How should South Africa redesign education, industrial policy, and fiscal incentives to harness artificial intelligence for productivity growth while limiting labour market disruptions?

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1. Introduction: Differentiating Technology Adoption from Economic Transformation

Commented [FK1]: The focus of the essay is on redesigning education policy so as to take into account the issue of AI amongst others. You should start with pointing the importance of education, how it contributes to dealing with socio economic issues and other important aspects of the economy. Then show how AI development can now enhance education to take into account the aspects mentioned in the title.

Artificial intelligence (AI) is significantly altering production organization, job roles, and competitive advantages in the global economy. Its importance extends beyond merely automating current tasks; it holds the potential to enhance decision-making, spur innovation, improve production processes, and foster entirely new economic opportunities. The realization of these prospects into sustainable productivity growth hinges on the surrounding economic conditions, which include human capital, infrastructure, investment levels, research capacities, and institutional efficacy (Filippucci et al., 2024; OECD, 2026a).

This distinction is particularly vital for South Africa, which grapples with enduring unemployment, inconsistent educational outcomes, waning industrial capabilities, and significant disparities in firms' technological proficiency. These structural issues raise concerns that AI may exacerbate economic inequalities instead of alleviating them (Department of Trade, Industry and Competition [the dtic], 2026; World Bank, 2019). A primary risk is that South Africa could evolve into a more advanced consumer of foreign technologies without cultivating the necessary domestic productive capabilities to harness their economic potential. Acquiring AI systems does not inherently lead to innovation, enhanced worker skills, or bolstered local industries. Companies require financial resources, skilled personnel, and organizational capacity to effectively integrate these technologies into their operations. In the absence of these complementary prerequisites, technological adoption may become concentrated in larger, well-resourced firms, leaving smaller enterprises and less-skilled workers with minimal benefits (Avenyo et al., 2024; Filippucci et al., 2024).

This essay posits that South Africa should pursue a productivity-led AI industrialization strategy, linking educational reform, industrial policy, and fiscal incentives with the enhancement of domestic productive capabilities. The core argument is that public support for AI should be evaluated through three criteria: its ability to foster additional productivity and innovation; its capacity to strengthen local technological and industrial capabilities; and its role in enhancing workers' involvement in the evolving economy. This strategy moves beyond assessing success merely through technology acquisitions or training enrolments, instead focusing on AI policy's contribution to productive transformation and equitable benefit distribution. Education must cultivate adaptable skills, industrial policy must create avenues for utilizing these skills, and fiscal policy must motivate investments

that yield tangible economic and social returns (Acemoglu & Restrepo, 2019; Brollo et al., 2024; Filippucci et al., 2024).

2. South Africa's Structural Challenge: Digital Growth Without Sufficient Productive Transformation

The economic implications of AI cannot be dissociated from the structural characteristics of the economy it enters. Technological advancement does not function in isolation from production conditions. Its impacts on productivity depend on the availability of complementary inputs, such as skilled labour, reliable infrastructure, financial resources, effective management, and market access. Consequently, firms adopting similar technologies may encounter vastly different outcomes due to their varying foundational capabilities (Filippucci et al., 2024; OECD, 2026a).

Evidence from South African manufacturing illustrates this unevenness in the capacity to embrace digital technologies. Avenyo et al. (2024) explored technology adoption through surveys of manufacturing firms, identifying innovation, foreign ownership, export exposure, and skilled human capital as critical factors linked with adoption. Their analysis also highlights the financial constraints that firms encounter. This study is particularly informative as it illustrates that technology adoption is influenced by economic conditions at the firm level, rather than solely by technology availability. However, the sample of 440 firms examined is not representative, a limitation recognized by the authors. The findings should inform the identification of adoption barriers rather than serve as generalized estimates applicable to all South African manufacturers (Avenyo et al., 2024).

