

RUDYCT ACADEMIC SERIES 2026

Global Economic Transformation in the Age of Artificial Intelligence: Policy Challenges for Developing Countries

Policy, Development, and Inclusive Transformation in the AI Era

Prof Rudy C. Tarumingkeng, PhD

www.ruduct.com/cv.pdf

July 2026

GLOBAL ECONOMIC TRANSFORMATION IN THE AGE OF ARTIFICIAL INTELLIGENCE

Policy Challenges for Developing Countries



AI-DRIVEN
PRODUCTIVITY



INCLUSIVE
INNOVATION



POLICY
CAPACITY



SUSTAINABLE
GROWTH



By Prof. Ir. Rudy C. Tarumingkeng, PhD

www.rudycet.com/cv.pdf

Abstract

Artificial intelligence is becoming a general-purpose technology capable of changing productivity, employment, trade, finance, public administration, industrial organization, and the international distribution of power. Its economic effects will not be uniform. Advanced economies possess greater computing capacity, research institutions, capital, data-intensive firms, and skilled labor, while many developing countries face deficits in electricity, connectivity, local data, digital capability, and regulatory capacity. This article examines the global economic transformation generated by AI and the policy challenges confronting developing economies. It argues that lower immediate occupational exposure does not guarantee protection: countries may experience disruption through trade, platform concentration, changing skill demand, and declining competitiveness before receiving a broad productivity dividend. A comprehensive policy framework is developed around four foundations—connectivity, compute, context, and competency—combined with industrial policy, labor-market institutions, social protection, competition, fiscal strategy, data governance, responsible AI, and international cooperation. Particular attention is given to Indonesia and other middle-income economies seeking to convert AI adoption into inclusive structural transformation. The central conclusion is that policy must move beyond passive technology consumption. Developing countries require the capacity to adopt, adapt, govern, and eventually create AI in ways aligned with local development priorities, social justice, democratic accountability, and sustainable growth.

Keywords: artificial intelligence; global economic transformation; developing countries; economic policy; digital divide; productivity; labor markets; industrial policy; data governance; inclusive development

1. Introduction

Artificial intelligence has moved rapidly from a specialized technological field into a central force in economic strategy. Machine learning systems classify, predict, recommend, optimize, and increasingly generate text, images, software, audio, scientific hypotheses, and designs. Firms use AI in customer service, finance, logistics, manufacturing, health, agriculture, education, and research. Governments use it to analyze data, allocate inspections, improve public services, and detect fraud. The technology is beginning to influence not only individual tasks but also the architecture of firms, markets, and global value chains.

The economic significance of AI derives from its broad applicability. Like electricity, the steam engine, and digital computing, AI can complement innovation across many sectors. It reduces the cost of prediction

and certain forms of cognitive production. Generative systems extend these capabilities to language and knowledge work, allowing people to produce drafts, code, analysis, and creative material at unprecedented speed. As complementary investments accumulate, productivity effects may spread through the economy.

Yet the transition is characterized by deep uncertainty. AI can complement workers, automate tasks, create new products, and lower entry barriers. It can also displace employment, concentrate market power, amplify inequality, and make countries dependent on foreign infrastructure and models. The outcome depends on technology design, organizational adoption, market structure, education, social institutions, and public policy. There is no single predetermined “AI future.”

The global distribution of opportunity is especially important. Advanced economies have extensive broadband, cloud infrastructure, capital markets, universities, research laboratories, intellectual property, and firms operating at scale. Many developing countries possess dynamic entrepreneurs and young populations, but they face constraints in electricity, affordable connectivity, computing resources, language data, specialized skills, and institutional capacity. AI may therefore widen international productivity gaps even when it creates useful applications locally.

IMF analysis has estimated that close to 40 percent of global employment is exposed to AI, with higher exposure in advanced economies and lower measured exposure in emerging and low-income countries. Lower exposure reflects occupational structures containing more manual and informal work, but it also indicates fewer immediate opportunities for AI complementarity. Without infrastructure and skills, developing countries may receive smaller productivity gains while still experiencing global price, trade, and competitive pressures.

The policy challenge is thus dual. Governments must manage displacement, inequality, privacy, safety, and market concentration. At the same time, they must avoid overregulation that prevents learning and local innovation. They must create foundations for adoption while developing domestic capacity to adapt technology to local languages, institutions, and development problems. They must cooperate internationally without surrendering sovereignty over critical choices.

This article develops an integrated framework for these challenges. It examines productivity, labor, trade, industrialization, finance, public administration, inequality, and sustainability. It then proposes policy strategies covering infrastructure, compute, data, skills, industrial policy, competition, social protection, fiscal governance, and international cooperation. Indonesia is used as an illustrative middle-income archipelagic economy with both significant opportunity and complex constraints.

2. AI as a General-Purpose Technology

General-purpose technologies affect many sectors, improve over time, and stimulate complementary innovation. Their impact does not appear immediately after invention. Organizations must redesign processes, invest in skills and data, establish standards, and develop new products. Early productivity statistics may therefore understate long-term effects, while public enthusiasm may overstate short-term readiness.

AI is distinctive because it operates on information, prediction, and symbolic tasks. Earlier automation focused heavily on routine manual and administrative activity. Modern AI can affect professional work in law, medicine, engineering, management, design, and education. Generative systems can produce plausible content without possessing human understanding, which expands usefulness while creating risks of error, bias, and false confidence.

The value of AI depends on complementary assets. A model alone rarely transforms an enterprise. Reliable data, computing infrastructure, cybersecurity, domain expertise, workflow integration, managerial competence, and employee trust are necessary. Firms that possess these assets can turn AI into productivity; firms without them may purchase tools that remain underused or create new risks.

Economic transformation occurs through several channels. AI can increase within-firm efficiency, improve product quality, accelerate research, create new services, and change the boundaries between firms and markets. It can lower the cost of coordination, enabling platforms and global delivery of knowledge services. It can also increase returns to scale because large datasets, computing capacity, and distribution networks reinforce one another.

These dynamics create a policy paradox. AI applications may become cheap and widely accessible through cloud services, suggesting democratization. At the same time, the underlying models, chips, cloud platforms, and research capability may remain concentrated. Developing countries can use powerful systems without controlling the infrastructure, standards, or value capture. Consumption is not the same as technological sovereignty.

3. The Emerging Geography of AI Power

The global AI economy is organized around semiconductors, data centers, cloud services, frontier models, software ecosystems, skilled labor, and intellectual property. Each layer contains bottlenecks. Advanced chips require complex design and fabrication networks. Cloud infrastructure is capital-intensive. Frontier model development requires large computational budgets and highly specialized teams. Platform distribution gives a small number of firms access to global users.

UNCTAD has highlighted the concentration of AI investment, corporate research, and market value in a limited number of firms and countries. Such concentration can produce innovation through scale, but it also creates dependency. Prices, access conditions, model policies, and standards may be determined outside developing countries. Local firms may become application-layer resellers while much of the economic surplus flows to infrastructure owners.

