# Artificial Intelligence and International Development

## An Introduction

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*in partnership with*

***The AI & Development Working Group***

*of*

**The International Development Innovation Alliance (IDIA)**

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## About this document

This paper has been developed by Results for Development in partnership with members of the IDIA Working Group on Artificial Intelligence & Development. It is designed to provide an accessible and concise entry point for actors working in international development who are interested in how artificial intelligence (AI) technologies can / will impact their work. Drawing on a rapid (rather than exhaustive) review of current reports, blogs and commentaries on AI offered by experts around the world, this report explores the history of AI, its current complexity and capabilities, and examples of how it is currently being used within development to support the Sustainable Development Goals. We thank all those who have contributed to this document, especially member agencies of the IDIA Working Group on Artificial Intelligence who acted as Critical Reviewers throughout the process.

## About the AI & Development Working Group

The IDIA Working Group on Artificial Intelligence & Development was established in January 2019 with the objective of providing a forum through which IDIA members and other actors from the public, private and academic sectors could come together to learn and collaborate around the deployment of AI in development policy and programming. Technology is a both a source of innovation and a key enabler of the innovation process. For example, the rapid penetration of mobile phones globally has almost instantaneously created a platform for all kinds of mobile-based innovative products and services to reach scale. The new wave of emerging technologies (especially artificial intelligence) now offers a similar paradigm shift in how we design, implement and scale development innovation, but is not without its risks in terms of its potential to exacerbate, rather than reduce, socio-economic inequalities. To ensure an informed approach, the AI & Development Working Group is creating a range of introductory materials (including this document) examining the responsible use of AI in development, before moving towards potential collaboration in scaling (a) promising AI-enabled innovations targeting the Sustainable Development Goals, and (b) AI functionalities that might be transferred from the private sector into development innovations for accelerated / expanded impact.

## About the International Development Innovation Alliance (IDIA)

IDIA is a unique collaboration platform that brings together the senior leadership from the innovation teams, labs and departments of some of the world's leading development agencies. With the shared goal of "*actively promoting and advancing innovation as a means to help achieve sustainable development*", IDIA is committed to the development of new products, services and ways of working, and ensuring that the lessons arising from both success *and* failure can be disseminated to inform the more efficient adaptation and scaling of innovations within different countries, populations and contexts. For more, visit www.idiainnovation.org.

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# Artificial Intelligence and International Development

*"Emerging ML/AI applications promise to reshape healthcare, agriculture, and democracy in the developing world… At the same time, the very nature of these tools — their ability to codify and reproduce patterns they detect — introduces significant concerns alongside promise." (USAID)*

Artificial Intelligence (AI) is evolving rapidly and is making substantial impacts in homes, businesses and political processes worldwide. Despite emerging over half a century ago, the field of AI is still relatively new, especially as it relates to its application within international development. As the driving force behind the Fourth Industrial Revolution, it is bringing deep and far-reaching changes to the way in which people live, work and play. At the same time as advances in AI are generating positive outcomes at scale across sectors and geographies, it is vital to consider how to ensure the responsible deployment of AI. This is especially important in the context of the AI divide, in which the Global South is arguably more vulnerable to the risks and challenges inherent in the design, development and implementation of AI technologies.

This short paper has been designed to provide a high-level introduction to AI and its relevance to international development; highlight some practical examples of its application within development programming; and signpost the reader to further materials and more in-depth resources on AI in development.

## 1. What is Artificial Intelligence?

### 1.1 A brief history

Much common use of and political activity around AI has only emerged in the last few years, with Canada the first country in the world to announce a national strategy for AI in March 2017. But today's advances rest on almost 70 years of research and development. The timeline on the following page highlights some key moments in the evolution of AI throughout the 20th and 21st centuries, which help to contextualize what is happening in the field of AI today.

Of note is the fact that coordinated discussion and efforts around AI in international development only began in around the last five years, with a call for a data revolution at the United Nations' High-Level Panel on the Post-2015 Development Agenda, the creation of the World Economic Forum's Centre for the Fourth Industrial Revolution in 2016, and the inaugural AI for Good Global Summit in 2017.

There are of course many more milestones and examples of technologies developed since the early 20th century, and for those interested in exploring the theoretical foundations of the field in more depth, the history of AI can be traced back much further to its early origins in mathematics and mechanics in the 1300s.

## Milestones in the development of AI

**1950**

Computer scientist Alan Turing publishes a paper, Computing Machinery and Intelligence in which he discusses how to build intelligent machines and test their intelligence.

**1955**

Newell, Shaw, Herbert Simon create the Logic Theorist, a program designed to emulate human problem solving skills and considered by many to be the first AI program.

**1956**

A landmark conference for the Dartmouth Summer Research Project on Artificial Intelligence, is hosted by John McCarthy and Marvin Minsky. It catalyzes the next twenty years of AI research.

**1960s**

The development of AI accelerates as computers become more powerful and more accessible, and machine learning algorithms improve. A natural language processing chatbot named ELIZA is created at the MIT AI Laboratory in 1964 and in 1966 the Stanford Research Institute creates the first mobile robot, Shakey, that could process reasoning about its actions and surroundings.

***"In three to eight years we will have a machine with the general intelligence of an average human being."***
Marvin Minsky, 1970

**1970s**

A period of skepticism and impatience around the advances made so far sets in. The end goals of a machine that could exhibit intelligence, abstract thinking and self-recognition are hampered by a lack of computational power, and funding and research slow.

**1980s**

A boost in funding in AI sees a number of advances. Just a few examples include: Hopfield and Rumelhart popularize "deep learning" techniques which enable computers to learn using experience; Douglas Lenat's Cyc is developed to codify the knowledge that composes human common sense; and the Feigenbaum's expert systems, which mimic human decision-making processes to provide advice to non-experts, are introduced in various industries.