This evidence reveals a significant policy risk: if government support canters primarily on subsidizing AI technologies, the firms most likely to benefit may be those that already possess the necessary financial and organizational resources for adoption. Smaller businesses, often facing greater capital and skills limitations, might remain marginalized. Such an outcome could exacerbate productivity disparities among firms, undermining broad industrial development. The appropriate response is not to distribute technology subsidies indiscriminately, but to address the complementary constraints that hinder otherwise viable enterprises from productively adopting technology (Avenyo et al., 2024; Brollo et al., 2024).

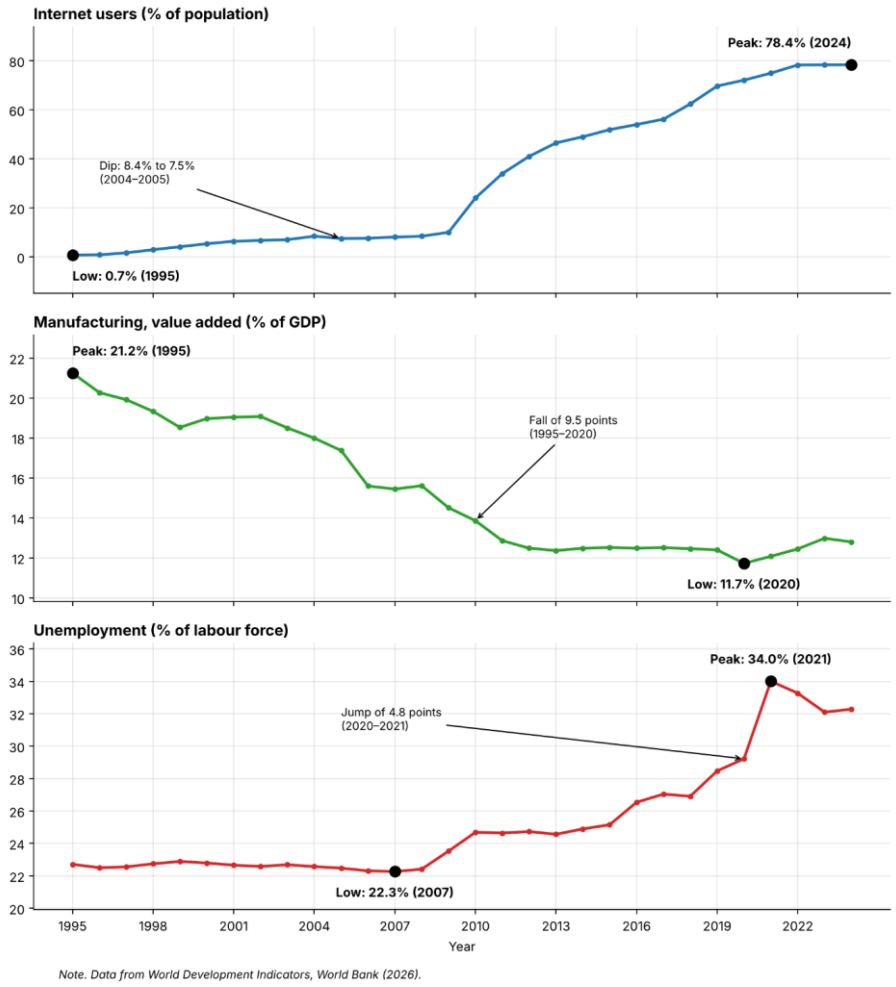
South Africa's industrial challenges heighten the urgency of this issue. The dtic's Industrial Development Strategy 2026 identifies deindustrialization, diminishing industrial capacity, inadequate investment in productive sectors, and infrastructure deficits as notable economic

challenges (the dtic, 2026). These factors are significant because AI can only enhance industrial performance when firms possess viable production systems capable of integrating technological advancements. An AI-supported manufacturing process cannot compensate for unreliable infrastructure, insufficient investment, or a weak domestic supplier base. Therefore, technology policy must be aligned with industrial renewal rather than regarded as a substitute for it (the dtic, 2026; OECD, 2026a).