Geopolitics reinforces this pattern. Export controls on advanced chips, security concerns, strategic subsidies, and competing technology standards shape access. Countries must navigate relationships with major powers while protecting commercial and national interests. A policy of complete autonomy is unrealistic for most economies, but passive dependence is also risky.

Regional cooperation offers an intermediate strategy. Countries can pool research, computing, language resources, cybersecurity, and regulatory knowledge. Regional data spaces and interoperable standards may create markets large enough to support investment. Cooperation can strengthen bargaining power with global providers while preserving participation in international innovation networks.

Domestic policy should distinguish layers of strategic importance. Not every country needs to build a frontier model or semiconductor fabrication plant. Many can create value through sectoral applications, adaptation, local-language models, data services, integration, safety evaluation, and specialized research. Strategic selectivity is more credible than attempting to reproduce the entire technology stack.

4. Productivity, Innovation, and the Diffusion Gap

AI can raise productivity by automating tasks, augmenting workers, reducing error, improving forecasting, and accelerating innovation. Studies of workplace applications often find that less experienced workers can gain substantially when AI provides guidance. This suggests a potential equalizing mechanism within firms. However, productivity gains depend on the quality of implementation and may not generalize across sectors or countries.

Diffusion is typically uneven. Large firms adopt earlier because they possess data, capital, technical staff, and capacity to absorb risk. Small and medium-sized enterprises face uncertain returns, vendor dependence, cybersecurity concerns, and skill shortages. If adoption remains concentrated, productivity dispersion may increase and dominant firms may gain market share.

Developing countries face an additional diffusion gap. Imported tools may not fit local languages, informal business practices, regulatory systems, or data conditions. Cloud cost may be high relative to wages. Electricity and connectivity may be unreliable. Managers may lack experience in redesigning processes. These constraints reduce the value of otherwise capable systems.

“Small AI” offers an important alternative. Lightweight models and narrow applications can run on ordinary devices or modest infrastructure. Agricultural diagnosis, translation, inventory planning, tutoring, document processing, and health decision support can create value without frontier-scale computation. The relevant question is not whether a country owns the largest model but whether it can solve important problems affordably and safely.

Policy should therefore support diffusion as an organizational and institutional process. Extension services, test centers, shared cloud resources, digital vouchers, standards, and university partnerships can help SMEs. Subsidies should reward verified adoption and capability building rather than equipment purchase alone. Demonstration projects should publish lessons, including failures.

5. Labor Markets: Exposure, Complementarity, and Displacement

AI affects tasks before it affects occupations. A job contains activities that may be automated, augmented, or unchanged. Clerical and language-intensive tasks often have high exposure to generative AI. Physical, interpersonal, and context-specific tasks may be less directly affected. Even where complete job replacement is unlikely, job content, skill demand, monitoring, and wage structure can change.

The ILO’s global research emphasizes that augmentation is often more plausible than complete automation, but exposure is uneven by occupation, gender, and income group. Clerical work has particularly high exposure. Because women are often concentrated in clerical roles, gender effects require attention. The impact also depends on whether firms redesign work to complement employees or use AI primarily to reduce labor.

Developing economies may have lower measured exposure because agriculture, construction, personal services, and informal work remain important. This can delay direct disruption, but it may also delay productivity gains. Moreover, export-oriented service sectors such as business-process outsourcing may be highly exposed even when the national average is low. Concentrated regional and sectoral shocks can be politically significant.

Global competition is another channel. A worker need not use AI to be affected by it. Foreign competitors using AI may lower prices or increase quality. Tasks previously outsourced to lower-wage economies may be automated or performed by smaller teams in high-income countries. Conversely, AI can help developing-country professionals deliver higher-value services globally if connectivity, language, trust, and skills are available.

Job quality matters. Algorithmic management can schedule, evaluate, and monitor workers. It may improve consistency, but it can also create opacity, intense workloads, and unstable hours. Labor policy

should ensure notice, data protection, human review, collective consultation, and appeal. Productivity should not be purchased through the erosion of dignity and bargaining power.

6. Skills, Education, and the Risk of Polarization

AI changes the value of skills. Technical capability remains important, but complementary human skills—domain knowledge, critical reasoning, communication, ethical judgment, creativity, and relationship management—become more valuable. People must know how to frame problems, verify outputs, recognize limitations, and integrate AI into real decisions.

Skill demand may polarize. Workers and firms able to use AI gain productivity and income, while others fall behind. Higher-income households can access better devices, connectivity, education, and professional networks. Older workers and people in rural areas may face greater transition barriers. Without policy, AI can widen inequality even when average productivity rises.

Education systems require reform at multiple levels. Basic education should strengthen literacy, numeracy, digital competence, and critical thinking. Vocational programs should combine technical tools with sector knowledge. Universities should integrate AI across management, medicine, engineering, agriculture, law, social science, and humanities. Students must learn both to use AI and to reason independently.

Teachers need professional development and institutional support. AI can assist lesson planning, translation, formative feedback, and individualized practice, but it cannot replace the relational and civic functions of education. Assessment must be redesigned so that students demonstrate understanding rather than merely submit generated output.

Lifelong learning is essential. Training must be linked to real job pathways, paid time, recognition, and employer demand. Generic online courses are insufficient for workers with limited time or confidence. Apprenticeships, modular credentials, mentoring, and local learning centers improve access. Social protection can support people during transition.

7. Inequality Within and Between Countries

AI can affect income distribution through labor, capital, prices, and ownership. If AI complements highly educated workers and raises returns to capital, income may concentrate. If it improves the productivity of less experienced workers and lowers the price of essential services, it can be equalizing. Market institutions and policy determine which mechanism dominates.

Wealth inequality may increase because ownership of AI-intensive firms and intellectual property is concentrated. Successful companies can scale globally with relatively limited labor. Capital gains accrue to investors, while adjustment costs fall on workers and communities. Taxation and shared ownership mechanisms become increasingly relevant.

Access inequality also matters. People with high-quality connectivity, paid subscriptions, English proficiency, and digital literacy receive better tools. Free systems may have lower quality or use personal data for commercial purposes. Public and educational access can prevent AI capability from becoming a luxury good.

Between countries, unequal foundations may widen productivity gaps. The World Bank emphasizes connectivity, compute, context, and competency as the four foundations of AI readiness. These are cumulative: weak electricity limits connectivity and compute; weak data reduce model relevance; weak skills reduce adoption; weak adoption reduces incentives for investment.

Development policy must address the entire system. Building data centers without skills and electricity planning may create enclaves. Training programmers without domestic demand may encourage migration. Collecting data without governance may enable extraction. Coherent sequencing and institutional coordination are necessary.

8. Trade, Global Value Chains, and Services

AI changes comparative advantage. Traditional trade theory emphasizes labor, capital, technology, and natural resources. AI alters the effective supply of cognitive capability. Firms in high-wage countries may automate tasks previously offshored. Developing countries may use AI to improve quality, reduce coordination cost, and enter more sophisticated services.

