeguard human rights and ensure data and privacy protection as well as data justice. These perspectives feed into recommendations for the design of policies that enable beneficial, inclusive, and rights-based AI in Africa.

2. Artificial Intelligence and Development

AI moves beyond just automated decision-making and algorithms, to include concepts on ML. Big data and algorithmic decision-making may be included under a broader AI rubric, in which case it is useful to understand algorithms as a "set of instructions" that are created, and given, through design – more so, of course in rules-based systems, than ML systems (Hong Chang & Kuen, 2019). However, a definition can be provided, which sees AI as computer programmes that mimic human intelligence and cognition (human intelligence being understood as reasoning, learning and problem-solving) (Marwala, 2015; PricewaterhouseCoopers, 2018).

There is significant potential for AI to directly contribute to improving public service delivery, by helping to address long-standing public service challenges "… such as high turnover rates, large unmanageable caseloads, administrative burdens, long waiting times, and delays in service delivery and language barriers" (Wirtz & Weyerer, 2019). These forms of AI for enhancing efficiencies, though, stand as a lower order imaging of AI benefits (Stahl, 2021). Human flourishing and development objectives should lead public sector design and implementation of AI (Stahl, 2021). Of course, equating public sector AI use with development outcomes is not sufficient. Development outcomes might be pursued by the private sector, or through public-private partnerships (Razzano, 2020). However, the development objectives on incorporated AI must be considered within the context of specific AI risks (Creese, 2020). Of particular concern is the way AI might contribute to uneven development.

3. AI Skills Capacity-building

It is generally accepted that the deployment of AI in Africa will generate new employment opportunities (through new types of jobs), accelerate organisational efficiency (through automated processes and decision-making) and improve public service delivery (through more responsive and personalised attention) in well-prepared settings (Pillay, 2018). However, existing infrastructure and skills gaps inhibit the ability of African countries to leverage the potential of AI, in terms of scientific contributions to AI development, local production of AI-based goods and services, and use of AI to deliver public services. Furthermore, as is occurring in other parts of the world, the introduction of AI is likely to lead to critical challenges such as misuse or uncritical acceptance of biased automated decision-making (Gwagwa Arthur et al., 2020; Trajtenberg, 2018). The ability to face these challenges will be largely influenced by the extent to which nations have nurtured an appropriately skilled workforce, not only with technical skills but also with the knowledge and training to govern the deployment of AI.

Technological developments and the associated rearrangements of socio-economic life, transformations of corporate processes and redesign of the workplace, are rapidly altering the skills and abilities required by the labour market (Bekhouche et al., 2017). Whilst AI innovation and workforce development are proceeding at speed in advanced economies, African countries face particularly severe AI, data science, and AI/data governance skills gaps, leading to renewed concerns about being left behind in the global economy, similar to the narratives that have characterised each technological revolution (Access Partnership, 2018; Gadzala, 2018). To address the anticipated sea change in the technological, employment and enterprise landscape, African governments are beginning to incorporate expectations about the role of AI into national development plans, including its application to growing the national economy through employment and entrepreneurship. Directly or indirectly, most African countries' technological visions anticipate some impacts on the functioning of the public sector (e.g., through enhancing e-government service, fostering e-governance or contributing to the achievement of national development agendas and potentially job losses through automated decision-making).

However, in spite of a growing community of Africa-based AI enthusiasts (Snow, 2019), developing a home-grown talent base to execute this vision remains a challenge due to infrastructural and educational system limitations. A recent review of AI capacity in Africa (Butcher et al., 2021) identified numerous capacity challenges including lack of AI experts and lecturers; limited capacity of educational institutions; poor funding for AI research, infrastructure and entrepreneurship; and male dominance in the AI community. Diversity challenges are also evident, especially gender-related but also in terms of other groups such as people with disabilities (Butcher et al., 2021; Centre for Intellectual Property and Information Technology Law, n.d.).

4. AI In Employment and Workforce Development

Digitalisation, which is driven by innovation and digital technologies such as big data analytics, cloud computing and AI, is expected to transform Africa's job markets. However, for Africa to benefit from this opportunity, states need to close digital connectivity gaps, invest in big data analytics, reskill the existing and future workforce, and harmonise policies, laws, and regulations (African Union Commission & OECD, 2021; Liu, 2019). Debates also abound as to whether AI will improve or worsen unemployment. Dystopian viewpoints anticipate drastic deterioration of job opportunities, resulting in employment losses (Ford, 2015; Frey & Osborne, 2017), whilst more optimistic viewpoints argue that, after a transition time, new types of jobs will be established and unemployment rates will remain low (Autor, 2015; Bessen, 2016; Miller & Atkinson, 2013).

Less attention has been paid to the practical ways in which AI itself could be used to improve employment outcomes for the general population; for example, by making it easier for jobseekers and employers to find each other. In the context of an already unequal society in which employment opportunities tend to be less readily accessible to people in resource-constrained environments, this type of efficiency-related benefit of integrating AI into existing systems will also bypass these populations. The unequal distribution of employment opportunities can be addressed by equitable human capital investment, which would permit greater equality in labour market outcomes (HSRC, 2013).

5. Research purpose

The two case studies presented in this report contribute to narrowing the knowledge gap on AI skills capacity building and AI use in workforce development in Africa, especially as it relates to the public sector. Despite the recognition of a skills gap in Africa, knowledge about the actual state of AI skills across the continent is quite thin, as is knowledge about institutions and initiatives working to fill the gap (apart from a few notably well-publicised programmes such as the African Masters of Machine Intelligence in Rwanda). Few measures of capacity exist, with current tools often depending on proxy indicators (e.g., Government AI Readiness index[1])[2] or having limited data on Africa (e.g., the AI Index,[3] AI Talent Report[4]). Equally unclear is the extent to which and how AI technology itself is being utilised within programmes aimed at boosting employment or building workforce capacity across economic sectors.

Our preliminary mapping of AI capacity-building efforts identified 31 programs in seven countries, the majority of which are either private-sector-led or based in institutions of higher learning in southern and eastern Africa. A few community networking platforms and non-profit initiatives were also found. These programs are illustrative of the types of AI capacity-building initiatives existent across the continent, although they are by no means exhaustively represented. For example, it was beyond the scope of the mapping activity to do detailed analysis of individual university programmes for evidence of AI courses, though these are clearly proliferating (such an analysis has since been completed by Butcher et al., 2021). Part of the challenge comes from the fact that programme objectives are often described generically, with no simple way to verify what (if any) AI components they have. It was also not possible to determine the level of uptake of global training platforms that are accessible in Africa, several of which have AI training modules.

Expanding the body of knowledge on AI in Africa is therefore, one of the key aims of this research. This is important to avoid assuming universal applicability of research done in non-African contexts. For the purposes of this research, AI is understood as computer programmes that are able to mimic human intelligence. AI is viewed as an output of capacity-building activities (e.g., developing a workforce able to create, deploy and govern AI products and systems) and as an input to development agendas (e.g., using AI to improve general labour force participation or educational outcomes). The Africa AI Accelerator provides a case of the former, while the Harambee Youth Accelerator a case study of the latter. The cases

[1] https://www.oxfordinsights.com/government-ai-readiness-index-2020

[2] For example, the Government AI Readiness Index (Shearer et al., 2020), which assesses the readiness of governments to use AI in public service delivery bases its evaluation of human capital on the levels of STEM graduates, quality of education in engineering and technology, digital skills and knowledge-intensive industries.

[3] https://hai.stanford.edu/ai-index-2019

[4] https://jfgagne.ai/global-ai-talent-report-2020/

address skills and capacity challenges from the perspectives of employment and entrepreneurship – two critical components of most national economic development plans – and formulated with some degree of collaboration between the public and private sector.

Part B: Conceptual Framing

While the two case studies have slightly different driving questions, they are designed to align with a set of interests defined in the overarching conceptual framework for the AI4D project (Table 1). Each study addresses these areas to the extent that the case study uncovers relevant connections. Based on these overarching questions, the types of data to be collected, specific methods to be used were determined for each case study (see Annexure A for methodology). The dimensions outlined in Table 1 provide the framework for analysing the cases.

Table 1: AI4D project conceptual framework

AI4D Analytical Areas	Skills Capacity and Workforce Development Dimensions
Programme features	**What are the characteristics of the programmes?** Describes the design of the programmes (including the extent to which there is an AI component), the status of their current operations, which actors are driving and implementing the process (government, private sector, civil society; domestic, foreign, global; demographic diversity, etc), and what their motivations appear to be.
Potential benefits	**What social and economic benefits are associated with the systems/use of the programmes?** Examines the anticipated benefits of the initiatives, whether these or other benefits are materialising, and what factors (e.g., socio-economic status, programme design, business model, regulatory environment) are facilitating or inhibiting beneficial outcomes, and how the programme fits into the AI knowledge and innovation ecosystem in the country.
Inequities and exclusions	**Who is participating in the programme opportunities and who is not?** Examines who is using the programme and for what purposes (positive and negative), and whether some populations (e.g., low income, women, rural) are systematically excluded (in terms of both programme management/delivery and use) or have different experiences and outcomes, and the potential reasons for inequalities. Where relevant, it also explores the extent to which the existing policy and regulatory environment provides frameworks to ensure equitable access to training and job opportunities.
Readiness challenges	**To what extent is the domestic environment equipped to support successful outcomes?** Examines how well-prepared the programme as well as the local environment is to deliver the expected outcomes. Potential lenses for this analysis include the capacity of the country to absorb programme graduates, connections between the programme and the general system of education, the comprehensiveness of the programme topics, and the adaptability of the programme to future technological developments.

Governance challenges	**What regulatory frameworks are in place to govern the use of AI in the programme?** Identifies any AI-related technical and regulatory frameworks that apply to the programme, the rights, and responsibilities they address and the internal consistency of the broader regulatory or technical environment.
Human rights challenges	**Does the programme, its mode of implementation, or its outcomes have any human rights implications?** Explores potential enhancements or violations of human rights emerging from the programme or its use of AI.
Risks and harms	**Does the programme mitigate or exacerbate existing social inequalities?** Examines whether there are any risks or harms associated with the programme's use of AI and if different groups are disproportionately affected.

Part C: Case Studies

6. Case Study 1: Developing AI Skills Through the Business Accelerator Model - The Africa AI Accelerator in Ghana

6.1 Background and Context

Science, Technology and Innovation in Ghana's Development Agenda

For several decades, like most other African countries, Ghana has been banking on science, technology and innovation (STI) as the key to socio-economic development, evident in a science and technology (S&T) policy in 2000, and STI policies in 2010 and 2017 (MESTI, 2017).[5] Ghana is also participating in the UN Global Pilot Programme on STI for Sustainable Development Goals (SDGs) Roadmap, which requires a commitment to developing an actionable strategy for accelerated development using STI. Within the broad STI framework, the role of ICTs has been prominent, with successive governments determined to usher Ghana into the information age through additional ICT policy interventions such as the 2003 Integrated ICT for Accelerated Development (ICT4AD) policy, the 2005 National Telecommunications Policy and the 2008 Electronic Communications Act, 2008 (though the latter two are more focused on regulating the telecommunications industry). The 2017 draft STI policy does not mention AI; however, a 2019 media article (Acquaye, 2019) reported that the government had developed a new STI framework based on seven pillars that included AI in the strategic technology pillar (the other pillars are: a presidential advisory council; an inter-ministerial coordinating council on STI; an Innovation and Research Commercialization Centre (GIRC); R&D funding STEM education; and legislation. These developments demonstrate the government's prioritization of science and technology in the national development agenda. However, the Ministry of Environment, Science, Technology and Innovation (MESTI) observes that budgetary allocation to STI has been consistently below the 1% of GDP recommended by the African Union (MESTI, 2017).

The 2017 STI policy objectives regarding ICTs are to:

[5] The 2017 STI policy is yet to be passed.

- Ensure STI capabilities exist to integrate ICT into all sectors of the economy including education, industry, agriculture, health and e-governance.
- Develop a national competence for computer hardware and software engineering and information security.
- Facilitate the development of modern ICT infrastructure to improve teaching, learning and research.
- Disseminate and pursue ICT for development (ICT4D) principles and ideals. (MESTI, 2017)

Of particular relevance to this study, areas singled out for attention include youth innovation, science and technology capacity building, promoting women's participation in STI, protection of intellectual property, and initiation of public-private partnerships (PPPs) to support the financing of STI (MESTI, 2017).

The policy places heavy emphasis on developing national innovation and entrepreneurship systems (Asante, 2019) and has a stronger focus on economic sectors than earlier policies (Quaye et al., 2019). Furthermore, a USD 10 million National Entrepreneurship and Innovation Plan[6] was launched in 2017, with a special focus on providing business support and seed funding to small ICT firms (GSMA Ecosystem Accelerator, 2018; Oxford Business Group, 2020b); and the 2018 national budget made reference to incentives for tech start-ups. At the same time, as evidenced in the fourth objective of the STI policy, there is an intent to instil an underlying motivation of social impact as expressed in ICT4D ideals.

The application of STI for public service delivery has been less emphasised – policies refer generically to the potential of STI in different public sector domains such as education, health and safety, but not so much for the actual delivery of service.[7] In general the public sector has struggled to digitalise its operations and despite some progress, continues to struggle with inefficiencies and deficiencies ranging from intermittent power supply to the rudimentary nature of e-government portals and services, to low digital literacy and the lack of ICT policy on e-government (Adu et al., 2017). Low internet access and low digital literacy amongst the general population have also been identified as challenges to the uptake of existing online government services (Agyei-Bekoe, 2013; Botchwey, 2018).