Digital connectivity introduces another critical aspect of this structural issue. Internet access fosters opportunities for education, communication, digital services, and engagement in contemporary production networks. However, increased connectivity alone does not imply that firms have become more innovative, that manufacturing has grown, or that employment opportunities have improved. The differentiation between access to technology and the capacity to utilize it productively is essential for understanding South Africa's AI challenge (Filippucci et al., 2024; World Bank, 2019).

Figure 1. Digitalisation, Manufacturing Performance and Unemployment in South Africa, 1995–2024

Figure 1
Internet use, manufacturing and unemployment in South Africa, 1995–2024



Note. Data from World Development Indicators, World Bank (2026).

Source: Author's compilation using World Development Indicators (World Bank, n.d.).
Note: Internet use is measured as a percentage of the population; manufacturing value added as a percentage of GDP; and unemployment as a percentage of the labour force. The indicators have different denominators and should be interpreted as separate trends, not directly comparable quantities. The period should reflect the common years for which all three series contain observations. The historical observations supplied for this figure

indicate a substantial increase in internet use, from 0.7% in 1995 to 78.4% in 2024. Over the same broad period, manufacturing value added as a share of GDP declined from 21.2% in 1995 to 11.7% in 2020, while unemployment reached a reported peak of 34.0% in 2021. These trends illustrate the necessity of distinguishing between digitalization and structural transformation. The challenge is to connect digital advancements with investment, industrial competitiveness, and the development of workers' productive skills (World Bank, n.d.; Filippucci et al., 2024).

Thus, South Africa requires more than a mere AI adoption initiative. It needs an economic framework that addresses the conditions dictating who can adopt AI, where the technology is utilized, and who benefits from the resulting productivity gains. This necessitates coordinated actions in education, industrial development, and fiscal policy, bolstered by labour-market institutions that can manage technological transitions (Acemoglu & Restrepo, 2019; Brollo et al., 2024).

3. Education Reform: Cultivating Capabilities Instead of Just Qualifications

Education serves as the cornerstone of a productivity-driven AI strategy, as technology not only alters the tools workers utilize but also the tasks they perform, and the competencies employers seek. However, equipping South Africans for an AI-enabled economy should not be confined to introducing coding courses or increasing enrolment in technology-related programs. The broader aim should be to cultivate workers who can analyse information, solve problems, make judgments, collaborate with others, and adapt to evolving occupational demands. While AI may automate certain tasks, it simultaneously elevates the value of complementary human skills, making a blend of technical and transferable skills increasingly crucial (Gmyrek et al., 2025; OECD, 2026b).

Reform should initiate with foundational education. Proficiency in mathematics, science, literacy, critical thinking, and digital literacy are essential for advanced technological learning. In the absence of these foundations, the advantages of specialized AI education will remain elusive for many learners. At the school level, digital education should focus on fostering the ability to assess information, comprehend computational processes, and utilize technology responsibly, rather than merely exposing students to digital devices. This aligns with the National Digital and Future Skills Strategy, which emphasizes the importance of developing capabilities for a changing economy (Department of Communications and Digital Technologies, 2020).

At the post-school level, the connection between education and productive sectors must be substantially strengthened. Technical and vocational education and training institutions

should collaborate with employers to create programs relevant to manufacturing, agriculture, energy, logistics, and other sectors where digital technologies can enhance production. Universities should broaden interdisciplinary learning that integrates economics, engineering, information systems, data science, and business management. Such programs would help produce graduates who understand both the technological tools and the economic challenges those tools aim to address (Department of Communications and Digital Technologies, 2020; OECD, 2026b).