Manufacturing value chains will use AI for design, quality, predictive maintenance, procurement, and logistics. Suppliers unable to meet digital standards may be excluded. Conversely, digital tools can help smaller suppliers demonstrate quality and traceability. Industrial policy should support standards, interoperability, cybersecurity, and supplier upgrading.

Services trade may experience particularly rapid change. Translation, coding, accounting, marketing, research, and customer support can be delivered digitally and augmented by AI. Countries with educated, multilingual populations can move toward higher-value services, but routine outsourcing models are vulnerable. Upgrading must occur before price competition intensifies.

Trade rules increasingly intersect with data flows, source code, cybersecurity, privacy, and digital taxation. Developing countries need negotiating capacity to preserve policy space while supporting cross-border

commerce. Rules should prevent unjustified localization but allow legitimate protection of sensitive data and public interests.

AI can also help exporters navigate standards, documentation, and market intelligence. Public export agencies can provide shared tools to SMEs. However, firms need protection against confidential data leakage and dependency on platforms that may compete with their users.

9. Industrial Policy in the AI Era

Industrial policy has returned to the center of global economic strategy. Major economies subsidize semiconductors, clean technology, research, and digital infrastructure. Developing countries cannot match the fiscal scale of advanced economies, but they can pursue disciplined, selective policies based on capabilities and development needs.

A useful strategy separates adoption, adaptation, and creation. Adoption uses existing tools to improve firms and public services. Adaptation modifies models for local language, regulation, and sector conditions. Creation develops new models, components, or research. Most countries should invest broadly in adoption, build strong adaptation capability, and select limited areas for creation.

Sector priorities should reflect local problems and comparative advantage. Agriculture, mining, manufacturing, health, education, logistics, disaster management, energy, and public administration may offer high social returns. Projects should have accountable owners, data governance, outcome metrics, and pathways for scale.

Public development banks and innovation funds can finance experimentation, but support should be conditional on learning, interoperability, skills, and local value creation. Permanent protection of inefficient firms should be avoided. Sunset clauses, evaluation, and competition maintain discipline.

Foreign direct investment can bring capital and expertise. Agreements should encourage training, research partnerships, supplier development, cybersecurity, environmental responsibility, and knowledge transfer. Local-content rules should be realistic and focused on capability rather than symbolic assembly.

10. Infrastructure: Connectivity, Electricity, and Compute

AI policy begins with physical infrastructure. Reliable electricity and affordable broadband are prerequisites. Many communities remain unconnected or face high prices and low quality. Expanding networks without affordability and skills leaves a usage gap. Universal service policies should address coverage, price, devices, and meaningful use.

Compute includes cloud services, data centers, high-performance computing, and access to accelerators. Countries need not own all infrastructure, but they require affordable and resilient access. Public research computing can support universities and startups. Cloud credits can help experimentation, while procurement should avoid long-term lock-in.

Data centers create opportunities and costs. They require electricity, water, land, networks, and skilled maintenance. Incentives should be linked to renewable energy, water stewardship, local capability, security, and transparency. A data center that receives subsidies while creating few linkages may not justify public cost.

Edge computing and smaller models can reduce dependence on continuous cloud access. They are useful for rural health, agriculture, industrial control, and privacy-sensitive applications. Architecture should match the problem instead of assuming that the largest model is always superior.

Cybersecurity is a national economic foundation. AI increases both defensive capability and attack sophistication. Governments need incident response, critical-infrastructure standards, workforce development, and cross-border cooperation. SMEs require shared support because they cannot maintain advanced security alone.

11. Data, Language, and Context

Models reflect the data on which they are trained and evaluated. Developing countries are often underrepresented in global datasets. Local languages, laws, cultural practices, diseases, crops, climate conditions, and informal institutions may be poorly captured. A fluent model may therefore appear universal while performing unevenly.

Building local data capacity does not mean collecting everything. Data governance should define legitimate purpose, consent, security, access, retention, and benefit sharing. Health, biometric, financial, and children's data require strong protection. Public trust is necessary for sustainable data ecosystems.

Language resources are a development priority. Translation, speech recognition, and local-language content can improve education, administration, commerce, and cultural participation. Universities, media, communities, and firms can collaborate on responsibly curated corpora. Contributors should receive recognition and protection.

Public data can support innovation when quality, documentation, and privacy are strong. Open-data programs should prioritize high-value datasets such as weather, transport, agriculture, geospatial information, and public procurement. Sensitive microdata may require secure research environments rather than public release.

Data sovereignty should be understood as capacity and rights, not isolation. Countries need to know where critical data are stored, which laws apply, who can access them, and how services can continue. Portability and interoperability reduce dependency. Cross-border flows remain essential for science and commerce.

12. Competition Policy and Platform Power

AI markets exhibit economies of scale, scope, and network effects. Large firms combine cloud infrastructure, models, data, distribution, and complementary services. Vertical integration can produce efficiency but also enable self-preferencing, exclusion, bundling, and control over business users.

Competition authorities need technical and economic capacity. Traditional measures based on current price may miss harms in zero-price or rapidly evolving markets. Control of data, compute, interfaces, and defaults can be more important than immediate revenue. Merger review should consider future competition and innovation.

Interoperability and data portability can reduce switching costs. Open standards enable local firms to build complementary products. However, mandates must protect privacy and security. Access remedies should be designed carefully so that dominant firms cannot use compliance complexity to exclude smaller rivals.

Public procurement can support competition by avoiding unnecessary proprietary dependence and dividing contracts where appropriate. Governments should retain access to data, documentation, and exit mechanisms. Open-source options deserve consideration when they provide security and capability benefits.

SMEs need fair access to digital markets. Platform rules, fees, rankings, and account suspension should be transparent and contestable. Competition policy intersects with consumer protection and labor regulation because the same platform may govern sellers, workers, advertisers, and users.

13. Fiscal Policy, Taxation, and Public Investment

AI affects fiscal policy through growth, employment, tax bases, expenditure, and government capability. Higher productivity can increase revenue, but labor displacement and profit shifting may erode traditional bases. Governments must finance infrastructure, education, social protection, and regulation while maintaining debt sustainability.

Tax policy should remain neutral enough to avoid discouraging productive innovation, but it should not subsidize automation regardless of social outcome. Accelerated depreciation and technology incentives

can favor capital over labor. Evaluation should examine additional investment, employment quality, capability creation, and distribution.

Digital and multinational taxation requires international cooperation. Profits generated through data, intangible assets, and remote services are difficult to allocate. Developing countries need administrative capacity and a fair voice in global rules. Excessively complex systems favor firms and states with greater expertise.

Public investment should be prioritized by social return. Rural connectivity, reliable electricity, education, health data, cybersecurity, and digital public infrastructure often create broad spillovers. Prestige projects with limited use should be avoided. Maintenance and institutional capability are as important as initial construction.