The e-Transform Initiative

The USD 97m World Bank-funded e-Transform initiative announced in 2014, signalled a shift in focus to address the inadequacies of the public sector more conscientiously by upgrading its systems to improve service delivery to the public. According to the Ministry of Communications and Digitalisation, the development objectives of e-Transform are to "…improve targeting of government resources, leading to more efficient use of public funds; improve efficiency and coverage of priority government services, particularly in rural and underserved areas; and nurture entrepreneurship and increase jobs through ICT-enabled entrepreneurship."[8] Interventions planned under e-Transform include "…unique electronic identification systems, that validate citizens and confirms rights to public services while promoting better access to online transactions, financial and other services; and innovative applications to improve service delivery in the priority areas of health, education, judicial, and parliamentary services."[9] Recognising that these interventions cannot succeed without improvement of citizens' access to ICTs,

[6] http://neip.gov.gh/

[7] The STI policy does not directly refer to the public sector, whereas it mentions the private sector several times.

[8] https://moc.gov.gh/e-transform-project

[9] https://moc.gov.gh/e-transform-project

the Minister for Communications and Digitalisation has also laid out several policy and programme activities underway to expand national connectivity (including the submarine fibre-optic cable project) and promote business innovation especially in rural areas (MOC RSIM's blog, 2021).

As stated in the objectives, promoting technology entrepreneurship is a distinct goal and World Bank reporting documents list the development of tech hubs under the "Enabling Environment for Digital Ghana" component of the initiative (Kelly, 2019). One of the tech hubs established and supported for this purpose is Ghana Tech Lab (GTL)—the organisation that originated the Africa AI Accelerator (AAIA) programme. From that perspective, there is a direct line from the AAIA to Ghana's public sector, although no government entity is involved in implementing the programme.

The allocation of government resources to GTL aligns with the national STI plan to leverage private capital for national innovation and a general orientation towards private sector-driven development. Considering the perpetual state of under-resourcing faced by most African governments, PPPs have become central to economic recovery plans and especially to the development of the digital economy. In Ghana, PPPs are seen as critical to bridging public infrastructure finance and efficiency gaps. These types of arrangements have produced some positive results for the public sector in Ghana (Chima & Kasim, 2018), such as in the government's transition to an e-tax and electronic business registration platform (Ampah & Sudan, 2016; Mensah, 2015; Tchao et al., 2017) and a telemedicine initiative[10] that started as a PPP in one district and was ultimately integrated into the Ghana Health Service and rolled out nationwide (Labrique et al., 2018; Modern Ghana, 2018). This model has been given an additional boost in the passing of the Public Private Partnership Act in 2020.

AI capacity-building in Ghana

The e-Transform initiative is silent on AI and other frontier technologies (it mentions Wide Area Networks, the internet, and mobile computing). However, there are glimpses of increased attention to the potential of AI in other initiatives associated with Ghana's development agenda. For example, the African Development Bank has announced that it is funding a 1million USD project to integrate AI-based customer service systems into national banks or other key government agencies in Ghana, Rwanda and Zambia (African Development Bank, 2021). The Ghana Investment Fund for Electronic Communications has also reportedly rolled out a Universal Access to Telephony Programme partly to improve access to data in underserved areas, in light of the drive to deploy AI for socio-economic development (Ghana News Agency, 2018). The then Deputy Minister of Communication, George Andah, called for measures to "drive the excitement of AI among the youth" (Ghana News Agency, 2018).

In recent years, Ghana has attracted high-visibility investments in local AI capacity building, especially seen in the decision of Google AI to site a research lab in Ghana.[11] Following the establishment of this lab, expectations are high that this will lead to an expansion in Ghana's R&D and innovation capacity around AI, in addition to transforming progress towards socio-economic development (Ghanaweb, 2019b; Gyan et al., 2021; Oxford Business Group, 2019). Ghana's STI policy provides for building a skilled workforce through the augmentation of research and development of facilities in educational institutions and other science institutions. However, calls for appropriate investment in human capital for STI often prioritise recommendations to support the creation or strengthening of innovation hubs such as GTL (e.g., Aduloju & Adedoyin, 2020; AUC/OECD, 2021; David-West et al., 2019; IIPGH, 2020; Isagah & Musabila, 2020; Quaye et al., 2020; Travaly & Muvunyi, 2020). Some argue that such hubs are taking over the role of building

[10] https://www.novartisfoundation.org/past-programs/digital-health/ghana-telemedicine

[11] The Google AI Lab in Accra opened in April 2019 (Ghanaweb, 2019a).

technological capacity in the country or that academic institutions should adopt similar hub-type models (e.g. Quaye et al., 2020). The AAIA emerged in this context of a national development agenda tied to expectations of private sector-driven economic growth and social impact.

6.2 Programme Description

6.2.1 Stated purpose

The broad aim of the Africa AI Accelerator is "to support the scaling of the next generation of Africa's AI start-ups" and "promote local innovations in the field of artificial intelligence, machine learning, and data usage."[12]

6.2.2 Technology

The programme does not use AI in its own operations but rather aims to support start-ups whose products or services are based on AI. Programme participants are developing a variety of AI-based products, and the Accelerator provides training and mentorship on AI skills and business development.

6.2.3 Business model

The programme is provided to participants free of charge. Funding and other programme resources come from the Ghana government and other partners (see Key actors below). The government initiative that provides the funding for GTL runs from January 2015 to October 2023[13] It is not clear whether there are any expectations that the programme will continue after the funding period.

6.2.4 Key actors

Key stakeholders include a range of implementing, funder, trainer, and investor groups. The primary implementing body is Ghana Tech Lab (GTL), a joint venture between Innohub[14] (a business incubator and impact investment platform) and Kumasi Hive[15] (a business incubator and technology skills training hub). There are three main funding partners, The Ghana Ministry of Communications and Digitalisation, indirectly supports the AAIA through its funding of GTL under the e-Transform project,[16] an initiative to transform the provision of government services using information technologies. GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) participates directly as a partner in the AAIA through its Fair Forward and Make-IT in Africa programmes. Thirdly, the core funding for GTL comes from the World Bank funding of the e-Transform initiative that was used to establish GTL. The amount allocated to the tech hub component (one mLab and one iHub in Accra and one mLab in Kumasi) is about USD 3.17million.[17] No details are available on what portion (if any) of the investment has gone into the AAIA.

Training partners include IBM, who provide the main technical training platform; and an unspecified number of trainers and mentors who provide technical and business development guidance. Finally, the programme has an unspecified pool of investors who provide seed funding to successful start-ups.

[12] https://africaaiaccelerator.com/

[13] World Bank reports show that the original end date was December 2021.

[14] https://innohub.com.gh/

[15] https://kumasihive.com/

[16] https://moc.gov.gh/e-transform-project

[17] http://documents1.worldbank.org/curated/en/612371619625384678/pdf/Ghana-AFRICA-WEST-P144140-GH-eTransform-Ghana-Procurement-Plan.pdf

6.2.5 Case study focus

This case study focuses on the activities of GTL within the AAIA programme and puts only a limited lens on the other actors. While GTL has other AI-related programmes, these are not examined. With only the Ghana context under review, a basic overview is provided of the selected start-ups in Ghana and the other programme countries, with slightly more attention paid to the Ghanaian start-ups.

Since the AAIA is only just turning out its first cohort, the purpose of this case study is not to evaluate the specific outcomes or impacts of the programme, but rather to locate the programme within the historical and current landscape of Ghana's national development plans. It addresses three key questions:

- To what extent does the business accelerator model contribute to building critical AI skills in African countries?
- To what degree does the approach of programmes like AAIA conform to or disrupt existing development models?
- To what extent are such business accelerator programmes likely to generate beneficial, inclusive and rights-respecting AI innovations that support public sector goals?

6.2.6 Genesis of the Africa AI Accelerator programme[18]

The AAIA programme provides technical training, business development support and seed funding to selected AI start-ups from Ghana, Rwanda, Uganda and South Africa. It is managed by the Ghana Tech Lab (GTL) in collaboration with GIZ (FAIR Forward and Make-IT in Africa initiatives) and IBM. GTL itself is a joint venture between Innohub and Kumasi Hive (both Ghana-based business support organisations) through the Ghana Ministry of Communication e-Transform initiative. The Lab describes itself as an "open collaborative Space for competent Digital skills training, seeding Innovations and Growing Start-ups".[19] It was established around the third quarter of 2019, when, as part of a drive to encourage local tech entrepreneurship, the Ghana government issued a call for proposals to set up a physical space providing training, business incubation, acceleration and seed funds for start-ups. GTL's programmes include several Labs covering AI, blockchain, robotics, cybersecurity, Internet of Things and virtual reality. In addition to the AAIA programme, GTL offers AI courses and runs regular start-up competitions, such as the National Artificial Intelligence Training Program (2 cohorts trained as of September 2019).

The AAIA is an offshoot of GTL's base AI training programme. GTL felt there were unexplored advantages around AI and ML and a lot of young enthusiasts with ideas. In 2020, the Lab run a training programme for some start-ups to provide an introduction to AI and spotlight the prospects for young technology entrepreneurs. This led to a decision to develop the AI accelerator programme and subsequently to conversations with GIZ to scale up the programme. A manager with GIZ's Fair Forward initiative explained that the goals of the AAIA aligned with Fair Forward's interest in improving framework conditions for tech start-ups to thrive.[20] This interest comes from its mandate to support the German government's AI strategy, which includes helping to improve the framework conditions for local development of ML and AI systems in Africa. Fair Forward's action areas comprise capacity-building, improving the accessibility of AI training data and supporting policy development, including ethical and human rights, taking into account the perspectives of participating countries. The expansion of scope to

[18] Unless otherwise indicated, details of the programme are primarily based on an interview with the Innohub CEO in February 2021, as well as publicly available information on programme and other websites.

[19] https://www.ghanatechlab.com/

[20] Interview with GIZ/Fair Forward officers, March 2020.

a broader African focus with four programme countries was a result of GIZ's interest in extending the programme to three other African countries in which the agency is working.

6.2.7 Programme process

Programme participants are selected through an application process (see selection criteria) and go through a six-month training and mentoring process culminating in pitches to potential investors. Participation is free of charge and includes:

- six months of tailored and interactive virtual and physical sessions;
- bootcamp training
- AI coaching and mentorship from IBM experts;
- access to IBM's Digital Nation Africa platform and other digital tools;
- business coaching and mentorship;
- access to investment opportunities; and
- matching with potential clients or partners

Technical training support is provided by IBM and consists of core AI skills courses available on the IBM training platform. There are eight core areas that participants can choose from, depending on their unique needs. Diagnostics are also done to match selected start-ups with coaches based on the stage of the start-up and their need for specific core AI skills.

6.2.8 Programme participants

The first cohort, selected in August 2020, comprised 11 start-ups, evenly spread across the four countries (Table 2).

Table 2. Africa AI Accelerator first cohort

Start-up name (country)	Product/Service	Founders	Business model
Diagnosify (Ghana)	App using AI to diagnose skin diseases and connect patients with dermatologists	2 male	B2C "patients"
Kwanso (Ghana)	App to prevent, track and monitor road traffic accidents	2 male	B2C and B2B passengers, drivers and regulators "corporations and individual business owners"
Xpendly (Ghana)	App providing personal finance management services	2 female	B2C "young African millennials"
Aqua Safi (Rwanda)	Information and monitoring system for fish farmers	2 male	B2B
Data Systems (Rwanda)	Education, e-commerce software development services	1 male, 1 female	B2B
Tabiri Analytics (Rwanda)	Automated cybersecurity services	3 male, 1 female	B2B
Chil AI (Uganda)	Cervical cancer testing and treatment services	1 male, 1 female	B2C Expectant mothers
Global Auto Systems (Uganda)	Information management systems for health care providers	1 male	B2B

Wekebere (Uganda)	Wearable devices for maternal and foetal health care	1 male, 1 female	B2C, B2B "expectant mothers" "doctors"
Congretype (South Africa)	Pest management. Provides societal-based solutions in renewable energy, ICT for development, and climate-smart agriculture	1 male	B2B, B2G
Openbanking (South Africa)	Provides a secure way for consumers to share financial information	1 male, 1 female	B2C "consumers including small businesses"

Source: AI Accelerator website, start-up websites.

6.2.9 Programme outcomes

Based on the project schedule, the six-month training period would have been completed in January 2021. Facebook posts indicate that a "Demo Day" event (including an investor pitch) was held in December 2020 to monitor progress of the selected start-ups (Figure 1). No further details are available about the status of the programme and its participants.