The urgency for this reform is underscored by South Africa's digital skills mismatch. The World Bank (2026) identifies a structural gap between the skills demanded by employers and those provided by the education and training system. Their analysis reveals deficiencies in foundational digital skills, program alignment, and workplace learning, despite the concurrent existence of unemployment and unfilled digital vacancies. This indicates that merely increasing the number of qualifications will not remedy the issue. Educational institutions must respond more closely to labour market demands, while employers need to engage in developing and providing relevant training (World Bank, 2026).

A pragmatic response would involve establishing stronger work-integrated learning arrangements. Universities and TVET colleges should partner with firms to facilitate structured internships, apprenticeships, workplace projects, and industry-supervised training. These arrangements would allow students to apply theoretical knowledge to real-world production challenges and provide employers with opportunities to identify and nurture potential employees. Small and medium-sized enterprises should also be included through shared placement arrangements and sector partnerships, as they may lack the resources to run extensive training programs independently (World Bank, 2026; OECD, 2026b).

Education reform must extend beyond preparing young individuals entering the labour market. Existing employees will require opportunities to acquire new skills as AI transforms work organization. Gmyrek et al. (2025) differentiate between occupational exposure to generative AI and the likelihood of complete job replacement. This distinction is vital because exposure indicates that tasks may evolve; it does not imply that entire occupations will vanish. Consequently, South Africa should establish a system of lifelong learning that allows employees to access modular training, recognized micro-credentials, and employer-supported reskilling. Publicly funded training should prioritize workers facing significant occupational changes and align learning opportunities with practical pathways into employment (Gmyrek et al., 2025; OECD, 2026b).

Finally, the integration of generative AI into education necessitates responsible governance. UNESCO advocates for human-cantered and age-appropriate approaches in utilizing generative AI in educational and research contexts (Miao & Holmes, 2023). South African institutions must implement clear guidelines on academic integrity, privacy, data protection, and the appropriate use of AI-generated content. Additionally, educators require professional development to ensure that AI enhances teaching and learning without undermining independent reasoning, human interaction, or the professional role of educators (Miao & Holmes, 2023).

4. Industrial Policy: Developing Domestic Productive and Technological Capabilities

While education reform can enhance the supply of skills, skills alone cannot drive economic transformation if the economy fails to generate adequate productive opportunities. South Africa, therefore, requires an industrial policy that directs AI towards domestic production, innovation, and the establishment of local technological capabilities. Absent such an approach, firms may become increasingly reliant on imported systems, while research, software development, advanced technical services, and other high-value functions remain concentrated elsewhere. The goal must be to engage more effectively in global technological networks while bolstering domestic capacity to create, adapt, and commercialize technology (OECD, 2026a; World Bank, 2019).

The initial focus should be on identifying sectors where AI can address specific production limitations. In manufacturing, potential applications include predictive maintenance, quality control, inventory management, and production planning. In agriculture, AI can facilitate crop monitoring, water management, and forecasting. In logistics, it can enhance route planning and supply chain coordination. In financial services, it can improve fraud detection, risk assessment, and service delivery. However, sector selection should be based on identifiable productivity opportunities, the potential for domestic value addition, and the availability of complementary infrastructure and skills, rather than merely the perceived sophistication of the technology (Filippucci et al., 2024; the dtic, 2026).

The dtic's Industrial Development Strategy 2026 presents a significant framework for linking technological enhancement with industrial renewal (the dtic, 2026). Its effectiveness will depend on translating strategic objectives into practical support for firms, investments in productive infrastructure, and the development of stronger local supplier capabilities. AI initiatives should be integrated into existing sectoral development programs and industrial master plans to mitigate the risk of establishing a separate technology agenda

that competes with, rather than reinforces, the country's broader industrial priorities (the dtic, 2026).