AI can improve tax administration through risk analysis and service, but automated enforcement requires safeguards. Errors can harm vulnerable citizens. Transparency, proportionality, human review, and appeal are essential. The state should not demand algorithmic accountability from firms while exempting itself.

14. Monetary Policy, Finance, and Macroeconomic Stability

AI can influence productivity, wages, prices, market structure, and therefore monetary policy. Rapid productivity growth could expand potential output and reduce some costs, but investment booms and concentrated wealth may affect demand. Central banks need scenario analysis because historical relationships may change.

Financial institutions use AI for credit, fraud, trading, and customer service. These applications can broaden access and reduce cost. They can also create correlated models, procyclical decisions, cyber risk, and opaque discrimination. Supervisors should examine model risk, concentration in third-party providers, and operational resilience.

Developing economies may depend heavily on foreign cloud and model providers. A disruption, price change, or geopolitical restriction can become a systemic operational risk. Financial regulators should map dependencies and require continuity plans. Concentration should be monitored across institutions.

Alternative data can improve credit assessment for people without formal histories, but it can also enable pervasive surveillance. Variables should be relevant and proportionate. Applicants need explanation, correction, and human review. Financial inclusion is not achieved when rapid credit leads to overindebtedness.

Capital flows may respond to perceived AI readiness. Economies with infrastructure and skills can attract investment, while others face a higher risk premium. Policy credibility, human capital, and institutions

therefore become part of macroeconomic competitiveness. Attempting to signal readiness through subsidies alone is insufficient.

15. Public Administration and State Capacity

AI offers governments tools to improve service, inspection, planning, translation, and fraud detection. In low-capacity environments, these benefits can be significant. Yet public decisions affect rights, and failures may have severe consequences. Government AI requires stronger, not weaker, accountability.

The first priority is process improvement. Automating a fragmented or unjust process can scale its defects. Agencies should simplify rules, improve data quality, and clarify responsibility before adding AI. Frontline public servants should participate because they understand exceptions and citizen needs.

Digital public infrastructure can provide identity, payments, data exchange, and registries as shared foundations. Its design should support inclusion, interoperability, security, privacy, and democratic oversight. Essential services need assisted and offline pathways for people who cannot use digital channels.

Procurement is a major vulnerability. Governments may buy systems they cannot evaluate, audit, or exit. Contracts should require documentation, security, performance testing, data rights, accessibility, incident cooperation, and knowledge transfer. Pilot results should be independently evaluated.

Regulatory institutions need expertise and resources. A central AI office can coordinate standards, but sector regulators retain domain responsibility. Independent audit, courts, ombuds institutions, civil society, and research institutions contribute oversight. Capacity should be distributed rather than concentrated in one executive unit.

16. Responsible AI and Democratic Governance

Responsible AI includes fairness, accountability, transparency, privacy, safety, robustness, and human oversight. These principles must be translated into requirements for different contexts. A low-risk translation tool does not need the same governance as an employment, credit, health, or law-enforcement system.

Risk-based regulation can support innovation while protecting rights. High-impact systems should undergo assessment, testing, documentation, monitoring, incident reporting, and appeal. Some applications may be incompatible with democratic values or scientific validity and should be restricted or prohibited.

Developing countries should avoid copying foreign regulation without adaptation. Institutional capacity, legal traditions, sector needs, and local harms differ. At the same time, alignment with international standards can facilitate trade and reduce compliance cost. Regulatory interoperability is preferable to complete uniformity.

Participation improves legitimacy. Workers, consumers, marginalized groups, professional bodies, and communities should contribute to rules and major deployments. Technical experts clarify capability and risk, but societal values require public deliberation. Transparency should be understandable rather than limited to technical documents.

Remedy is essential. People affected by significant automated decisions need notice, reasons, correction, human review, and compensation where harm occurs. Complaint systems must be accessible. An ethical principle without remedy is a promise without enforcement.

17. Social Protection and a Just AI Transition

Even when AI increases total income, transitions can impose concentrated losses. Workers may lose jobs, hours, bargaining power, or professional identity. Regions dependent on vulnerable industries may decline. Social protection and active labor-market policy distribute risk and sustain political support for innovation.

Unemployment insurance, income support, health coverage, and pensions should remain portable across employment forms. Platform and informal workers need coverage. Financing mechanisms must recognize that firms benefiting from productivity also have responsibilities for transition.

Training should be connected to demand and local opportunity. Programs require career guidance, employer partnerships, recognized credentials, and evaluation. Relocation is not always feasible or desirable; place-based investment can create new activity in affected regions.

Worker participation can improve adjustment. Consultation over monitoring, work redesign, training, and deployment reveals problems and creates legitimacy. Collective bargaining can negotiate productivity sharing, hours, and safeguards. It should be seen as an innovation institution rather than an obstacle.

A just transition also considers gender, disability, age, and informality. Standard programs may miss people outside formal payroll systems. Community organizations, cooperatives, local government, and digital public infrastructure can help reach them. Policy must measure who actually benefits.

18. Sustainability and the Environmental Cost of AI

AI can support climate modeling, smart grids, efficient industry, agriculture, logistics, and ecosystem monitoring. It can accelerate materials discovery and renewable-energy integration. These benefits are important for developing countries vulnerable to climate change.

AI also has an environmental footprint. Data centers use electricity and water; chips and devices require minerals, chemicals, and manufacturing; short equipment cycles create electronic waste. The footprint varies by model, architecture, electricity source, and location. Claims of sustainability require life-cycle analysis.

Policy should encourage efficient models, renewable power, heat management, water stewardship, durable hardware, repair, and recovery. Data-center incentives should disclose resource use and consider local scarcity. Communities should participate in location decisions and benefit agreements.

The rebound effect deserves attention. Lower costs can stimulate greater use, offsetting efficiency. AI used to optimize advertising and consumption may increase material demand. Governments and firms should evaluate net outcomes rather than assuming that digital means green.

Developing countries rich in critical minerals face opportunity and risk. Demand for chips, batteries, and infrastructure can support industrialization, but extraction may harm communities and ecosystems. Value addition, environmental enforcement, transparency, and fair benefit sharing are essential.

19. International Cooperation and Global Governance

AI crosses borders through models, data, cloud services, trade, security threats, and information flows. No country can govern it alone. International cooperation is required for standards, research, safety, cyber incidents, competition, taxation, and capacity building.

Developing countries need meaningful representation. Rules created by a small group may reflect their risks and interests while overlooking language, infrastructure, informality, and development priorities. Multilateral institutions should support participation with research, finance, and negotiating capacity.

Global public goods include safety research, open scientific resources, disease and climate models, language tools, and evaluation methods. Public funding can ensure that knowledge is not entirely enclosed by private ownership. Access should be paired with security and responsible use.

Capacity building should go beyond workshops. It should finance infrastructure, institutions, research careers, regulatory teams, and long-term partnerships. Short projects can create reports without durable capability. Universities and regional organizations are essential anchors.