Figure 1. AAIA events

Source: Africa AI Accelerator Facebook[21]

6.3 Analysis: Prospects of the Business Accelerator Approach to AI Skills and Innovation Capacity Building

With their dual purposes of technical training and business incubation, tech hubs are becoming an increasingly central part of national development plans, although their actual delivery of the expected outcomes is yet to be ascertained (De Beer et al., 2016). Within the political and economic environment in Ghana, the Africa AI Accelerator program reflects a particular development perspective – that the pathway to achieving human development (as expressed in the SDGs) is through economic development, of which entrepreneurship, and particularly technology entrepreneurship, is an essential component. However, due to the low level of technical AI skills and growth-oriented business abilities, the promotion

[21] https://www.facebook.com/AfricaAIAccelerator/photos/a.121634352897351/207122134348572/ ; https://www.facebook.com/AfricaAIAccelerator/photos/a.138363564557763/207903947603724/

of AI entrepreneurship must be accompanied with appropriate training. While Ghana's national STI plan includes allocation of resources for capacity building in schools and universities, these investments seem to be happening without the type of fanfare that accompanies the work of tech hubs.

There is a persistent view that formal educational institutions are proving inadequate in turning out work-ready computer science and related graduates and that tech hubs across the world have stepped in to fill the void, not only in terms of technical skill, but also policy development (Atiase et al., 2020; Onukwue, 2020). At the same time, there are suggestions emerging that the expectations being attached to tech hubs are unrealistic (e.g., Afrilabs & Briter Bridges, 2019; Bayuo, 2017; Csikszentmihalyi et al., 2018), with Afrilabs & Briter Bridges (2019, p.14), for example, noting that "hubs seem to have - somewhat mistakenly - become the proxy to address the totality of the ecosystems they belong to. This has caused many to attribute to these hubs a role and a duty that has often proven to be problematic. …This has led to a shift in responsibilities from civil society, private sector, and the government to these hubs, which have found themselves being tasked with unlocking opportunities that can be out of their scope". This section discusses the potential and challenges of capacity-building programmes like the AAIA in the Ghanaian context.

6.3.1 Potential benefits: Advancing national development goals through private sector capacity building

Enhanced human development: The AAIA requires applicants to "have a business model with a social impact, i.e., with a solution to a problem as described in the Sustainable Development Goals".[22] Areas highlighted in the call for applications include health services and natural language processing. It also encourages applications from AI start-ups with open-source, open data business models, noting that this provides "the opportunity for ecosystems to evolve and collective efforts to solve problems." Ultimately, the products of the first cohort speak to several domain areas of relevance – health, finance, agriculture, for example. Two of the participating start-ups (Uganda-based Chil AI and Wekebere) expressly address issues related to women's health. However, as will be discussed in subsequent sections, the relevance of the innovations to populations that need them most remains questionable.

Improved public service delivery: The inclusion of technology entrepreneurship development in the objectives of e-Transform is curious because it appears to constitute a separate objective from that of improving public service delivery. Reviewing the first cohort of AAIA start-ups shows that at present, their innovations do not have any direct applications to public sector institutions. A similar observation was made by David-West et al. (2018) and Kelly and Firestone (2016), who found very limited engagement of tech hubs with universities and government institutions. According to management of the AAIA, as a catalytic platform, the programme "in and of itself will not be producing solutions for government, but you can find the right start-ups with government tech solutions and then leverage to match them".[23] So far, it appears that this possibility has not emerged. This indicates a missed opportunity to actively apply the work of the accelerator to the functioning of the public sector, for example by inviting applicants working on innovations that are directly applicable to public sector activities, including a training element to sensitise participants to the potential relevance of their innovations to the public sector, or encouraging government agencies to participate in the programme as potential investors or users.

Promotion of local innovation: Studies have found that tech start-ups and innovation hubs in Africa play an important role in fostering local innovation (De Beer et al., 2016; Kodjokuma, 2018). While some

[22] In call for applications - https://www.movemeback.com/initiatives/ghana-tech-lab-africa-ai-accelerator-program/

[23] Interview with Innohub executive.

view tech start-ups in Africa as largely adopting western or even colonial (Ali, 2016) models of innovation, others argue that there is a thread of local relevance and grounding in the emerging ecosystem (Avle & Lindtner, 2016; Csikszentmihalyi et al., 2018). The technical training received by AAIA participants is based on the platform of a western global organization, IBM; as such it is likely to be, at best, generic in the sense of focusing on purely technical training needs. However, AAIA mentors and investors include local businesspeople and angel investors, which could be sufficient to connect the training and mentorship to the local context. According to the management of the AAIA, the local relevance of the programme is reflected in the fact that the selected start-ups come into the AAIA with their existing ideas developed locally and based on their particular national contexts. Coaching is meant to help start-ups address their own identified capacity gaps rather than to push them in a predetermined direction. Without prejudging effectiveness or marketability, the health, finance and transportation-related foci of the Ghanaian start-ups for example, do align with local needs and national priorities. Properly directed, they could serve to meet the real needs of the most disadvantaged populations in the country.

Development of the technical and business ecosystem: Organisational models or programmes such as the AAIA contribute to developing the broader technological and business ecosystems by attracting or identifying entrepreneurial talent, enhancing their skills in areas that need development, and consolidating and channelling resources (financial and non-financial) towards promising enterprises. Research by VC4A, for example, found that ventures that join incubator or accelerator programmes secure on average 23% more investment than those that do not join such programmes (van Halen, 2014). Nevertheless, finding willing investors remains a challenge for most African entrepreneurs. Due to its preference for start-ups that already have a proof of concept and some degree of operational track record, it could be argued that the AAIA mitigates investment risk by channelling resources to start-ups that have a higher chance of success. However, successful start-ups benefit not only their founders, but can also create employment. In the long-term, this could help to build investor confidence and ultimately boost the entire ecosystem, enabling the government to achieve its vision of technology-facilitated development through employment and entrepreneurship. So far, the e-Transform investment in tech hubs is reported to have generated or sustained 644 jobs[24] (Kimura, 2021), which probably does not include the outcomes of the AAIA considering its early stage.

Bolstering capacity of female entrepreneurs: One of the areas highlighted in the AAIA invitation for participants is that the programme is interested in applications from start-ups with female founders, although this is not a prerequisite. The organizing partners, Ghana Tech Lab, GIZ, and IBM note that they are "committed to encourage and support female founders in the field of artificial intelligence and machine learning."[25] This objective is somewhat being achieved since more than half of the first cohort have at least one female co-founder. At GTL's National Start-ups Investment Pitch Summit in 2019, the top three winners were female-led start-ups (Nyantakyi, 2019). However, as will be discussed in the next section, on balance, female participation in the AAIA is low. Of the 644 jobs generated by the tech hubs, almost 40% were jobs created for women (Kimura, 2021), much higher than the 100 jobs targeted by the initiative. Determining whether or not this is an adequate achievement for the investment is beyond the scope of the case study.

[24] It is not possible to conclude whether this is an adequate achievement for the investment.

[25] In call for applications - https://www.movemeback.com/initiatives/ghana-tech-lab-africa-ai-accelerator-program/

6.3.2 Inequalities and exclusions: Digital tools and analogue barriers?

Notwithstanding the abovementioned potential benefits, the accelerator model itself, as well as the outputs of its participants could have the result of deepening existing social and economic inequalities or creating new ones. In this sense, the pivot of attention to AI follows the same trend as previous technologies, from the industrial era to the information age.

Socio-economic barriers to participation:

Eligibility criteria for the AAIA skew towards already relatively advantaged or successful businesspeople. In addition to having been in operation for at least one year and being readily available for all programme sessions, applicants are required to have any of the following:

- an AI or ML product or service;
- the prerequisites to include AI or ML into existing products or services including a detailed concept;
- products or services, which are needed to develop AI or ML products or services including training data collection;
- traction with early revenue and early customers, with a clearly demonstrated potential to scale; and
- a venture profile on VC4A with appropriate information for business and financing partners.

These requirements are likely to favour urban-based professionals with above-average education and access to digital and financial resources for technology development. Real examples of how these types of criteria present barriers to people in low-resource environments can be seen in some social media posts in response to other GTL programmes asking questions about challenges such as cost of transportation to the programme site, inability to commit to attending all sessions due to being in school or at work, or whether the programme would be provided in their region of the country.

Gendered barriers to participation

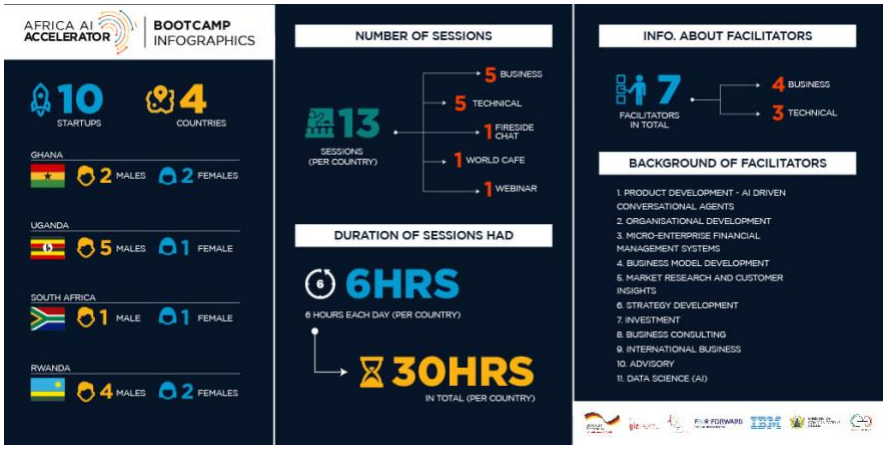
Notwithstanding its active effort to recruit female entrepreneurs, based on the programme website as well as review of the 11 selected start-ups' websites, the majority (68%) of the founding partners are male (15 identified compared to 7 female founders or co-founders). One start-up has only female founders, five have only male founders, four have an equal number of male and female founders and one has majority male founders. An infographic on the programme's Facebook page shows that overall, there were twice as many males (12) as females (6) participating in the bootcamp component of the accelerator (Figure 2).[26] The applicant pool itself was similarly oriented with 33% (17 out of 34) of the applicants having a female founder.[27] This is also consistent with general trends in GTL's bootcamps, as a 2019 post by GTL states that out of 300 trainees in a previous bootcamp, 35% were female.[28] Research by Quaye et al., (2020, p.2) confirms "male dominance in the STI Ecosystem in Ghana". They found over 80% of research and commercial organisations had male focal persons. Considering that low bar, the 32% representation of women in the AAIA is a strong result.

[26] https://www.facebook.com/AfricaAIAccelerator/photos/a.121634352897351/187359956324790

[27] https://www.facebook.com/AfricaAIAccelerator/photos/a.121634352897351/139946687732784/

[28] The report also indicates that 28 innovators were selected for the GTL AI incubator programme but does not state how many were females.

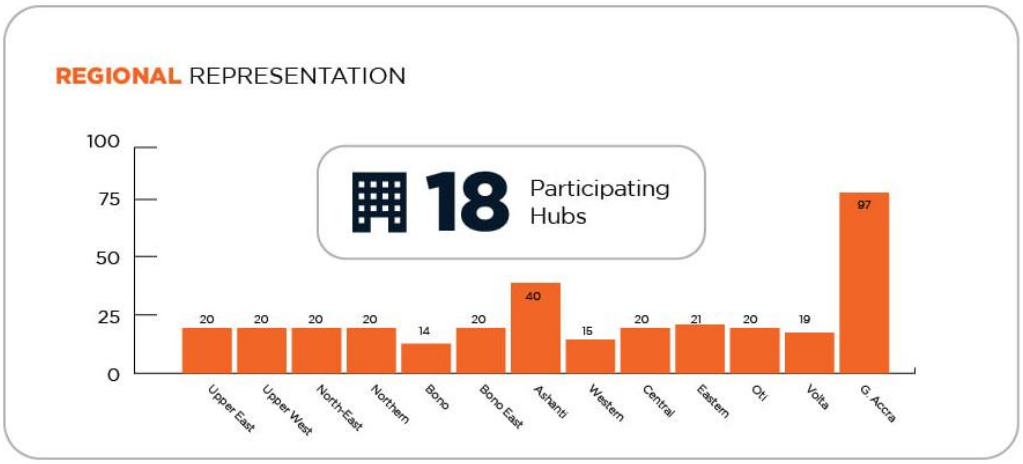
Figure 2: Infographic on first cohort bootcamp



Source: Africa AI Accelerator Facebook[29]

Potential intersectional imbalances (in this case, gender- and geography-related) can also be seen in a GTL training for women (unrelated to the AAIA) in which almost 40% of participants came from two (Greater Accra and Ashanti) of Ghana's 16 administrative regions (Figure 3).

Figure 3: Ghana Tech Hub 3-week National Female Pre-Tech Training Programme



Source: GhanaTechLab Facebook Page[30]

Socio-economic barriers to benefits

Despite the clear expectations that AI, like previous general-purpose technologies, will contribute to equitable socio-economic development, the absence of a national AI policy means there is no framework to ensure this happens. At present there are no clear strategies to ensure inclusive design and implementation of AI innovations (Yeboah, 2020).

Based on the types of AI innovations being generated by participants of the AAIA programme, their ideal target market would consist of smartphone owners. Data on Ghana indicates that at the end of 2019, 55% of the population owned mobile phones and there were about 15 million smartphone devices in use (Omondi, 2020). Smartphone ownership is estimated to be about 35%, with significant socio-economic

[29] https://www.facebook.com/AfricaAIAccelerator/photos/a.121634352897351/187359956324790

[30] https://www.facebook.com/GhanaTechLab/photos/a.659475454447589/1297879537273841

divides especially related to education and, to a lesser degree, income (Pew Research Center, 2018). For example, 66% of those with secondary or above education reported owning a smartphone, compared to 25% of those with less education. The income-based gap was smaller – 38% of those with higher income (above the country median) and 24% of those with lower income reported owning a smartphone.