A central proposal of this essay is the creation of a South African AI Productivity Partnership Programme. This initiative would unite government departments, universities, technical colleges, industry associations, research institutions, and participating businesses. Its purpose would be to assist firms in identifying production challenges, evaluating suitable AI applications, developing employee skills, and assessing resultant productivity gains. Rather than solely financing technology purchases, the program would support the entire adoption process: diagnosis, implementation, workforce development, and performance evaluation. This approach addresses evidence that firms' adoption decisions are shaped by skills, innovation, and financial constraints (Avenyo et al., 2024; Filippucci et al., 2024).

The program should prioritize sectors with established productive activities and realistic potential for technological advancement, including manufacturing, agriculture, and logistics. Smaller enterprises should have access to shared AI testing facilities, technical guidance, and collaborative research services. Universities and public research institutions could provide specialized expertise, while firms contribute operational insights and identify commercially relevant issues. Participation should be competitive and transparent, with support contingent upon credible implementation plans and measurable outcomes. This would help prevent public resources from being concentrated among firms that would have adopted the technology independently (Avenyo et al., 2024; Brollo et al., 2024).

Domestic research and development should constitute another essential component of industrial policy. AI adoption should not be confined to procuring foreign systems; it must also generate opportunities for developing locally relevant applications, research expertise, and technological knowledge. Mazorodze et al. (2025), through an industry-level panel covering 66 South African industries from 1993 to 2023, analyse the connection between R&D and labour and capital productivity. Their findings underscore the significance of human skills in comprehending the productivity contributions of research investments. Although the study does not assess the impact of AI adoption directly, it provides pertinent evidence that innovation spending and human capabilities should be considered in tandem (Mazorodze et al., 2025).

Public procurement can further bolster domestic innovation by creating opportunities for local tech firms to pilot and supply solutions to public entities. Government demand can assist early-stage companies in establishing a market, developing products, and gaining

experience. However, procurement practices must remain competitive and transparent. Local suppliers should not receive indefinite protection from competition; support should be linked to technical performance, value for money, innovation, and the cultivation of capabilities that can compete in broader markets (OECD, 2026a).

5. Fiscal Incentives: Linking Public Support to Economic Value

Fiscal policy can shape the direction and pace of AI adoption, but incentives must be carefully structured due to limited public resources. South Africa faces competing demands across education, health care, infrastructure, social protection, and economic growth. Tax breaks and grants carry an opportunity cost: revenue allocated to one area cannot be utilized elsewhere. The pertinent question is not merely whether an incentive attracts private investment, but whether it generates additional economic activities and social benefits that would not have occurred otherwise (Brollo et al., 2024).

The existing research and development incentive under Section 11D of the Income Tax Act serves as a useful starting point. The South African Revenue Service notes that qualifying R&D expenditures may qualify for enhanced deductions, contingent upon statutory requirements and approval conditions (South African Revenue Service, n.d.). This incentive could support authentic AI-related research, including the development of locally relevant applications, new industrial processes, and technological advancements. However, merely purchasing an existing commercial AI product should not automatically classify as R&D. Maintaining this distinction is crucial to ensure that public support fosters innovation rather than subsidizing routine business expenses (South African Revenue Service, n.d.).

A restructured fiscal framework should differentiate between various barriers to AI adoption. First, qualifying R&D incentives should motivate firms to develop or significantly enhance technologies and production processes. Second, competitive matching grants could assist viable small and medium-sized enterprises in overcoming initial adoption costs. Third, training incentives could encourage employers to invest in recognized employee development and workplace learning. Fourth, collaborative research grants could facilitate partnerships between universities and firms to create local technological solutions. These instruments should target distinct market failures rather than serve as blanket subsidies for all technology expenditures (Brollo et al., 2024; Filippucci et al., 2024).

Importantly, public support should be tied to performance. Firms receiving adoption grants should conduct baseline assessments of their production processes and outline expected improvements from the proposed investment. Evaluations could then track changes in

output per worker, production costs, product quality, energy efficiency, innovation activity, and employee training. Not every project will succeed, especially in contexts of high technological uncertainty. Nevertheless, transparent selection processes, time limits, independent evaluations, and the potential withdrawal of support from consistently underperforming projects would enhance accountability and minimize the risk of public resources being appropriated by established firms (Brollo et al., 2024).