International cooperation must coexist with strategic autonomy. Countries should diversify suppliers, retain exit options, protect critical data, and develop local expertise. Autonomy is the capacity to choose and adapt, not an attempt to eliminate interdependence.

20. A Policy Framework: The Four Cs Plus Institutions

The World Bank's four foundations—connectivity, compute, context, and competency—provide a clear starting point. Connectivity includes electricity, networks, affordability, and devices. Compute includes cloud, data centers, accelerators, and edge systems. Context includes local data, language, law, and sector knowledge. Competency includes technical, managerial, professional, and regulatory skills.

These foundations must be combined with institutions. Competition determines whether firms can enter. Data governance determines trust and access. Education shapes capability. Labor institutions shape distribution. Fiscal policy finances public goods. Democratic oversight protects rights. Industrial policy connects technology to structural transformation.

Sequencing matters. Basic connectivity and electricity often have the broadest return. Shared computing and data resources can then support universities, startups, and public agencies. Sectoral pilots create learning. Skills programs grow alongside demand. Regulation becomes more specific as evidence accumulates.

Policy should distinguish national missions from general foundations. Missions target problems such as agricultural productivity, disaster resilience, public health, education, logistics, or energy. They mobilize cross-sector collaboration and produce demonstrable value. Foundations prevent missions from becoming isolated projects.

Measurement should include adoption, productivity, jobs, wages, firm entry, inclusion, service quality, rights, and environmental impact. Counting strategies, laboratories, or applications is not enough. Independent evaluation and public reporting strengthen learning and prevent technology theater.

21. Indonesia: Opportunities and Strategic Choices

Indonesia combines a large domestic market, young population, dynamic digital sector, extensive natural resources, manufacturing ambitions, and archipelagic geography. AI can improve logistics, agriculture, fisheries, mining safety, manufacturing, health, education, disaster management, finance, and government service.

Geography makes connectivity and distributed delivery central. Low-bandwidth, mobile, edge, and local-language applications may create more value than prestige frontier projects. Digital systems should

complement teachers, health workers, agricultural extension, and local government rather than assume their replacement.

Bahasa Indonesia and regional languages require sustained investment in data and evaluation. Universities, media, communities, and firms can collaborate while protecting rights and cultural ownership. Local-language AI is both an inclusion policy and a foundation for domestic innovation.

Industrial policy can connect AI with downstream processing, manufacturing quality, energy efficiency, and SME upgrading. Foreign investment should develop suppliers and skills. Data centers should align with renewable energy, water availability, cybersecurity, and local research.

Labor policy should anticipate exposure in clerical work, finance, media, education, and business-process services. Reskilling must be linked to sector strategies and real jobs. Informal workers and microenterprises need accessible tools, finance, social protection, and fair platform governance.

Institutionally, coordination is critical. Digital, industrial, education, labor, finance, competition, data protection, and environmental policies interact. A national strategy should assign responsibilities and budgets, establish measurable missions, and preserve independent oversight.

22. The Political Economy of AI and Development

AI policy is not only a technical question of infrastructure and skills. It is a political-economic question about ownership, bargaining power, distribution, and the authority to set rules. Technology changes the resources available to different actors. Firms controlling cloud infrastructure, platforms, proprietary data, and models can influence market access and public policy. Governments controlling identity, data, and digital services can improve administration but also increase surveillance. Workers and citizens may receive valuable services while losing voice.

The distribution of AI rents matters. Economic rent arises when firms receive returns beyond those necessary to sustain investment because they control scarce assets, intellectual property, networks, or standards. Frontier models and cloud infrastructure may generate substantial rents. Developing countries using these services pay fees, contribute data, and create application markets, but they may capture only a small share of total value. Competition, taxation, local capability, and contractual bargaining determine distribution.

Intellectual-property regimes influence access and innovation. Strong protection can reward research, but overly broad control may limit adaptation and learning. Developing countries need access to scientific knowledge, model evaluation, and interoperability. Open-source models can reduce barriers, though they

still require compute, expertise, and security. Policy should support a plural ecosystem of proprietary, open, public, and sectoral models.

Data are a source of power because they improve services and create switching costs. A platform that observes transactions can enter adjacent markets and compete with businesses that depend on it. Public authorities should scrutinize conflicts of interest, self-preferencing, and exclusive contracts. Data portability and neutral interfaces can support contestability, but implementation must protect confidentiality.

Political influence may grow with economic concentration. Large technology firms possess specialized knowledge that governments need, creating regulatory dependence. They can shape public narratives about what is technically possible and which rules are feasible. Transparent consultation, independent research funding, revolving-door safeguards, and legislative capacity reduce capture.

Domestic elites also matter. AI programs can become vehicles for procurement, centralized control, or prestige without broad benefit. A national strategy may announce laboratories and large infrastructure while neglecting schools, rural electricity, SMEs, and maintenance. Public investment should be evaluated by opportunity cost and distribution, not technological symbolism.

Informality creates a distinctive political economy. Digital platforms can formalize payments and records, improving access to finance and protection. They can also create private regulation outside conventional labor and commercial law. Workers and merchants may depend on algorithms they cannot inspect. The state must extend rights and dispute resolution without eliminating the flexibility that makes informal livelihoods viable.

The relationship between national security and development requires balance. Governments may restrict technology or data because of legitimate security concerns. Security language can also protect incumbents or suppress accountability. Decisions should be evidence-based, proportionate, time-limited, and subject to independent review. Economic resilience is strengthened by diversification and capability, not secrecy alone.

Public participation affects legitimacy. Citizens are more likely to trust digital transformation when they understand purpose, see benefits, and possess remedy. Communities should have influence over systems that affect welfare, employment, policing, health, and education. Participation may slow decisions, but it can prevent costly failure and conflict.

Ultimately, AI policy distributes opportunity and risk. A credible development strategy makes this distribution explicit. It identifies who finances infrastructure, who owns resulting assets, who receives subsidized access, who carries transition costs, and who is accountable for harm. Technical plans without a theory of distribution are incomplete.

23. Agriculture, Food Systems, and Rural Transformation

Agriculture remains a major source of employment and livelihood in many developing countries. AI can support weather forecasting, crop diagnosis, irrigation, input management, yield estimation, market information, insurance, logistics, and traceability. Because farms are diverse and often small, the development value of AI depends on affordability, local relevance, and institutions that connect information to action.

Precision agriculture is frequently associated with sensors, drones, satellite imagery, and machine learning. Large farms can integrate these systems with machinery. Smallholders may benefit more from mobile advice, community weather stations, cooperative services, and extension officers using AI. Policy should not assume that individual ownership of advanced equipment is necessary.

Local data are crucial. Crop disease appearance, soil, microclimate, farming practice, and language vary. Models trained elsewhere may misdiagnose conditions. Agricultural research institutes, universities, farmer organizations, and firms can build validated datasets. Farmers should know how their data are used and receive benefits through improved service, compensation, or collective infrastructure.