Ghana also has the second highest adoption of mobile data in sub-Saharan Africa (Kepios, 2020; Omondi, 2020). But although internet use is rising, it is still low at 28%, according to RIA's 2018 After Access survey data – partly related to low smartphone ownership levels (Gillwald & Onkokame, 2019). According to (Kepios, 2021) almost 99% of internet users are smartphone owners and 90% of internet users do so via a smartphone.

Furthermore, the ability of the neediest populations to avail themselves of the AI innovations emerging from the accelerator programme is questionable from a business perspective. There is a high likelihood that the products and services will be more aligned with the needs and financial capabilities of relatively wealthy populations. As Yeboah (2020, p.3) found, AI entrepreneurs in Ghana are being confronted with the "high cost of innovating for low-income groups compared to the low cost of innovating for affluent communities". This could be compounded by the fact that public services such as security and surveillance (Bagson & Owusu, 2016), in general, have also tended to serve urban and affluent regions of the country much better than the more economically-disadvantaged.

6.3.4 Prioritisation of technical and business skills capacity-building

The goals of the AAIA are framed as responding to the need for local AI innovation to address local problems—specifically the programme "has been designed … to promote local innovations in the field of artificial intelligence, machine learning, and data usage."[31] It also presents a vision of AI helping to achieve the SDGs and support inclusive development in Africa. The programme recognises the need for additional skilling even for entrepreneurs already offering AI innovations – hence it offers both technical and business capacity-building.

Notwithstanding the human development vision associated with the programme, it has a distinctly commercial orientation. GTL's base AI training program (out of which the Accelerator programme emerged) aims to "enable start-up companies build profitable business and scale them across the African continent using modern AI technology tools and business strategies".[32] It comprises six weeks of training and two months of business incubation and includes internship opportunities for participants. The AAIA is run in a similar way. In the official programme description, both social and commercial enterprise language come through strongly (see Box 1). However, applicants are required to be for-profit organisations. Furthermore, the five programme objectives (Box 1) continue the business-oriented tone – strengthened technical competence, strengthened business capacity, product readiness, investment readiness, and partner agreements.

Box 1: Programme description[33]

> The Africa AI Accelerator program is structured to identify entrepreneurs with innovative high growth AI solutions that are commercially viable, socially driven and creatively designed and can be refined and scaled through an acceleration program. We seek passionate teams with post-idea and early stage solutions that demonstrate market relevance, commercial viability and early traction. Running

[31] https://africaaiaccelerator.com/

[32] https://www.ghanatechlab.com/base-programs

[33] Source: https://africaaiaccelerator.com/index1.html

as a pilot for 10 AI start-ups from Ghana, South Africa, Rwanda and Uganda, the program has been structured to holistically support Artificial Intelligence and Machine Learning start-ups for sustainable and inclusive development in Africa. The program will run for 6 months, with an approach anchored on strengthening the business and technical capacity of participating start-ups. Customized to boost collaboration between start-ups and corporates, commercial partners and investors, participating start-ups will come out of the program having received adequate support to meet clear growth aspirations through measurable targets setting.

Objective / Expected Outcomes of Program
The program is designed to meet the following objectives:

1. Strengthened Technical Competence
With cross-range training in AI, ML and other related disciplines, tailored skills development support and coaching, entrepreneurs on the program will exit having strengthened their technical capacity in AI and ML.

2. Strengthened Business Capacity
The selected participants will be exposed to business training and capacity development required towards building highly scalable AI businesses out of their innovative solutions. With training and expert support from experienced business coaches and mentors, entrepreneurs will be able to develop a strong business model for their solutions.

Start-ups will come out with the following done as part of the program:

- Business Model Report
- Business & Strategic Growth Plan
- Market Analysis Report
- Internal Control Manuals (Finance Policies and Procedures Manual; HR Manual)

3. Product Readiness
Our highly intensive program will support participating start-ups in building MVPs, refining and testing their solutions, thereby making them market-ready.

4. Investment readiness
With entrepreneurs' technical and business capacities strengthened, participating start-ups will be in good positions to attract funding from Angel Investors, early stage focused VC funds and other investors.

5. Partnership Agreements
Through structured networking and introduction to relevant corporate bodies and institutions, the entrepreneurs will sign strategic agreements that will prove useful for customer acquisition, product roll out, corporate R&D integrations, etc.

6.3.5 Domestic environment

Several elements of the Ghanaian environment and the public sector specifically are gearing up for the potential deployment of AI technologies and services. However, overall, there are significant gaps that will present challenges for building AI capacity for employability, entrepreneurship and public sector service delivery. Supportive factors include:

Enabling policy environment. As noted above, interest in and support for technology entrepreneurs in Africa has increased dramatically over the last decades. After a long period of pursuing large-scale industrialisation, the language of entrepreneurship has become the common thread running through economic recovery efforts in Ghana. And the focus on ICT-driven development has put a spotlight on

digital entrepreneurship. According to (GSMA, 2019), the number of active tech hubs in Africa grew from 442 in 2018 to 618 in 2020. However, the environment is not fully supportive, as "unfavourable regulations and an immature ecosystem" including taxes and the cost of spectrum are still cited as barriers to the growth of tech start-ups (Kodjokuma, 2018; Oxford Business Group, 2020c).

Aspirational population. According to managers of the AAIA programme, an enabling factor for the AI ecosystem is a "youthful population that seems to want to try".[34] This is seen in the enthusiastic response experienced by the AAIA as well as GTL's other AI training and incubation opportunities.

However, numerous challenges remain from both supply and demand angles. As observed by a GIZ officer:

> "AI, machine learning is comparatively intensive in business terms – you need the training data, you need computing power, you need some more computing power to deploy it, you might need software engineering to integrate it… which works when you have an environment that finances you all the way until you have built this up and you make money. And then you need basically some market to sell it if you want to do it commercially…"[35]

Lack of technical skills. AI education in Ghana is limited in relation to both technical and governance skills—according to the Institute of ICT Professionals, Ghana (IIPGH) (2020), technical knowledge is sparse, with few AI courses in colleges and universities and only a few computer science and engineering experts with AI skills. Our own search for AI programmes in Ghanaian universities only found clearly advertised AI and ML courses at Ashesi University[36] and a short course on big data engineering at the Kwame Nkrumah University of Science and Technology (KNUST)[37] In a presentation on integrating AI ethics into tertiary education in Ghana, a professor at KNUST indicated that the university offers undergraduate and graduate courses in AI in its Computer Engineering, Computer Science, Telecommunication Engineering and Electrical Engineering programmes.[38] An interest in improving skill levels is one of the reasons the AAIA was established, although its focus on already functional AI enterprises might limit impact on the broader skills environment. As discussed in the section below on AI governance, training of talent in other skill areas such as AI ethics and governance is limited, and in any case, probably not feasible in the absence of a national AI policy. Acquisition of AI governance capacity will be particularly important for public sector actors, should they ultimately adopt any of the innovations coming out of the AAIA.

Limited access to business capital. The high cost of start-up capital is a continuing challenge (IIPGH, 2020; Oxford Business Group, 2020c; Quaye et al., 2020) as is the need for "patient capital"[39] (Oxford Business Group, 2020a). There is a lack of investors willing to provide long-term capital, resulting in high failure rates (Kodjokuma, 2018). At the same time, there does appear to be large amounts of capital being channelled towards the tech start-up model by global development agencies as well as private sector or non-profit corporate social responsibility (CSR) operations. This appears to be very much related to the strong social impact undertones of most start-ups, although the causal direction is unclear. Several

[34] Personal interview with Innohub executive.

[35] Personal interview with GIZ officer.

[36] https://www.ashesi.edu.gh/academics/programmes/computer-science/computer-science-courses.html

[37] https://myhealthbasics.site/2020-short-course-on-big-data-engineering-by-knust/

[38] Presentation by Prof. Jerry Kponyo at workshop on Integrating AI ethics into higher education curricula in Africa, September 30, 2020. https://rainafrica.org/wp-content/uploads/2020/10/RAIN-200930.pdf

[39] Interview with Innohub executive.

institutions in Ghana such as Meltwater Entrepreneurial School of Technology,[40] Ghana Innovation Hub,[41] and Global Start-up Ecosystem[42] have accelerator initiatives that include seed funding. Make-IT Africa has already supported over 450 tech hubs or start-ups in Africa, including 115 in Ghana.[43] US-based Oracle has announced plans to launch an acceleration programme for 500 tech start-ups in Ghana (Ogunfowoke, 2019). The venture capital industry is also steadily growing in Africa. While in 2019, there was a large increase (20% year on year) in early-stage investments (USD 1.2m), the majority of venture capital (USD 48m) in Africa has gone to growth-stage enterprises (Partech Africa, 2020). More research is needed to examine the role of traditional banking institutions in supporting the start-up economy in Ghana.

Access to infrastructure and computing power. Poor connectivity and inadequate computing equipment, low storage capacity, and electricity and internet outages are additional barriers that data scientists and AI innovators have to contend with, especially outside the major cities (IIPGH, 2020; Kodjokuma, 2018; Pilling, 2020). According to Kepios (2021), the average download speed of mobile internet connections in Ghana declined by 24% between 2020 and 2021, while that of fixed internet connections grew by 48%. Considering that most of the Ghanaian population depends on mobile internet and that fixed internet connections are largely limited to corporate environments or wealthy communities, this indicates a further entrenchment of the capacity to innovate with AI (and to access AI innovations) within communities of relative advantage. Within the public sector, the long-term viability of AI systems could also be compromised by poor equipment maintenance culture (Achampong, 2012; Effah et al., 2021).

Access to training data. Low data capability is a serious challenge stifling start-ups' innovative capacity—most of the available training data is held by large corporations (IIPGH, 2020). This challenge is also noted by the founder of minorHealth AI Labs in Ghana,[44] who points to the large amount of medical imaging data accumulated by hospitals in the country but which is inaccessible to AI start-ups (Pilling, 2020). It is unclear where participants in the AAIA obtain the data for their innovations.

Access to viable markets. Consumer purchasing power in Ghana is fairly low, presenting challenges to the delivery of high-end technological products (IIPGH, 2020). This constraint is also acknowledged by management of the AAIA, who noted the lack of early adopters, "especially for products that you have to pay for".[45] Yet, the selected start-ups' services rhetorically appear to be targeting end-consumers, and especially marginalized and low-income groups. Unsurprisingly, there are differences or inconsistencies in how some products are described in the context of the AAIA and on the individual start-ups' websites. For example, the Kwanso product is presented as an information tool on safe driving and traffic congestion; however, on its Google Play page, it appears to be marketing a surveillance tool to business locations. While stating that there are only 25 dermatologists in Ghana, Diagnosify presents its aim to bridge the gap between dermatologists and the population by helping to diagnose skin diseases and then connecting users to a dermatologist or pharmacy for treatment. This service will be most useful to

[40] https://techbuild.africa/mest-express-accelerator-2021-open-ghana-start-up/

[41] https://mfidie.com/the-acceleration-factory-of-the-ghana-innovation-hub-launches-call-for-applications-for-tech-companies/

[42] https://globalstart-upecosystem.com/accelerator/

[43] https://make-it-initiative.org/africa/start-up-pool/?_sft_ctx_country=ghana

[44] The Lab has developed an AI system that can make diagnoses from chest x-rays and is also using AI to try to understand differential susceptibility to malaria in different parts of the country (Pilling, 2018).

[45] Personal interview with Innohub CEO.

those that can afford to consult a dermatologist or the cost of treatment whether at a clinic or pharmacy. Since commercial viability is a critical criterion for the programme, it is only natural that the start-ups would be confronted with the practical difficulties of pursuing B2C models directed at low-income populations and may be compelled to pivot towards more profitable markets.

6.3.6 AI governance – Human rights, risks and potential harms

The three domains covered by the Ghanaian start-ups are health (Diagnosify), finance (Xpendly), transportation (Kwanso). Based on publicly available information, there is no indication of their approach to addressing data protection or other risks and harms. The health and finance products are clearly designed to collect, analyse and in the case of Xpendly,[46] share personal data. Neither has an accessible privacy policy (the link to Terms and Conditions on the Diagnosify website is non-functional, and there is none on the Xpendly website).

The workings of Kwanso are unclear – information on Google Play present it as a tool to "Take control of your road safety by knowing the speed at which your vehicle is travelling" and to "Get the evidence here to speak up if the driver is over speeding".[47] On the other hand, the formal start-up profile[48] as well as other sources indicate that it is a CCTV tool for businesses to manage congestion and customer service (Wig, 2020)—which could have public surveillance implications. Links to the company website and its privacy policy are either broken or flagged as dangerous. Apart from the agriculture-oriented innovations, all the start-ups from the other three countries also appear to have a similar characteristic of handling personal data. The AAIA does include AI ethics as a topic in its training, although no information is available on the precise amount and content of this training – the Facebook page reports on one bootcamp that included a webinar on algorithmic bias (Figure 4).

Figure 4: Facebook post on boot camp

Source: AAA Boot Camp Facebook[49]

However, prioritising ethical concerns can be a tall order for struggling start-ups. A former tech entrepreneur expressed the challenges in a workshop on responsible AI and start-ups, saying:

[46] Xpendly provides for users to receive customized marketing from financial institutions.