Fiscal policy must also account for how productivity gains are distributed. If firms primarily utilize AI to reduce labour costs without investing in workforce transitions or new productive activities, the benefits may disproportionately Favor capital owners. Brollo et al. (2024) emphasize the role of fiscal policy in broadening the advantages derived from generative AI. In South Africa, incentives could therefore Favor firms that integrate technological advancements with employee training, feasible redeployment, and the creation of higher-skilled roles. Such conditions should encourage inclusive adjustments without necessitating that firms maintain every existing task regardless of its economic viability (Acemoglu & Restrepo, 2019; Brollo et al., 2024).

South Africa should exercise caution against imposing sweeping taxes on automation or AI adoption, as such measures could deter productive investments, particularly among firms already facing high costs and limited access to financing. A more suitable approach would be to uphold a fair tax system while implementing targeted incentives, skills programs, and social protections to address the distributional consequences of technological change. The objective should be to promote innovation while ensuring that the broader economy benefits from the advantages it generates (Acemoglu & Restrepo, 2019; Brollo et al., 2024).

6. Labor-Market Policy: Managing Displacement While Creating Pathways to New Employment

The connection between AI and employment cannot be reduced to the notion that every automated task signifies a permanent job loss. Technological advancement can displace workers from existing roles while simultaneously generating new tasks and occupations. Acemoglu and Restrepo (2019) categorize these processes into displacement and reinstatement effects. The former occurs when technology supplants tasks previously performed by humans, while the latter surfaces when new tasks arise that require human input. The balance between these effects is influenced by the trajectory of technological development and the economic institutions guiding its adoption (Acemoglu & Restrepo, 2019).

For South Africa, this distinction carries significant policy implications. The country must navigate both extremes: neglecting the potential for labour displacement while resisting technologies that could enhance productivity. Workers engaged in routine administrative; clerical, customer service, and certain production roles may undergo considerable changes in their tasks. However, exposure to generative AI should not be misconstrued as an indication that entire occupations will cease to exist. The suitable response is to bolster workers' adaptability and facilitate their transition into emerging opportunities (Gmyrek et al., 2025).

This necessitates a labour market transition system that connects employers, training institutions, and workers. Employment services should deliver accessible information regarding changing occupational prerequisites and available training opportunities. Employers should be encouraged to identify tasks likely to evolve prior to executing significant technological restructuring and, where economically viable, offer retraining or redeployment. Training programs should be developed in collaboration with worker representatives and employers to ensure that the skills acquired align with genuine occupational demand rather than generic training objectives (ILO, 2026; OECD, 2026b).

Social protection also plays a critical role. Workers who lose jobs during technological transitions may require temporary income support, employment assistance, and avenues to acquire new skills. This support should facilitate transitions into productive work rather than becoming disconnected from employment services and training. The goal of labour market policy is not to hinder economic evolution, but to ensure that workers are not left to bear its costs alone (ILO, 2026).

7. Governance and Implementation: Transitioning from Policy Ambitions to Measurable Accountability

A productivity-led AI strategy necessitates institutional coordination, as its execution spans education, industry, finance, labour, communications, and public administration. Fragmented responsibilities can result in duplicated programs, inconsistent funding, and weak accountability. The government should therefore establish a clear coordination framework linking relevant departments, universities, businesses, labour organizations, and research institutions. Its duties should encompass identifying sector priorities, aligning skills programs with employer needs, coordinating funding, and monitoring measurable outcomes (ILO, 2026; OECD, 2026a).