AI recommendations involve risk. A farmer may invest scarce income based on advice about seed, fertilizer, or harvest. Systems should communicate uncertainty and connect users to qualified human support. Providers should not use advisory platforms primarily to promote products without disclosure. Conflict-of-interest rules protect trust.

Market platforms can reduce search costs and connect farmers to buyers, finance, and logistics. They can also concentrate bargaining power. Transparent grades, fees, prices, and dispute resolution are necessary. Cooperatives can use shared digital tools to aggregate supply and negotiate. Public market information provides a counterweight to private control.

Agricultural insurance may use satellite and weather data to reduce verification cost. Index insurance can pay quickly, but basis risk occurs when the index does not reflect actual loss. Farmers need understandable terms and complaint mechanisms. Public-private schemes should monitor distribution and avoid excluding areas with weak data.

Traceability can improve food safety and access to premium markets. It may also impose compliance costs on small suppliers. Standards and technology should be proportionate, interoperable, and supported by training. Buyers demanding sustainability data should offer stable contracts and fair prices rather than shift all cost upstream.

Rural transformation includes nonfarm activity. AI-enabled logistics, finance, education, tourism, and services can diversify local economies. Reliable electricity and connectivity therefore have benefits

beyond agricultural applications. Policies should support regional innovation centers and local entrepreneurs instead of designing rural communities solely as technology recipients.

Climate change increases urgency. AI can improve early warning, drought monitoring, crop selection, and water management, but it cannot substitute for infrastructure, land governance, research, and social protection. The strongest approach integrates intelligence with institutions and farmer knowledge.

For Indonesia, archipelagic geography, diverse crops, fisheries, forests, and climate risk create significant opportunity. Local-language mobile services, satellite monitoring, port and cold-chain intelligence, and extension partnerships may deliver broad value. Governance must protect small producers, indigenous communities, and ecological limits.

24. Health, Education, and Human Development

Health and education are central to both welfare and economic capability. AI can extend expertise, reduce administrative burdens, support diagnosis and learning, and improve resource allocation. These sectors also involve vulnerability, rights, professional responsibility, and unequal access. Errors can cause lasting harm, so governance must be rigorous.

In health, AI can analyze images, support triage, forecast demand, translate communication, and assist clinical documentation. Developing countries with specialist shortages may benefit substantially. Yet clinical performance can vary across populations, devices, and disease prevalence. Local validation is necessary before deployment.

Human oversight must be meaningful. Clinicians need training, time, relevant explanations, and authority to disagree. A nominal approval step does not protect patients if staff are pressured to follow the model. Override patterns should inform improvement. Critical services require safe operation during network or vendor failure.

Health data are highly sensitive. Governance should address consent, secondary use, security, research access, retention, and benefit sharing. Centralized datasets can improve research but create attractive targets and surveillance risks. Federated approaches and secure environments may reduce unnecessary movement of data.

Telemedicine and AI can connect remote communities, but physical examination, medicine supply, referral, and trust remain important. Digital systems should strengthen community health workers and clinics rather than create advice without treatment pathways. Success should be measured through health outcomes and equity, not consultation volume alone.

In education, AI can provide tutoring, translation, feedback, content generation, and administrative support. Students in under-resourced settings may gain access to explanations and practice. However, inaccurate information, linguistic bias, privacy, commercial influence, and dependency threaten quality.

Teachers remain central. They interpret student needs, motivate, protect, socialize, and cultivate citizenship. AI should reduce repetitive work and provide useful insight while preserving professional judgment. Training and participatory design improve adoption. Systems should work in local languages and low-bandwidth environments.

Assessment requires redesign. If AI can generate conventional essays and answers, education must emphasize reasoning, oral explanation, projects, application, and reflection. Prohibition alone is unlikely to succeed. Students should learn when AI assistance is appropriate, how to verify it, and how to disclose use.

Equity must be monitored. Well-resourced schools may combine skilled teachers with premium tools, while poorer schools receive automated substitutes. Public policy should ensure that AI narrows rather than widens educational inequality. Procurement should require accessibility, privacy, evidence, interoperability, and freedom from manipulative advertising.

Human development connects the sectors. Healthy, educated populations can adopt and create technology. AI policy that neglects nutrition, basic education, public health, and social trust lacks foundations. Investments in human capability are not secondary responses to AI; they are the primary development strategy.

25. Urbanization, Infrastructure, and Public Services

Rapid urbanization creates complex challenges in transport, housing, energy, water, waste, safety, and service delivery. AI can integrate data and support planning, but “smart city” programs sometimes prioritize technology procurement over institutional reform and citizen needs.

Transport applications include traffic prediction, route planning, public-transit scheduling, and infrastructure maintenance. Optimization should include accessibility, safety, emissions, and low-income neighborhoods, not only vehicle speed. Data from mobile phones and cameras require privacy safeguards and clear purpose.

Energy systems can use AI for demand forecasting, renewable integration, fault detection, and loss reduction. Smart meters improve visibility but may enable intrusive household monitoring or remote disconnection. Consumer protection and cybersecurity are essential. Benefits should reach low-income customers through reliability and affordability.

Water systems can detect leaks, predict demand, and monitor quality. These applications often offer clear social returns. However, technology cannot correct inadequate tariffs, maintenance budgets, governance, or illegal connections by itself. Institutional reform and community engagement remain necessary.

Land and housing systems may use geospatial data to identify change and plan infrastructure. Automated valuation or enforcement can disadvantage informal communities when legal records are incomplete. Governments should avoid treating absence from a database as absence of rights. Participatory mapping and due process are important.

Public safety applications carry high risk. Predictive policing and facial recognition may reproduce biased enforcement and expand surveillance. Developing countries should require strong evidence, legal authority, necessity, proportionality, and independent oversight. Some applications may be inappropriate regardless of promised efficiency.

Digital twins can support scenario planning for floods, transport, and land use. Their assumptions and uncertainty should be transparent. A visually impressive model is not a neutral representation of the city. Residents, planners, engineers, and social scientists should contribute to interpretation.

Procurement should begin with service problems. Open standards, modular contracts, data rights, local maintenance, and exit options reduce dependence. Municipalities need technical staff capable of managing vendors. Shared national resources can help smaller cities.

Inclusive urban technology provides assisted channels, local-language communication, accessibility, and offline alternatives. Citizens should be able to report errors and influence priorities. A smart city is not one with the most sensors; it is one that uses information to improve equitable urban life.

26. Measuring AI Readiness and Development Impact

Indices of AI readiness are useful for comparison but can oversimplify. Countries may score well on strategies and institutions while lacking implementation. National averages can conceal regional and social gaps. Measurement should support diagnosis and learning rather than become a competition for rankings.

Foundation indicators include electricity reliability, broadband coverage and price, device access, cloud availability, research compute, cybersecurity, data quality, language resources, and skills. These indicators should be disaggregated by region, gender, income, age, disability, and firm size where possible.

Adoption indicators should distinguish experimentation from routine use. The number of firms reporting AI says little about depth. Surveys can examine which functions are affected, whether workflows changed,

which workers use tools, and what barriers remain. SME and public-sector adoption deserve separate analysis.