[47] https://play.google.com/store/apps/details?id=com.kwanso

[48] https://ai-start-ups.netlify.app/servicehub

[49] *https://www.facebook.com/AfricaAIAccelerator/*

> "Teaching the … ethical and moral perspective … is usually a challenge when you're talking about start-ups and engineers… it was very tough for me to put such things … as a priority … because I just needed to get the business running and I needed to get investors on board and needed to get customers on board… the last thing I was thinking about at that particular time was the ethics and the moral perspective of it"[50]

Appropriate governance structures therefore need to be in place to protect users' data and privacy. The existence of data protection and cybersecurity policies and institutions in Ghana indicates that the risks of the digitalized and data-driven economy have not been overlooked. However, the landscape of risks and potential harms is unclear due to the nascent nature of the industry and the lack of focused research on this topic. While Ghana currently has no laws specifically on AI, efforts are underway to build those structures (see Background and context section above), though their status and efficacy is unclear. Working with UN Global Pulse, Ghana's Ministry of Communication and digitalization and the Data Protection Commission held a workshop in June 2019 to develop an ethical AI framework for Ghana. Increasingly, local scholars, technologists and regulators are drawing attention to AI-specific ethical and other regulatory issues that are critical for proper governance of AI-based systems (Aden, 2020; IIPGH, 2020; Travaly & Muvunyi, 2020). This includes calls for science programmes in Ghana's higher institutions of learning to institutionalise AI ethics into their curriculum. As at the end of 2020, AI ethics was not being taught as a distinct course in any departments of Ghana's premier science and technology university.[51]

Data protection expectations were enacted into law in 2012 (Data Protection Act). In addition, noting that "the accelerated growth in amounts of data available enabled by Artificial Intelligence, Machine Learning, Blockchain and Internet of Things and driven by cloud computing platforms has increased the aggregation of personal data from multiple sources for decision making based on individual behaviour and preferences, with the potential invasion of privacy", the government has charged the Data Protection Commission to ensure that personal data is safeguarded (MOC RSIM's blog, 2021).

Although several African countries have or are developing data protection laws, critics argue that most African countries lack the institutional capacity to support AI development and deployment. Challenges include inadequate or poorly enforced legislation, lack of political will and low public awareness of rights (Abdulquadir, 2020; Arakpogun et al., 2021). For example, surveys show that less than 16% of the population has concerns about how companies use personal data (Kepios, 2021). Agyei-Bekoe (2013) linked this tendency to lack of awareness of privacy issues, as well as the communal nature of Ghanaian culture. This unevenness has implications for entrepreneurs planning to target regional markets. With reference to Ghana, Alunge (2020) concludes that the Data Protection Act does not provide rigorous protection in some areas. Acknowledging the need to build capacity for data governance, in 2020, the Data Protection Commission licensed over 500 Data Controllers, registered 74 new Data Protection Supervisors and accredited three institutions to train Data Protection Supervisors (Government of Ghana, 2021). Commenting on the application of AI to health projects in Ghana, Pilling observes that "the hunger for data that such projects generates is tricky in a continent that has not yet grasped the regulatory implications of accessing personal information" (Pilling, 2020).

Efforts to shore up cybersecurity and build related human capacity are also evident. Cybercrime is however known to be widespread in Ghana, especially in the financial sector – usually in the form of

[50] RAIN-Africa Workshop: Responsible AI and Start-Ups, March 17, 2021. https://rainafrica.org/2021/02/16/rain-africa-workshop-responsible-ai-start-ups/

[51] Presentation by Prof. Jerry Kponyo at workshop on Integrating AI ethics into higher education curricula in Africa, September 30, 2020. https://rainafrica.org/wp-content/uploads/2020/10/RAIN-200930.pdf

internet fraud/scams but increasingly targeting sensitive national institutions (Antwi & Lulin, 2018; Burrell, 2012; Media Foundation for West Africa, 2017; Motiwala, 2017) – which is likely to become an even more serious threat with the capabilities of AI. According to Adu and Adjei (2018), most Ghanaian companies have limited awareness of cybersecurity, and "are not integrating legal aspects into their information security policies". A National Cyber Security Centre was set up in 2018 and the Cyber Security Act 1038 was passed in December 2020. The Act provides for protection of critical information infrastructure, protection of children on the internet, and development of the country's cybersecurity ecosystem (MOC RSIM's blog, n.d.). To build cybersecurity awareness and human capital, the government has also launched a 5-year cybersecurity awareness programme (Government of Ghana, 2021). It is unclear what the status of local authorities is with regards to trained personnel to enforce the Cybersecurity Act. Prior to establishment of the Act, some analysts had noted the limited capacity of law enforcement and security agencies (Ennin & Mensah, 2019). Others have identified concerns about insiders enabling unauthorised access to data in online government systems (Botchwey, 2018).

6.3.7 Conclusion

This case study set out to examine the contribution of the Africa AI Accelerator to building AI skills in Ghana, to assess whether this approach to entrepreneurship development represents a new model of human development, and on that basis, to consider the likelihood that the programme would lead to the production of beneficial and inclusive AI products and services.

Overall, the programme appears to help fill an existing need for capacity-building in both AI skills and business development by providing opportunities to access technical training, business mentorship and start-up funding. Broader impact on the growth of a skilled AI workforce at the national level remains to be seen as the programme has only just turned out its first cohort of 11 start-ups—arguably a mere drop in the bucket considering the overall AI skills deficiency. In the longer term, investment in more foundational skill building through educational institutions such as universities might be more impactful as such training will produce larger cohorts on a yearly basis, and likely build a broader range of capacities – e.g., for basic AI research, work-ready skills, governance abilities, and AI entrepreneurship.

The AAIA facilitates the distribution of resources (and power) to particular activities and organisations within the local (and global?) AI ecosystem. In terms of the extent to which the Accelerator's approach conforms to or disrupts existing development models, the programme largely maintains an orientation towards neoliberal models of development, essentially contributing to the government's commitment to the technology entrepreneurship as the engine of national growth. The capacity-building focuses on technical and business skills, buttressing the assumption that successful business performance will translate into delivering human development.

The business incubator approach is becoming more entrenched and receives more media attention compared to the relatively low-key investment in university education and research and development – possibly a result of more resources being put into publicity, the global fascination with the language of the SDGs and social impact, the longer timeframes of university education and research, and possibly academia's more cautious approach towards technology advancements. Long-term sustainability of this model as an approach to development, however, remains questionable considering its high dependence on venture and donor capital, and the lower capacity of entrepreneurs in developing countries to sustain the shocks of experimentation characteristic of technology hubs in more advanced economies.

While it is too early to assess the impacts of the AAIA on the production of beneficial, inclusive and rights-respecting AI, the results so far demonstrate that such programmes do contribute to AI technical and entrepreneurship capacity-building through training and mentorship. Start-ups have a focus on local

problems and solutions, concentrated around fintech, agriculture and health. However, the programme criteria will likely attract relatively high socio-economic status applicants; and is also likely to foster innovating for high-income consumers. This will only repeat trends already seen with older technologies such as computers, mobile phones and the internet. Being primarily dependent on government and donor funding, the scalability and long-term sustainability of the programme is uncertain. Critically, there is no direct connection to public sector service delivery—such connections could potentially augment the ability of the programme to reach less affluent populations. Policy and legal frameworks are also not in place to ensure that AI is ethically deployed. These all suggest that as far as the goals of AI for development are concerned, the social and economic impacts of these types of programmes might turn out to be less dramatic than advocates hope, and the risks and potential harms remain high.

Programmes like the AAIA that seek to accelerate technological development may represent more opportunity than risk and might not directly cause harm; however, they could launch the country on yet another technological trajectory for which its population and leadership are unprepared. Learning from experiences with mobile and internet technology, relatively slow progress may be a good thing to enable appropriate capacity and governance frameworks to be established.

7. Case Study 2: AI in Workforce Development: The Harambee Youth Employment Accelerator in South Africa

7.1 Background and Context

Youth and the South African labour market

Youth unemployment is one of South Africa's primary socioeconomic concerns (Stats SA, 2020). In the first quarter of 2021, the number of youth (15–24 years) not in employment, education or training (NEET) was around 10.2 million, accounting for 32.4% of youth (Stats SA, 2021). In general, the NEET rate for females in this age range is higher than that for males, although both have declined slightly (by 1.6 and 1.8 percentage points respectively) since 2020 (Figure 5). Youth are also particularly susceptible to job loss in times of economic crisis such as experienced during the COVID-19 pandemic. Employment data from early 2021, for example, shows that whereas about 19% of prime age adults lost their jobs between October 2020 and January 2021, the job loss figure for youth was 31% (Espi et al., 2021).

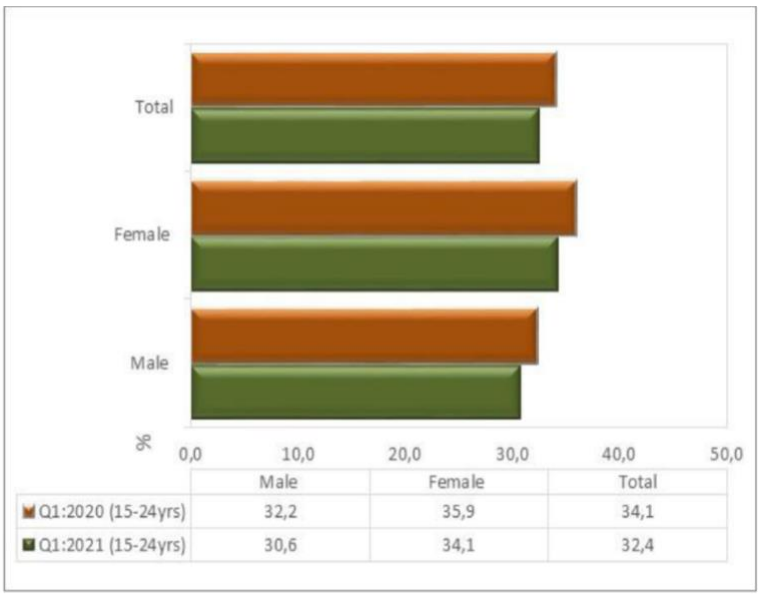


Figure 5: NEET rates for youth aged 15–24 years by sex

Source: Stats SA, 2021, p.14

A variety of socioeconomic circumstances contribute to this problem, including education levels, gender, and locality. Unemployed youth generally have poor educational backgrounds; some have dropped out of school; and most lack the literacy, numeracy, and communication skills required in the labour market (Oosthuizen & Aalia, 2014). Young women have higher unemployment rates than young men (Stats SA, 2021), despite having higher educational attainment (Wang & Beyleveld, 2021); and have suffered greater job losses and slower employment recovery during the COVID-19 pandemic (Casale & Shepherd, 2021; Wang & Beyleveld, 2021). Vestiges of the apartheid era add an additional layer of disadvantage based on race and class.

Organisational adoption of AI

Some scholars argue that AI will play a critical role in improving employment and economic growth in South Africa, by increasing productivity and income levels of workers (University of Pretoria, 2018), while others predict that advancements in automation and artificial intelligence over the next few decades may result in large job losses or labour fragmentation, widening income and societal inequalities (Korinek & Stiglitz, 2017; Méda, 2016). Over 96% of the South African business sector is expected to benefit financially from AI-related solutions to optimise their operations (Business Tech, 2019), although the precise nature of these benefits is unclear. As Holdren et al. (2016) points out, there is little reason to believe that the net effects of AI transformation globally would be significantly different from previous technological developments, which have increased wage disparities, especially among workers with high school diplomas, whose relative wages have fallen from more than 80% of those with college degrees to less than 60%. South Africa also scores poorly in the Human Capital Index, directly signifying its vulnerability to 4IR disruptions (Presidential Commission on the Fourth Industrial Revolution, 2020). Recent job losses in the banking and mining sectors in South Africa, which have seen the highest job losses in recent years, have been linked in part to digitalisation. Scholars have also demonstrated that the impacts of digitalisation on the employment process are variable—in some cases there is no effect on hiring processes, and vacancies and abandoned searches actually increase (Carbonero et al., 2018; Warning & Weber, 2018).

While highlighting potential risks associated with excessive automation or the labour market's inability to adjust to the new required skills, (Acemoglu & Restrepo, 2018) identify four processes that could counteract the recessionary effects of automation: a revenue effect, an economic activity impact, the deepening of automation (via increased productivity), and the introduction of new tasks.

AI policy and skills development

According to a 2019 report by the National Advisory Council on Innovation, South Africa wants to triple the number of science and technology researchers in order to keep up with other upper-middle-income countries (National Advisory Council on Innovation, 2019). The study also discovered that, over the past decade, the percentage of industry researchers versus those in higher education has decreased, as has government support for business R&D. This means that the government must do more to promote a dynamic and ambitious private sector.

Adjusting to emerging trends fuelled by frontier technologies calls for renewed policies focused on anticipating needs for skills through regular workforce assessment, teaching transversal skills like learning to read, and cooperation among education, research and industry sectors (ILO, 2020). The South African national strategy for harnessing the Fourth Industrial Revolution (4IR) for education and workforce development suggests using the potential of technological innovation to grow the economy. In addition, the government proposes reskilling and investing in curriculum innovation and adopting

intersectoral and multistakeholder approaches to AI in education planning and governance (Ramaphosa, 2020). Although the standard of oversight and incorporation of education and training institutions into the proposed government policies vary, an examination of policy and government strategies reveals how much national development is recognised to be dependent on education and training institutions' ability to respond to emerging and changing labour market needs.