The development of South Africa's national AI policy also highlights the significance of institutional credibility. In June 2026, the Cabinet approved withdrawing the draft AI policy

to allow for reworking and the establishment of appropriate national standards for ethical AI usage (South African Government, 2026). This indicates that the retracted draft should not be presented as an adopted national policy. The revised policy process provides an opportunity to enhance technical reviews, public consultations, institutional accountability, and the reliability of the evidence underpinning governmental decisions (South African Government, 2026).

Governance must also address the risks associated with AI, including privacy breaches, biased automated decisions, cybersecurity threats, and inaccurate outputs. In education, safeguards should protect learners' information and uphold academic integrity. In employment, AI-assisted recruitment and workplace monitoring should be subject to adequate oversight. In public administration, individuals impacted by automated decisions should have access to meaningful explanations and review mechanisms. Responsible governance is intertwined with economic development: trust, accountability, and legal certainty are essential for sustainable adoption (Miao & Holmes, 2023; OECD, 2026b).

Lastly, the effectiveness of AI policy should be assessed based on outcomes rather than the number of technologies procured, training programs launched, or partnerships announced. The proposed AI Productivity Partnership Programme should report on changes in firm-level productivity, manufacturing value added, R&D activities, small business adoption, employee training, and worker transitions. Evaluations should differentiate between improvements attributable to the supported intervention and changes that would have occurred independently. This distinction is crucial for identifying additionality and ensuring that public spending yields genuine economic benefits (Brollo et al., 2024; Filippucci et al., 2024).

A distributional aspect should also be incorporated into evaluations. Productivity gains that predominantly accrue to a small number of large firms or highly skilled workers may enhance aggregate output without generating sufficiently wide social benefits. Monitoring should therefore scrutinize which firms receive support, which workers access training, whether employment opportunities improve, and whether historically underserved regions can engage in the technological transition. Such evidence would allow for policy adjustments as conditions evolve and would make inclusion a measurable outcome rather than a vague aspiration (Brollo et al., 2024; OECD, 2026a).

8. Conclusion: Positioning AI as a Catalyst for Domestic Productive Capability

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Artificial intelligence presents South Africa with the prospect of enhancing productivity, bolstering industrial competitiveness, and generating new avenues for economic growth. However, these advantages will not materialize simply from firms acquiring advanced systems or educational institutions implementing digital technologies. They depend on the nation's capacity to cultivate complementary capabilities that enable productive technology application, generate domestic value, and create opportunities for workers (Filippucci et al., 2024; OECD, 2026a).

This essay advocates for a productivity-led AI industrialization strategy cantered on three interlinked interventions. Education reform must foster foundational, technical, and transferable skills while reinforcing the connection between learning and employment. Industrial policy must channel AI toward domestic production, innovation, and local technological development. Fiscal incentives must reward genuine productivity, research, and workforce development, rather than subsidizing technology acquisitions without clear economic returns. These interventions must be supported by labour-market institutions that facilitate reskilling and safeguard workers during transitional periods (Acemoglu & Restrepo, 2019; Brollo et al., 2024; Gmyrek et al., 2025).

The proposed South African AI Productivity Partnership Programme offers a practical framework for aligning these priorities. By uniting government, industry, educational institutions, and research organizations, it would assist firms in identifying productive applications, nurturing local expertise, and evaluating whether public support yields measurable improvements. Its success should be assessed not solely by the volume of AI investments but by additional productivity, enhanced domestic capabilities, and more inclusive employment opportunities (Avenyo et al., 2024; Filippucci et al., 2024).

Ultimately, South Africa faces a decision between adopting AI as an imported solution and leveraging it as a tool for economic transformation. The former approach risks deepening technological dependency and existing inequalities; the latter necessitates intentional investments in people, enterprises, research, and institutions. The measure of success should, therefore, be South Africa's ability to create economic value from technological change, rather than merely consuming innovations produced elsewhere. The goal is not only to prepare South Africa for an AI-driven economy but to forge an economy capable of shaping AI to serve its own productivity, industrial growth, and inclusive prosperity.

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