Productivity measurement should compare outcomes with credible baselines. Revenue or output may change for unrelated reasons. Pilot evaluation can use matched sites, phased rollout, or experimental designs. Qualitative evidence explains why results differ. Benefits should include quality, resilience, and innovation, not only labor savings.

Labor indicators include task change, employment, wages, hours, job quality, skill use, hiring, and distribution of gains. Exposure estimates are not forecasts. Actual adoption and organizational decisions determine effects. Monitoring should focus on vulnerable sectors and regions.

Inclusion indicators assess who has access, capability, and benefit. Registration or connectivity is insufficient if people cannot use services meaningfully. Accessibility, local language, affordability, complaint resolution, and human support are relevant. Distribution should be examined rather than summarized by averages.

Governance indicators include impact assessment, incident reporting, audit, data protection, procurement standards, competition enforcement, and remedy. The existence of a law does not demonstrate implementation. Budgets, staffing, case outcomes, and public trust provide stronger evidence.

Environmental indicators should include electricity, carbon, water, hardware life, electronic waste, and avoided impacts. Data-center growth should be integrated into energy planning. Application benefits should be assessed against the technology's life-cycle footprint.

International position can be measured through research collaboration, exports, patents, open-source contribution, local startups, value-chain roles, and dependency on providers. The goal is not maximum self-sufficiency but increasing capability and bargaining power.

A national dashboard should remain limited enough to guide decisions. Each indicator needs ownership, frequency, data quality, and a link to policy action. Independent statistical institutions can improve credibility. Public reporting enables debate and accountability.

27. Scenarios for Developing Countries

In a passive-consumption scenario, countries import models and cloud services while local firms remain users. Productivity improves in leading organizations, but value capture flows abroad. Skill and regional gaps widen. Government capacity remains dependent on vendors. This path is easy initially but creates long-term vulnerability.

In a protectionist-isolation scenario, governments restrict data and foreign technology without building credible alternatives. Costs rise, innovation slows, and domestic users receive inferior services. Sovereignty is asserted formally but capability remains weak. Selective security measures are necessary, but isolation is not a development strategy.

In an inclusive-adaptation scenario, countries invest in the four foundations, local language and sector adaptation, SME diffusion, skills, competition, and responsible governance. They participate globally while retaining bargaining power and exit options. Productivity gains spread more broadly, though implementation requires coordination and patience.

In a strategic-creation scenario, selected countries develop research and firms in niches aligned with existing capabilities. They may specialize in tropical agriculture, local languages, logistics, health, climate adaptation, mining technology, or public digital systems. Success depends on universities, patient capital, demand, and global networks.

These scenarios are not mutually exclusive. A country may consume frontier infrastructure, adapt applications broadly, and create in selected domains. The policy objective is a balanced portfolio that avoids both technological dependence and unrealistic ambition.

28. Differentiated Strategies Across Development Levels

Developing countries are not a homogeneous group. Low-income countries, commodity exporters, small island states, manufacturing economies, service exporters, and large middle-income markets face different constraints. A common framework is useful, but priorities should reflect fiscal space, population, economic structure, geography, institutions, and technological capability.

Low-income countries often receive the highest return from foundational investment. Reliable electricity, affordable connectivity, basic digital public infrastructure, education, and administrative data improve many sectors beyond AI. Ambitious frontier projects may absorb scarce resources while serving a narrow group. Lightweight applications in health, agriculture, translation, and government administration can create value when connected to human institutions.

Financing is a major constraint. Multilateral development banks and donors should treat digital foundations, cybersecurity, language resources, and regulatory capacity as development infrastructure. Funding should include maintenance and workforce costs. Projects should avoid tied procurement that creates dependency on one supplier. Regional facilities can share compute and expertise.

Small island and climate-vulnerable states may prioritize disaster forecasting, coastal monitoring, energy systems, tourism, remote services, and health access. Scale limits domestic infrastructure, making

regional and cloud partnerships important. Resilience and data continuity require diversified connectivity and secure backup.

Commodity-exporting economies can use AI for exploration, safety, processing, logistics, environmental monitoring, and revenue administration. The risk is that AI merely increases extraction without diversification or community benefit. Policy should connect technology investment to downstream capability, local suppliers, environmental enforcement, and transparent public revenue.

Labor-intensive manufacturing economies face pressure from automation and digitally coordinated supply chains. Their strategy should combine technology upgrading with workforce development and supplier support. Competing only through low wages becomes less sustainable. Quality, speed, customization, green production, logistics, and engineering capability offer stronger positions.

Countries specializing in business-process services must move from routine transactions to higher-value analysis, relationship management, implementation, and domain expertise. AI should be integrated into training and service design. Firms need trusted data governance and cybersecurity to serve global clients. Transition support is important for clerical workers.

Large middle-income economies have greater scope to develop domestic platforms, sector models, research computing, and venture ecosystems. They can use public procurement to create demand and standards. Their main risk is dualism: advanced urban firms adopt AI while SMEs, rural regions, and informal workers fall behind. Diffusion and competition should therefore accompany frontier investment.

Countries with strong universities but weak commercial ecosystems should improve technology transfer, research careers, startup finance, and public-sector demand. Academic excellence can be lost through migration when local opportunity is absent. Diaspora networks, joint laboratories, and regional markets can connect knowledge to application.

Institutional quality affects strategy. Countries with limited regulatory capacity should begin with clear, enforceable rules for high-risk sectors rather than comprehensive frameworks that exist only on paper. Procurement standards, data protection, and sector guidance may provide practical early safeguards. Capacity can grow through cases and evaluation.

Fiscal strategy should also differ. Wealthier middle-income countries can invest in research and public compute. Low-income countries may use pooled facilities and negotiated cloud access. Tax incentives should be limited where infrastructure, skills, or public services have higher returns. Every incentive should have a development rationale, measurable conditions, and an exit.

Despite differences, several principles are universal: build human capability; protect rights; preserve competition; demand interoperability; connect pilots to real institutions; share gains; and evaluate

outcomes. Differentiation is not an excuse for weak standards. It is a method for aligning ambition with capability while creating a path toward greater agency.

29. Implementation Roadmap

The first stage is national diagnosis. Governments assess electricity, connectivity, compute, data, skills, firm capability, research, regulation, competition, and sector opportunities. Diagnosis should identify regional and social disparities, not only national averages.

The second stage is prioritization. Leaders choose a limited number of missions with high development value and feasible data. Each mission has accountable ownership, stakeholder participation, safeguards, and measurable outcomes. Procurement supports interoperability and knowledge transfer.

The third stage is foundation investment. Broadband, electricity, shared computing, cybersecurity, language resources, and education receive coordinated support. Universities and technical institutes become hubs for regional diffusion. SME programs connect tools with process improvement.