South Africa's national strategy on the 4IR focuses on bridging capability and strengthening ties between government, industry, and academia, by establishing research centres, hubs or industrial parks designed for AI development. A focus of education policies is workforce and skills development at all stages of education. These policies highlight the need for technology curricular development in primary and secondary education, such as the piloted integration of robots and coding into South Africa's basic education curriculum (Malinga, 2020). Critiques of the 4IR, which have been pushed to the forefront of South African digital policy, highlight the lack of an inclusive and equitable agenda in the country's National Development Plan. For example, (Gillwald, 2020b) stresses that certain prerequisites must be satisfied in order to properly leverage the capabilities of advanced technologies to contribute to national policy concerns such as job creation, poverty alleviation and equality. Among these are long-overlooked supply-side interventions to improve affordable and meaningful digital access in addition to demand-side strategies to increase the absorptive capacity of users, firms, citizens.

AI governance

Recent advances in machine learning techniques and increased big data analytics have enabled highly sophisticated and complex algorithmic decision-making capabilities that can benefit society. However, there are considerable concerns about bias (e.g., from the use of unrepresentative datasets in decision-making) leading to unfair results that can negatively impact life opportunities, particularly in the public sector, from education to policing to court rulings. Nevertheless, policy frameworks must also safeguard privacy and ensure digital equality whilst not restricting innovation. Even with the relatively slow pace of AI development, the adoption and successful implementation of data protection and privacy policy frameworks in South Africa, such as the Protection of Personal Information Act (POPIA), remains a crucial reference point for ensuring that critical safeguards are in place to maximise the benefits of AI (GISW, 2019, p.59).

But AI will implicate other areas of law, not just data protection frameworks. The ability of algorithms and machine learning to supplant public sector decision-making has administrative justice implications (Cobbe, 2018; Razzano, 2020). Notably too, AI governance issues strongly implicate issues of liabilities and the assignment of obligations, amongst other things (Petit, 2017). There are inherent challenges for the law in seeking to try and adapt swiftly to technological implications – for instance, its inherent 'pacing problem', that is the inability of political processes to keep up with the pace of technological innovation (Thierer, 2018). But principle-based policy for AI governance will be well-informed by South Africa's strong constitutional framework, which entrenches human rights across socio-economic and civil-political dimensions. Entrenched protections, for instance, in relation to equality (Section 9 of the Constitution of South Africa), human dignity – as a key foundational principle (Section 10), administrative justice (Section 33), privacy (Section 14), access to information (Section 33) and others, already prescribe a normative basis for helping to determine an AI governance regime.

Although South Africa does not yet have a national AI policy, there is evidence that the government is exploring how to regulate and use AI. The Presidential Commission on the Fourth Industrial Revolution (C4IR), established in 2019, comprises specialists on AI and other new technologies. The 2020 report of the Commission includes a litany of recommendations related to the implementation, governance and expected impacts of 4IR technologies such as AI. The recommendations include, for example: update

legislation to align with 4IR developments, establish a cybersecurity institute, and prepare South Africa for the impacts of AI on work by investing in human capacity development (Presidential Commission on the Fourth Industrial Revolution, 2020). South Africa's Centre for the Fourth Industrial Revolution, which is aligned with the World Economic Forum's Centre for the Fourth Industrial Revolution and Network for Global Technology Governance, also seeks to establish policies and governance mechanisms that will allow South Africa to use AI responsibly. However, concerns have been raised about the South African government's investment in a 4IR centre. For example, Gillwald (2019) argues that government priorities are misplaced, due to the lack of corresponding investment in broader and more independent policy research on 4IR, and the absence of an overall digital policy strategy to achieve the necessary coordination throughout the state and between the public and private sectors.

In addition, the South African government has implemented policies and programs to promote the use of AI technology, which could aid in the introduction of AI in public services. The Centre for Public Sector Innovation, for example, promotes the application of emerging technology to transform public services (Centre for Public Service Innovation, 2013). In addition, in October 2019, the Department of Science and Innovation hosted a panel discussion on the use of technology in local governments to strengthen partnerships and establish policy dialogue between communities, municipalities and technology developers. The main goal of such actions, whether in skills development or developing effective labour market strategies, is to establish models that work towards reaching unemployed youth. In this regard, initiatives such as the Harambee Youth Accelerator illustrate collaboration between public and private entities to use AI technology to augment youth unemployment initiatives in South Africa.

7.2 Programme Description[52]

7.2.1 Stated Purpose[53]

Harambee Youth Employment Accelerator seeks to develop "African solutions for the global challenge of youth unemployment". Their stated goals include removing the employment barriers faced by young people in Africa and catalysing "inclusive hiring". The enterprise is particularly focused on supporting jobseekers who are excluded from the formal job market by connecting jobless youth with work opportunities that fit their talents and potential. To improve the employability of students, unemployed youth or the currently employed workforce, Harambee offers job-seeking training via its mobi site SAyouth.mobi, and via its partner network. In addition, it assesses labour market needs and helps employers gauge work-readiness of potential recruits.

7.2.2 Technology

Harambee uses ML methods, not as standard practice, but in an experimental and limited manner: (1) to increase the number of candidates who accept invitations for introductory workshops at a Harambee centre, and (2) to match jobseekers with potential employers. Thus, both AI/ML technologies have only been used as experiments in their various test cases to explore how they can be incorporated in their

[52] Note: The case study predominantly refers to Harambee's business model pre-Covid-19. Harambee has since formally partnered with the SAYouth in connecting youth with learning and earning opportunities and shifted to a remote and online service offering on SYYouth.mobi. This mobile platform is a free service to both employers and work seekers. Hence reference to work readiness programs, in-person workshops, assessments and employer fees are historically accurate, but not applicable to the business model as of July 2021. Visit Harambee.co.za for current overview of its business model.

[53] Unless otherwise indicated, information on the programme comes from the programme website (https://www.harambee.co.za/), interviews with Harambee management, and confidential materials obtained from Harambee.

business process. For example, Harambee applied AI in a test case to analyse job vacancy characteristics and detect and monitor skills demand in the workforce in near real-time.

7.2.3 Business Model

Harambee is a globally award-winning non-profit social enterprise developing scalable solutions for the youth labour market across the formal and informal economy. Harambee's business model focuses on identifying specific sectors in the South African economy that hold employment potential and assessing the current and future recruitment needs of employers in these sectors. Its services are two-fold: equipping its candidates with job-related and behavioural skills interventions (bridging programs) to enhance their employability; and providing recruitment services to employers. Harambee has formed recruitment partnerships with over 150 businesses to date. These include financial services firms, retailers (both supermarkets and high-end luxury goods stores), hotels and fast-food restaurants. Harambee facilitates placement for its beneficiaries by inviting employers (partners) to screen candidates who have completed the bridging program. Employers then select and offer roles to candidates who qualify and meet their requirements. Harambee is also working with policymakers and civil society to innovate, organise and scale up established youth community-based services.

Yellowwoods Capital, a privately owned investment company, founded Harambee, initially as a social investment. The project has since developed into a PPP, with Harambee using public funds from the Jobs Fund, a challenge fund established by the National Treasury to support innovative projects with the potential to generate jobs in an economy in desperate need of them. Harambee also recoups some of its costs by charging fees to the almost 200 employers that use its services.

7.2.4 Case study focus

This case study assesses the implications of using AI and ML in human capital development for the purpose of making job opportunities more accessible to marginalized youth. It considers the following questions:

- How is Harambee using AI in its employment programmes?
- To what extent is the domestic environment equipped to support successful outcomes?
- Does the use of AI in Harambee programmes mitigate or exacerbate existing social inequalities?
- Does the use of AI in Harambee programmes have any human rights implications?

This study reflects on whether Harambee's use of AI/ML can or has improved programme processes and outcomes. It also explores some of the ways in which ML/AI may fail or be ill-suited for deployment in employment programmes. Awareness of these harms should help organisations like Harambee avoid unconsciously perpetuating them, to enable risk mitigation strategies that prevent harmful outcomes and ensure that AI/ML are contributing to a fair, equitable and empowering experience for job seekers in South Africa. Since the organisation is only using AI as an analytical tool, the case study considers the implications rather than actual impacts of AI and ML in its operations.

7.2.5 How Harambee Uses ML and AI – Model Test Cases in Workforce Development

Improving conversion rate of workshop invitations

Harambee used ML/AI to increase the number of candidates who accept invitations to introductory workshops at a Harambee centre. Candidates are often invited to these workshops with only a partial profile. Harambee monitored interactions with candidates in the network and used that historical data to estimate the likelihood of a candidate attending a workshop after receiving an invitation. This was done by applying a ML method to develop a model based on time and distance from home to workshop site,

enabling analyses that would have been difficult with traditional statistical tools. Putting a premium on transparency and interpretability, Harambee then built a system that only draws on the most predictive and well-understood factors of the model. As such, ML was used as an analytics tool rather than as a direct decision-making mechanism.[54]

Job matching

Harambee has conducted test cases utilising big data and ML techniques to identify unemployed youths for job opportunities and match them to job openings. When an organisation approaches them with a variety of open positions, the central question they ask is who within the wide pool of possible applicants has the greatest chance of succeeding. Filling openings is a two-part task in that a position must be a good fit for both the business and the job seeker. Given that transportation can be a significant barrier to retaining a job, it is a key consideration for Harambee in matching candidates to job opportunities. The cost of transportation, which can consume a significant portion of a job seeker's salary and is a big indicator of dropping out, is an important factor for job seekers.

Previously, Harambee used straight line distances to estimate travel costs, but most people commute to work through an unregulated taxi system with no standardized routes or fares, so their findings indicated that real costs do not equate to straight lines.[55] To improve travel cost estimates, Harambee surveyed 15,000 candidates for their real travel time, cost and distance over a three-month period. This information was used to build a model capable of predicting the cost per kilometre for taxi fares across the region. Harambee also developed an algorithm tailored to match South Africa's informal taxi routes, more closely representing people's actual travel patterns. The model was placed on cloud infrastructure, enabling real-time optimization of candidate-to-opportunity matching with high geographical precision. This strategy was designed to maximize applicant salaries, particularly in low-wage employment.

The insights derived from the test cases are used by Harambee to segment the market and improve their candidate selection process. The organisation is able to better understand data points, explain outcomes from the systems, and help make appropriate decisions.

7.3 Analysis

7.3.1 Potential benefits

Analytical insights. Through various test cases using AI and ML to make data-driven predictions, Harambee has gained insights that have enabled the organisation to segment the market and select candidates for open positions. As an organisation that supports young people in South Africa to find work amidst high youth unemployment, Harambee compiles extensive profiles of jobseekers, allowing them to match productive young people who typically lack formal qualifications for suitable jobs. Harambee has interacted with over one million young people to collect, what it believes to be, the largest dataset on youth employment in South Africa. Over 400,000 of these young people have been invited to attend face-to-face support sessions at Harambee centres; and about 240,000 have found employment by working for themselves, government programs or the private sector. While this is certainly a positive outcome for the youth who have gained employment, questions remain about the extent and sustainability of these outcomes. For example, to make a determination on the real impact, additional information would be needed on aspects such as the quality and duration of the jobs obtained.

[54] Confidential document supplied referring to 2018 analysis.

[55] Confidential document supplied, 2021.

Process and outcome efficiency. Organisational operations have been enhanced by using AI analysis of the characteristics of job vacancies to identify and monitor skills demand and the constantly changing skills requirements of the workforce in near real-time. When matching candidates to different job categories and determining candidates' eligibility for a workshop, the matching algorithm identifies relevant variables in a dataset efficiently in a short period of time, without the normal delays associated with manual market analysis and matching candidates to job opportunities. The random predictive model revealed that the physical position of the candidate, the time between the invitation and the workshop date, and the time between the last engagement with Harambee and the invitation were the most important factors determining whether a candidate would attend an introductory workshop. A three-day lead time was discovered to be ideal, and the recency of interaction was incorporated into a new spatial invitation policy, which has seen the conversion rate rise from 2% to about 25%.[56]

7.3.2 Potential for algorithmic bias

AI and ML technology have been found to perpetuate automated racial profiling, promote surveillance, and reinforce sexist and racial stereotypes (Buolamwini, 2019; Vogel, 2020). Algorithms may thus be used in ways that result in disparate or unjust results for minority and majority groups, whether deliberately or accidentally. When complex ML models make errors, it can be difficult to determine transparency or pursue redress. These flaws were identified as the most significant challenges Harambee faced when deploying its ML/AI test cases. In an interview with experts from Harambee, they indicated that:

> "Over the years we learned that a lot of our classic indicators that we use in matching have got a little bit of an internal bias. We found that some of our measures for things that are a little bit of an agency, a voluntary agency has got a slant towards males. And we've learned that some of our assessments, like literacy or learning potential, might also have a little bit of a bias towards a particular group." (Harambee personal interview, March 08, 2021)

Key questions that needed to be addressed included: Whether AI systems would make the decisions about candidates' eligibility in the matching process with employers or whether this decision would be made by a human being; and what social standards would be factored into the AI system and its applications to make them equal, inclusive, ethical and values-driven. Harambee's answers to these questions have been to adopt a hybrid approach with AI performing the data-intensive tasks and producing recommendations, and a human assessing the output of the AI and factoring in other considerations to make the final decisions.