The fourth stage is responsible experimentation. Sandboxes and pilots test technology and institutions under real conditions. Independent evaluation examines productivity, inclusion, rights, security, and environmental effects. Failure is documented so that learning becomes public capital.

The fifth stage is scale and integration. Successful systems are linked to budgets, workforce plans, standards, and public or commercial operating models. Old processes are retired where appropriate. Vendor dependency and continuity are managed.

The sixth stage is continuous governance. Strategies are reviewed as technology and evidence change. Incidents, labor outcomes, market concentration, and environmental costs are monitored. Parliament, regulators, audit institutions, civil society, and research bodies contribute oversight.

30. Conclusion

Artificial intelligence is reshaping the global economy through productivity, innovation, labor, trade, finance, and state capability. Its effects will be powerful but uneven. Developing countries face fewer immediate disruptions in some occupations, yet they may also receive smaller gains and experience competitive pressure before domestic capability matures.

Policy must therefore reject technological fatalism. AI outcomes are shaped by infrastructure, market institutions, education, labor relations, business strategy, regulation, and international rules.

Governments are not choosing between innovation and protection. They are choosing how to combine innovation with inclusion, resilience, rights, and long-term development.

The four foundations—connectivity, compute, context, and competency—are necessary but not sufficient. They require competition, data governance, industrial policy, fiscal capacity, social protection, democratic accountability, and environmental responsibility. Adoption should be broad, adaptation should be deep, and creation should be strategically selective.

For Indonesia and other developing economies, the most credible route is not to imitate every frontier project. It is to build capabilities that solve local problems, upgrade firms, strengthen workers, and increase bargaining power within global networks. Small and specialized AI can be as developmentally important as frontier models.

The future distribution of AI benefits will depend on institutional choice. Countries that invest early in people, public goods, local context, and accountable governance can convert AI into inclusive structural transformation. Those that remain passive may find that intelligence is abundant but economic agency is scarce. The central policy task is to ensure that AI expands national and human capability rather than deepening dependency.

Glossary

AI exposure.. The degree to which tasks within an occupation can be affected by AI through automation or augmentation.

Algorithmic management.. The use of data and algorithms to allocate, monitor, evaluate, schedule, or discipline work.

Artificial intelligence (AI).. Computational systems capable of prediction, classification, generation, perception, optimization, or decision support.

Compute.. The processing infrastructure required to train and operate AI, including chips, cloud services, data centers, and edge devices.

Connectivity.. Reliable and affordable access to electricity, telecommunications networks, internet service, and digital devices.

Context.. Local data, languages, laws, institutional knowledge, and sector conditions required to make AI relevant and reliable.

Competency.. The technical, managerial, professional, research, and regulatory skills needed to use and govern AI.

Data governance.. The rules, rights, roles, and controls governing data collection, access, protection, use, sharing, and retention.

Digital public infrastructure.. Shared digital foundations such as identity, payments, registries, and secure data exchange.

Edge computing.. Processing performed near the source or use of data rather than entirely in a remote cloud.

General-purpose technology.. A technology with broad application, continuing improvement, and capacity to stimulate complementary innovation.

Industrial policy.. Coordinated public action to develop productive capabilities, sectors, technologies, or structural transformation.

Interoperability.. The ability of different systems, organizations, or services to exchange and use information.

Model concentration.. The concentration of advanced AI development and control in a small number of firms or countries.

Productivity dividend.. The increase in output or value made possible by a technology after complementary investments and organizational change.

Responsible AI.. AI designed and governed to support fairness, accountability, transparency, privacy, safety, robustness, and human oversight.

Small AI.. Affordable, focused, and often lightweight AI designed for specific tasks and capable of operating on modest infrastructure.

Social protection.. Policies that protect people against unemployment, income loss, illness, old age, and economic transition.

Strategic autonomy.. The capacity to make, adapt, and sustain critical technology choices while participating in international networks.

Technology diffusion.. The spread and effective adoption of technology across firms, sectors, regions, and groups.

References

- Acemoglu, D., & Restrepo, P. (2018). Artificial intelligence, automation and work. In A. Agrawal, J. Gans, & A. Goldfarb (Eds.), *The economics of artificial intelligence: An agenda* (pp. 197–236). University of Chicago Press. <https://doi.org/10.7208/chicago/9780226613475.003.0008>
- Agrawal, A., Gans, J. S., & Goldfarb, A. (2019). Artificial intelligence: The ambiguous labor market impact of automating prediction. *Journal of Economic Perspectives*, 33(2), 31–50. <https://doi.org/10.1257/jep.33.2.31>
- Autor, D. H. (2015). Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives*, 29(3), 3–30. <https://doi.org/10.1257/jep.29.3.3>
- Bessen, J. E. (2019). AI and jobs: The role of demand. In A. Agrawal, J. Gans, & A. Goldfarb (Eds.), *The economics of artificial intelligence: An agenda* (pp. 291–307). University of Chicago Press. <https://doi.org/10.7208/chicago/9780226613475.003.0010>
- Brynjolfsson, E., Li, D., & Raymond, L. R. (2025). Generative AI at work. *The Quarterly Journal of Economics*, 140(2), 889–942. <https://doi.org/10.1093/qje/qjae044>
- Cockburn, I. M., Henderson, R., & Stern, S. (2019). The impact of artificial intelligence on innovation: An exploratory analysis. In A. Agrawal, J. Gans, & A. Goldfarb (Eds.), *The economics of artificial intelligence: An agenda* (pp. 115–146). University of Chicago Press. <https://doi.org/10.7208/chicago/9780226613475.003.0004>
- Furman, J., & Seamans, R. (2019). AI and the economy. *Innovation Policy and the Economy*, 19, 161–191. <https://doi.org/10.1086/699936>
- Georgieff, A., & Hyee, R. (2022). Artificial intelligence and employment: New cross-country evidence. *Frontiers in Artificial Intelligence*, 5, 832736. <https://doi.org/10.3389/frai.2022.832736>
- Gmyrek, P., Berg, J., & Bescond, D. (2023). Generative AI and jobs: A global analysis of potential effects on job quantity and quality. *ILO Working Paper*, 96. <https://doi.org/10.54394/FHEM8239>
- Korinek, A., & Stiglitz, J. E. (2021). Artificial intelligence, globalization, and strategies for economic development. In B. M. Fraumeni (Ed.), *Measuring economic growth and productivity* (pp. 53–70). Academic Press. <https://doi.org/10.1016/B978-0-12-817596-5.00004-2>
- Trajtenberg, M. (2019). AI as the next GPT: A political-economy perspective. In A. Agrawal, J. Gans, & A. Goldfarb (Eds.), *The economics of artificial intelligence: An agenda* (pp. 175–186). University of Chicago Press. <https://doi.org/10.7208/chicago/9780226613475.003.0006>

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118–144. <https://doi.org/10.1016/j.jsis.2019.01.003>

World Bank. (2025). *Digital progress and trends report 2025: Strengthening AI foundations*. World Bank. <https://doi.org/10.1596/978-1-4648-2201-8>