> "…the systems mostly make recommendations and then individuals still choose the actual candidates. It's a combination of the system and then an actual person that create the formula" (Harambee personal interview, March 08, 2021).

> "From Harambee's institutional knowledge and our mission statement, we know that we want to use certain characteristics in our matching algorithm, like proxies for a work seekers exclusion. We will add these to factors that we identify through using big data analysis (including AI). If subsequent analysis shows that some of our predictors have some bias (like our initial proxy for agency/ drive), we correct for that by removing that variable and correcting in the algorithm for the bias. The important principle for us is to not blindly trust the machine. The moral responsibility to do the best for our work seekers stays with us, the humans."

[56] Confidential document supplied, 2021.

To address concerns about algorithmic bias, Harambee has also concentrated on developing better proxies for employability, using their own internal data and maintaining a reflexive mindset in relation to data use.[57] However, one of the most critical initiatives that has prepared them for this came well before their involvement in ML. Traditional proxies for employability, such as literacy and numeracy ratings, as well as the possession of a high school Matric, were found to be poor predictors of job performance by Harambee early on. Harambee used their own data to prove that people who did poorly on school exams could still be effective employees. Harambee has spent years developing personalised tests of learning ability and cumulative experience, rather than relying on conventional proxies.

This critical move has resulted in a dataset that accounts for the public education system's socio-economic inequities and the potential employability of young people in South Africa. Using standard measures of literacy and numeracy to forecast job performance in a machine learning model would have replicated the same social bias that exists in the educational system. Harambee has set itself up to collect data that more accurately represents each candidate's ability and provides a stronger basis for subsequent ML research by understanding the shortcomings in conventional proxies.

7.3.3 Inequalities and exclusion

Harambee believes AI/ML technologies improve efficiency by automating labour-intensive tasks, or offer new insights by finding patterns in large, complex datasets. At the same time, as noted above, the very nature of these tools, and their ability to codify and reproduce the patterns they detect introduces significant concerns around biases and unfairness. Many machine learning algorithms tend to improve the cost-effectiveness of resource utilization by selecting more precise targeting of services. Predictions that consistently favour certain classes of individuals will perpetuate exclusions and exacerbate marginalization. Harambee's matching algorithm may predict who is likely to be hired among candidates and, in the process, decrease the chances of more skilled and able candidates getting job opportunities. Different conditions could easily overlap, affecting the same people via algorithmic biases that reinforce each other.

Notwithstanding their reasoned approach, an important additional element is that some of the most abundant variables within Harambee's dataset (such as geographical location and household income) may be subtly biased. For example, geographical location metadata can be a valuable source of information about candidates' activity, mobility, and social networks. Certain groups are likely to be underrepresented, such as poor and rural populations. Inequality and marginalisation already plague South Africa and may be exacerbated by badly implemented ML tools. If rural people are relatively absent from employment datasets due to their historically lower formal labour force participation, the hiring algorithm used by Harambee would give qualified rural residents unfairly low scores, resulting in fewer people from rural areas being placed at partner organisations. They would consequently continue to be absent from the latest training data collection if judgment rules are based on the performance rates of (mostly urban) recruits. This scenario could also apply to women; however, Harambee has taken significant steps to remove gender barriers with the result that women compose two-thirds of its placements and network and are therefore well represented in the training data.

Since all their data is drawn from previous forecasts, this type of skewed feedback loop could lead to a scenario where Harambee never realizes the predictions are inaccurate because the model produces self-fulfilling outputs that cannot be discredited. While ML models can help decision-makers make more objective and fair choices, the dynamics that emerge may have the opposite effect: automating the

[57] See for example, a 2020 article on Harambee's approach to using data - https://www.harambee.co.za/using-data-to-power-scale/

status quo. People who were discriminated against before model implementation are still discriminated against, but the current prejudice is concealed under a veil of computational impartiality. This is a problem to be particularly aware of with Harambee's test cases, where social differences may be long-standing or entrenched, making them difficult, if not impossible, to "fix" in a model.

To guard against automated bias and ensure contextualised decision-making, Harambee's ML/AI tools and new datasets are checked by the management committee before analytical insights are incorporated into the process of matching applicants to jobs (see also sections below on governance and human rights). Having people from a wide range of backgrounds to contribute to the understanding of new insights helps orient their ML tools towards including diverse values (Paul et al., 2019).

7.3.4 Governing AI systems

The first draft of the UNESCO recommendations on the Ethics of Artificial Intelligence which support AI development emphasises principles of human dignity, human rights and fundamental freedoms, diversity and inclusiveness, environmental flourishing, and peace promotion (UNESCO, 2020). Along with common principles such as transparency, safety, privacy, and non-discrimination, the document discusses the importance of multi-stakeholder governance in ensuring that AI advances development goals, promotes AI awareness and literacy to empower citizens to make informed choices about their use of AI, and encourages continuous evaluation of AI to ensure that it continues to improve along with the SDGs.

Human-centred AI or AI built on ethical design standards and used in accordance with agreed fundamental norms, necessitates human-centred AI governance. Harambee's discussion of liability principles is a clear example of the more complex governance policies being explored. According to Harambee officials, they have a robust internal governance system in place that is responsible for vetting all of their AI algorithms and machine learning models and how they make decisions to prevent biases.

> "Harambee has a group of people that vets and all the algorithms before they go into production. We run simulations to see what is happening, interrogate what the results are in terms of what are we picking from output, for example, female representation, rural versus urban, and we look at this type of things" (Harambee personal interview, March 08, 2021).
>
> "We use a continuous learning cycle with our ML test cases. And the reason for that is purely because we haven't gotten to a point where we are comfortable with AI results without some outside view. We must be very aware that our particular target model is extremely vulnerable and any of our models would include bias in that data if not properly checked" (Harambee personal interview, March 08, 2021).

Instituting mechanisms to make AI systems accountable could further enhance this approach. If candidates are graded (e.g., for job interviews) and want to know what they can do to improve in the future, is the model interpretable enough to provide answers? If candidates feel they have been wrongly evaluated, is there a way for them to seek redress? These feedback processes are often missing in the development process of ML/AI tools, even when decisions are made without algorithmic help. Correcting this is likely to be more about institutional processes and priorities than about technology.

These issues of data subject rights are even more opaque when addressed in the context of non-profit social enterprises like Harambee. The recently enacted Protection of Personal Information Act (POPIA) provides mechanisms to access data and help ensure its accuracy. But, there is also in Section 71 a stipulation that: "Subject to subsection (2), a data subject may not be subject to a decision, which results in legal consequences for him, her or it, or which affects him, her or it to a substantial degree, which is

based solely on the basis of the automated processing of personal information intended to provide a profile of such person including his or her performance at work, or his, her or its credit worthiness, reliability, location, health, personal preferences or conduct". There are exceptions in that clause, but how will it apply in the case of Harambee?

7.3.5 Human rights & data privacy

Harambee's data repository includes features such as geographical location, educational backgrounds, and household income level for over a million jobseekers. Harambee has used this internally generated dataset, collected over the years from its community, to automate its data analysis processes. Utilising ML and AI-enabled tools in a meaningful, inclusive and equitable manner (even in experimentation) calls for responsibility and accountability on the use of these technologies, recognition that these innovations have the potential to cause harm, and a commitment to resolving or eliminating such harms. For example, candidates who interview with Harambee have a right to know how these tools ensure accuracy, inclusion and equity.

Globally, different stakeholders are grappling to enforce ethical AI frameworks and governance standards (Jobin et al., 2019). AI technologies need to be developed based on ethical principles derived from structural frameworks such as the Universal Declaration of Human Rights and the application of human rights in the context of ICT, such as the Information Society Code of Ethics. If AI systems lack a fundamental understanding of privacy or do not adhere to human dignity values, there is a substantial risk that they will violate data protection legislation (Tony, 2020). To achieve ethical, trustworthy and beneficial AI, the issue of ethics must be anchored on empirical evidence of the strengths and weaknesses of these technologies. For example, promoting safe and reliable AI necessitates understanding specific use cases and how AI technologies may be appropriate in some situations, but fail in others.

Experts argue that current human rights regulations could be better tailored to tackle AI ethics concerns. Proposals to this purpose focus on specific innovations, such as ML (Kuner et al., 2017; McGregor et al., 2019), or on specific implementation fields, such as workforce development (Paul et al., 2019), or broadly recommend the application of human rights standards to the field of AI as a whole (Commissioner for Human Rights, 2019; Latonero, 2018; WEF, 2019). Many of the ethical problems raised by Harambee in test cases using AI/ML models are also human rights issues, such as privacy and bias, as already discussed. Harambee ensures compliance with the recently passed stringent POPIA and is bound similarly by GDPR to anonymise the data of its candidates.

> "We do ask for permission from our candidates to… share relevant personal information with employers because that's at the heart of what we do… we connect employers with… candidates. But we believe that all we do is within the South African legal framework". (Harambee personal interview, March 08, 2021)

Data protection and privacy will become much more critical in Harambee's work in the coming years. Considering the test cases piloted at Harambee already, two strong trends are creating a dynamic interaction – ML resources are data-intensive, and their widespread use (both in development systems and in society at large) would drive up data demand. With data as the basis of all ML/AL resources, Harambee endeavours to subject its use of data to the scrutiny of independent review boards:

> "We have strong partnerships with research organizations, often universities, and in this kind of partnership, our work is evaluated through the university's ethics or research board. For projects that require this kind of consent, additional standards follow the Harambee process". (Harambee personal interview, March 08, 2021)

7.3.6 AI talent deficit

One of the most frequent challenges Harambee has faced when developing its AI systems is access to talent with the requisite AI technological ability. Similar challenges are also being experienced by education institutions where they are competing not only with one another, but also with the industry for the current small pool of new AI researchers and practitioners. This somewhat reduces the amount of expertise available inside higher education institutions, leading some students to forego tertiary education in favour of direct mentorship and preparation in an industry environment. As a result, higher education organisations often lack the internal capacity needed for AI production and frequently lack the expertise, even at the intermediate level, to develop talent that can use AI effectively.

This creates challenges for social enterprises, such as Harambee, trying to find the right talent to support the building of AI-based systems. Considering whether the South African ecosystem is currently capable of producing the required talent pool, officers from Harambee noted the skills deficit and retention challenges in their data analytics work, not only in terms of technical ability, but also in terms of ethics and social sensitivity:

> "We need the research component and the technical skills to build these algorithms".
>
> "I do think that talent is out there. But the problem is if we take the mission of solving unemployment out of the equation...it's difficult to really attract qualified data scientists to stay with us internally. And what you're seeing in the development space is where we find people who bring value in ML who want to partner on a part-time basis and stay with us over a very long period of time to connect these dots, so that is definitely one way that we solve that problem".
>
> "It is challenging to retain talent that can find the balance between understanding the nuances and the additional risks and all these things about biases...the complexity of the South African labour market and with the background, talent and the passion to go and use the latest ML and AI models". (Harambee personal interview, March 08, 2021)

The scarcity of qualified workers has hampered Harambee's development of fully automated systems. Although the South African labour market can provide people with skills for model development, the entire life cycle of an AI project involves more than just statistical analysis. Recruiting data scientists willing and able to familiarize themselves with the data and process it into a valuable resource for AI systems has been challenging — an interesting limitation considering their skills, but one that highlights the complexity of constructing well-functioning AI systems. This is an industry-wide challenge also, as noted by the Managing Director at Microsoft in a media report:

> "'Many AI experts argue that it's not simply a lack of technical skills that slows the progress of AI, but also a greater need for a culture of experimentation. Though AI is in its early stages of development in South Africa, it bodes well for AI maturity in the country that businesses are actively experimenting with exciting new AI use cases,' said Lillian Barnard, MD at Microsoft". (Noik, 2019)

Related to this is the nascent state of AI skills endowment, coupled with an eagerness to deploy the technology in an accelerated fashion, further exacerbating the mismatch between organisational goals, AI skills, AI system prerequisites such as data and ethical AI prerequisites such as diverse data sets:

> "What we are seeing is that there are increasingly many universities, organisations or others who use the power of emerging technologies, and big data in the development space. And I don't think that model is solved yet. But quite often the industry has not figured out how to … use these types of tools in a really efficient way. The development organisations are learning how to

> tap into that resource. And it's quite often even without having all the internal skills available." (Harambee personal interview, March 08, 2021)
>
> "There are lots of people who are now being trained in these algorithms, but they lack the experience or the sense of how to implement them, particularly in the development space. "Responsible use of the technology needs to combine the magic of the innovation with old school industry knowledge and problem solving". (Harambee personal interview, March 08, 2021)

7.3.7 Conclusion

Organisations that embrace AI technologies for developmental purposes in workforce-related activities have access to a wide variety of previously inaccessible tools, new ways of looking at data and new solutions to old problems. This case study explored the Harambee Youth Accelerator programme in terms of whether the programme mitigates or exacerbates social inequalities, whether the programme might have any human rights implications, and whether the South African environment is equipped to support successful outcomes of the programme's use of AI. It discussed a variety of legislation and human rights-related issues (such as algorithmic transparency, unfairness, bias, discrimination, accountability, negative effects on employees, privacy and data protection, and liability for damage) and how they are or are not addressed by Harambee.

This case study concludes that despite existing gaps in the South African education system, skills deficits in the labour market, and continuing human rights and governance uncertainties, there are still opportunities resulting from AI-based technologies. Because of the large reduction in capital costs brought about by AI applications as well as the fact that the direction of technological change is, at least in part, driven by the relative supply of low- versus high-skilled labour, Harambee stands to benefit from AI automation for its job-matching efforts, provided it is implemented at a small-scale and with a risk-based assessment approach.

Harambee uses various proxies such as geographical location, educational background and household size to determine qualified candidates; and has outsourced the task of identifying suitable candidates to AI algorithms that search through the programme's database based on these features. The potential risks are linked with widening wealth inequalities. However, it is not the actual programmes of Harambee that are likely to exacerbate social inequality or exclusion. Rather, the main issue here is that the use of AI/ML to gain new insights into the attributes of candidates and predict their success in certain types of jobs has the potential to reinforce social inequities. Indeed, AI algorithms and ML systems have frequently failed to ensure equality, most notably by generating biased decisions against people of colour.

South Africa has a dark history of using apartheid spatial planning to deliberately place marginalised people in remote areas where accessibility to economic, social and educational opportunities was impossible, and to this day, these problems persist. Therefore, Harambee's proxies could be built on historical data that results in biased decisions; hence the possibility to either exclude certain groups of people from their dataset or systematically find them to be unsuitable candidates for attractive job opportunities in urban centres. Harambee has committed to addressing this issue by developing better proxies using their internal data. For instance, they have included personalised testing, learning ability and cumulative experience rather than depending solely on conventional proxies.

With regard to having a supportive ecosystem for the implementation of AI systems, the government is proposing reskilling and investing in curriculum development in addition to adopting intersectoral approaches to AI in education planning and governance. In the long term, this should help to address some of the skills deficit challenges that organisations like Harambee are facing.

The development, deployment and use of AI/ML technology by Harambee provides an example of organisations trying to build the structure and frameworks to advance responsible and accountable AI technology practices, combining ethical and human rights approaches in a deliberate way. Harambee is aware of the potential harms of using ML in their work; the fact that they have deployed it primarily in test cases shows their careful consideration of possible effects. While noting Harambee's positive efforts in attempting to mitigate these issues (such as establishing an ethics council that checks its AI algorithms), this area requires ongoing examination and adaptability, given the gravity of the potential effects of AI technologies, particularly on vulnerable individuals and groups.

Part D: Thematic Analysis and Conclusions

8. Discussion

These case studies shed light on some of the dynamics of ongoing efforts to trigger socio-economic development through building capacity in AI entrepreneurship and to integrate AI and data capabilities into employment and workforce development initiatives. The Harambee Youth Accelerator represents a case of AI as an input into general workforce development, while the Africa AI Accelerator represents a case of AI products and AI skills as outputs of non-formal capacity-building efforts. As implied by the names of the initiatives, both have a similar underlying objective to *accelerate* positive outcomes in their areas of focus. They provide the opportunity to explore the use of AI by social enterprises for improving employment and other development outcomes, and the impact of private sector activities on the AI ecosystem in African countries.

8.1 Public sector, Public-private partnerships and social impact agendas

The two case studies illustrate efforts by governments to leverage AI and data technologies for national development but with no direct application to the delivery of public services. In the case of the Africa AI Accelerator, despite falling under a government initiative expressly intended to transform the delivery of government services, the initiative does not actively seek to generate AI innovations for the public sector. Likewise, all indications are that Harambee's partner employers do not include public sector agencies, although such a partnership seems like a natural fit. The apparently loose links that the two cases have with the public sector also raises questions about what types of public-private partnership models are at play. PPPs can be beneficial for workforce growth and re-skilling. But the political economy of PPPs could result in clashing or competing agendas and power dynamics that prioritize the interests and motives of some partners over others (Boardman & Vining, 2012). As Razzano (2020, p.2) notes, "the question of public obligations with private actors is a fundamental one for considering the future of the AI-enabled economy". Without strong public sector involvement, especially with a new and fast-evolving technology, the behaviour of PPPs is likely to err on the side of private sector partners.

However, this is not a foregone conclusion—as seen in the case of Harambee, the organisation appears to be consciously attempting to maintain a social impact agenda, e.g., by ensuring that multiple stakeholders contribute to shaping its use of AI/ML. Although it is unclear who the most influential stakeholders in this partnership are, the strong social impact overtones of Harambee could be linked to the source of its funding and the more obvious association it has with youth employment goals. The AAIA, on the other hand, driven as it is by the goal of promoting business prosperity, is understandably more likely to prioritise advancing private sector success criteria. Again, with this initiative, it is unclear who the most influential stakeholders are but, by all appearances, key partners such as the Ghana

government and GIZ see the business accelerator model as a way of indirectly achieving social goals by facilitating business interests. Thus, it is not surprising that there does not appear to be any specific expectation or pressure around how social impact is defined or achieved.

8.2 "Acceleration" as the new leapfrog development thesis?

Notions of accelerated development are not new in Africa. For several decades, the leapfrog thesis has imbued information and communication technologies with visions of enabling countries in the global south to jump over or bypass stages of development and emerge as equal or competitive partners in the global economy and secure higher standards of living for citizens. On balance, this vision has not been achieved with technologies such as computers, the internet or mobile phones (Gillwald & Onkokame, 2019). Yet this imaginary does not die and in the rise of business incubation and accelerator models, we are arguably seeing a revisioning of the leapfrog thesis in an even more targeted context. In both case studies, the use of AI is seen as a way to accelerate outcomes, whether directly by making operations more efficient and effective (Harambee) or indirectly by enabling business organisations to come up with innovations to solve social and economic problems (Africa AI Accelerator). However, in the absence of the requisite talent pool and governance framework, the impulse to accelerate AI development itself, as well as the application of AI for human development is questionable (see Gillwald, 2020a; Gillwald, 2020b; Gillwald et al., 2019; for examples of Research ICT Africa's critique of 4IR ambitions in Africa).

As the case of the AAIA in Ghana has shown, even attempts to establish the prerequisites (such as a trained workforce) for successful AI deployment should be approached with care lest it result in widening social inequalities. This recommendation by Kozlowska (2021, blog post) is worth considering: "we need to take a step back and consider which social processes can or should be sped up through algorithmic intervention and which should not be… sometimes ethical AI means slow AI". In the same vein, African governments and other entities working on AI in Africa should consider that sometimes AI for development might mean slow AI. Regarding the use of AI in workforce development, the Harambee Youth Accelerator is an example of a programme that, despite its name, has chosen the slow AI route by limiting the integration of AI into its operations, opting not to institute automated decision-making but rather to use AI to inform decision making by humans.

Rapid skills development can produce short-term boosts in expertise, however, as assessments of the similarly speed-oriented bootcamp training model have demonstrated, in the long-term, the result is often a work-ready but narrowly tooled workforce with primarily entry-level job capabilities (Garrido & Sey, 2016). In contrast, the slower (e.g., formal education system) route may produce less work-ready graduates, but with a broader knowledge base, critical thinking preparation and more readiness for management level positions.

8.3 Inclusions and exclusions

The case studies illustrate both encouraging and concerning trends in AI deployment. On the positive side, AI analysis is enabling Harambee to make advances in labour force inclusion. The workforce development applications of AI are being integrated with human input and more diverse employability criteria to counteract the effects of the status quo and bring normally excluded youth into the labour market. On the other hand, the challenges of inclusive business development and social impact are becoming evident in the commercial model of the AAIA, where the people benefiting from the capacity-building investment are not likely to come from relatively disadvantaged areas.

8.4 Implications for investment in AI skills capacity building

It is noteworthy that the capacity-building efforts of tech hubs, accelerator programs and similar initiatives tend to grab the public imagination so much more than traditional pathways such as formal education or vocational training. The flashiness of private sector-led social impact and accelerator initiatives stand in contrast to the more low-key activities of other actors. Yet few assessments have been able to concretely demonstrate long-term impact on economic growth, much less on social development or poverty reduction, in low and middle-income regions. It is also unclear the balance of resources going into different institutions for the purpose of building AI skills or employing AI systems and what the cost-benefit ratio is. For every unit that goes into supporting AI entrepreneurs through accelerator programmes, how much goes to basic AI research and development, for example? How are these investments being monitored and evaluated to determine whether programmes and incubated enterprises are functioning beyond pilot stage, whether the outputs or outcomes are worth the investment, how resilient the outcomes are, and what would be the most productive avenues to which to channel investments?

9. Recommendations

Align state-funded initiatives to public sector and public administration capacity building goals. Considering the overlap of social impact ambitions underlying the AI initiatives and national development plans, as well as the increasing pressure on governments to support (both policy-wise and with direct funding) these types of private sector activities, there are opportunities for renewed experimentation with public-private partnerships. Such experimentation could explore ways to co-opt the relative agility of private enterprise more intentionally for targeted public sector goals related not only to general workforce development, but also to specifically building the public sector workforce and enhancing its ability to utilise (and govern) AI for the public good in areas such as provision of basic utilities, education, health, agriculture and finance. This will however also require separate capacity-building of public sector officials to expose them to non-private-sector-driven considerations around AI.

Improve data availability. There is an urgent need for open data on the deployment of AI, especially in the public sector. Transparency is needed to enable understanding of whether and how AI is being used across sectors and what measures are in place to mitigate risks and harms.

Perform social and economic risk assessments prior to AI. Where decisions have been made to deploy or promote the deployment of AI, it should be preceded by social and economic risk assessments to ensure that there is an appropriate awareness of the associated implications. This includes considering the appropriateness of applying accelerator models to socio-economic development and innovation for the poor, and determining what tweaks, if any, would be needed to make the model more successful for social impact goals. While private sector firms could police themselves, public policy should also institute rules and regulations to establish benchmarks or expectations around firm behaviour and acceptable risk levels, for example.

Develop AI governance skills. AI capacity-building programmes tend to focus on technical skills with only passing (if any) attention to governance issues. To ensure AI is developed or implemented with due considerations of its potential risks and harms, capacity-building organisations should include AI governance, ethics and cybersecurity training as central components of their curriculum.

Invest public resources in reducing socio-economic inequalities. Addressing social and economic inequalities would also lessen the likelihood of AI-powered systems exacerbating existing inequalities. For example, states should invest in improving the quality of education for all, to lay the foundation for

integrating AI and any subsequent technologies into the economy more seamlessly. This would be a critical requirement to ensure that existing imbalances in general and technology-specific skills do not continue to act as barriers for disadvantaged populations to join the formal or informal AI workforce. Countries should not expect the private sector to drive their national development agendas.

Future research. One limitation of the AI4D project is that it had a relatively narrow goal of conducting a high-level assessment of the state of AI deployment in the public sector across Africa. This was done largely through desk research, meaning a high dependence on publicly available information. The finding of limited public sector AI capacity-building and workforce development applications could be a function of this research methodology which might have led to easier identification of private sector initiatives that have an interest in promoting their activities publicly. Even with the selected methodology, direct access to public officials could also have assisted in obtaining greater insights; however, this was not possible withing the schedule of the study. Follow-up studies with an expanded methodology will enable deeper analysis of the issues uncovered by the desk research and limited interviews. These could include getting a clearer picture of public sector use of AI, examining the nature of AI4D public-private partnerships, obtaining concrete measures of the amount and types of AI talent, measuring the short-, medium- and long-term outcomes of business accelerator programmes along with their cost-benefit, evaluating investment in different types of AI capacity-building models, and identifying concrete examples of workforce-related human rights impacts of AI in Africa.

Annexure A: Methodology

Landscape mapping

The mapping exercise for this thematic area took the form of a general online search for examples of programs or initiatives in Africa that either offer training on AI skills within and outside the formal education system targeted at students, jobseekers or the currently employed workforce; or use AI to facilitate job placement. Cases were chosen from the initiatives identified in the mapping activity.

Case study selection criteria

Selection of the case studies was based on three main criteria. First the initiative had to have an identifiable AI component. Secondly cases were selected based on their potential to illuminate some of the key issues identified via the high-level mapping of initiatives and the literature review, especially the impact of AI on employment outcomes and the ecosystem of AI research and development. Finally, the cases needed to have existed for a sufficient period to enable examination of their operations and at least preliminary outcomes. An effort was made to achieve some geographic spread by selecting at least two cases and drawing them from different regions of Africa.

The rationale for selecting the Africa AI Accelerator programme was that it has a clear focus on AI, a connection to the public sector through its funding by a government ministry, and the programme's capacity-building goals align well with this thematic area. The Harambee Youth Accelerator was selected based on media reports that it was using AI in certain aspects of its programmes. In addition, the programme has a clear youth capacity-building agenda, though for employability rather than specifically for AI skills.

Data sources

The primary data collection method was desk research to gather publicly available information on the institution and programmes. This included company and programme sponsor websites, technical reports, social media sites, and academic literature. Information was also gathered on the national policy environment related to AI, education, and entrepreneurship. Unstructured interviews and email exchanges with programme officers were also used, when possible, to obtain programme materials and additional insights directly from implementing organisations.

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