**1990s**

Many landmark goals are achieved. In 1995 advances in natural language processing are demonstrated through the chatbot ALICE which engages in conversation; in 1997, IBM's Deep Blue defeats the reigning world chess champion and grand master; and in 1998 Dr. Breazeal develops Kismet, a robot that recognizes and displays emotions.

***"Within thirty years, we will have the technological means to create superhuman intelligence. Shortly after, the human era will be ended."*** Vernor Vinge, 1993

**2000s**

The development of more sophisticated robots continues (such a driverless cars, industrial robots and drones) and AI capabilities are mainstreamed through applications such as Apple's Siri, Google's Assistant and Amazon's Alexa. The application of AI is gathering pace through the availability of big data which is used to shape industries such as telecoms, marketing and financial services. Specific attention is brought to AI in the sphere of international development, with a call for a "data revolution" at the United Nations' High-Level Panel on the Post-2015 Development Agenda, the creation of the World Economic Forum's Centre for the Fourth Industrial Revolution in 2016, and the inaugural 'AI for Good' Global Summit in 2017. ■

## 1.2 Defining Artificial Intelligence

Since the term 'artificial intelligence' first emerged in the 1956 Dartmouth College research proposal (which described *'the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it'*), definitions of AI have continued to surface, emphasizing various different aspects of the field (see IDRC's 2018 paper Artificial intelligence and human development: toward a research agenda for examples).

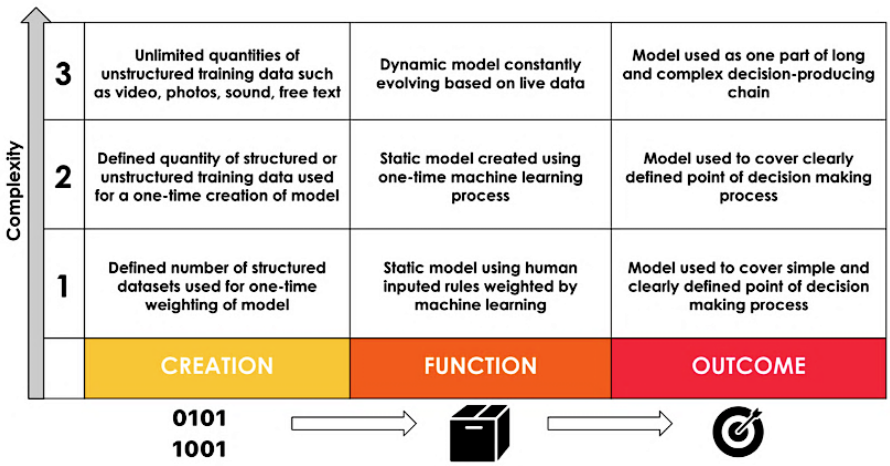
For the purposes of this paper, we use the definition proposed in the 2018 USAID report Making AI Work for International Development, which is a useful starting point for non-AI-experts in the development community:

> ***Artificial intelligence*** *uses computers for automated decision-making that is meant to mimic human-like intelligence. Automated decisions might be directly implemented (e.g. in robotics) or suggested to a human decision-maker (e.g. product recommendations in online shopping); the most important thing for our purpose is that some decision process is being automated. AI often incorporates machine learning (when using data-driven predictions to make better decisions) but doesn't have to. For shorthand, you can think of AI as "smart automation."*
>
> ***Machine learning*** *is a set of methods for getting computers to recognize patterns in data and use these patterns to make future predictions. For shorthand, you could think of machine learning as "data-driven predictions."*

But beyond the textbook definitions, descriptions of AI are numerous and diverse, reflecting the vast array of functions that AI is able to perform (e.g. data processor, decision-maker, navigator); the benefits AI may bring to an individual, a business or society; and/or the various goals which AI systems are built to accomplish, which range from simple systems that can replicate discrete human behaviors, to highly advanced systems that truly simulate human cognition (i.e. that think exactly like humans do).

## 1.3 Levels of complexity; how far advanced are we with AI?

The popular conception of the power of AI is typically far more advanced than is actually the case at present. It is therefore useful to understand how far along we have come in understanding and developing AI in terms of the complexity of things it is currently able to achieve. To do this, it is helpful to approach AI in terms of its three core elements: inputs, processes and outcomes. Each of these elements can involve varying levels of complexity. For example, at one end of the spectrum, an algorithm may apply strict rules and weightings to small, structured datasets in order to produce a discrete decision or action. At the other end, an algorithm may be built to process and re-process unlimited quantities of unstructured data, resulting in complex decisions and/or actions.



Different levels of complexity of AI: 1-3

While the speed at which AI research is developing makes it difficult to clearly delineate the boundaries of our achievements so far, a broad framework of 'low', 'medium' and 'high' levels of AI complexity - such as that published by Nesta (right) - is useful in helping to articulate progress made to date, categorize AI solutions that have been developed and articulate progress, and structure dialogue around broader governance and policy issues.

Others grappling with this issue use terms such as 'weak AI' (also referred to as 'narrow' or 'applied' AI) and 'strong AI' (also referred to as 'full AI' or 'artificial general intelligence') to describe low and high complexity AI respectively. Commentators suggest that the vast majority of AI applications that are in use today (including those typically deployed in the development sector) fall into the 'weak' category, while 'strong' AI that truly mimics human reasoning remains an unproven concept, with as yet no tangible examples of systems that have reached this level of sophistication. Increasing efforts to bridge these two extremes are observable in the emerging body of work on systems that use human reasoning as a framework, but which do not aim to perfectly replicate it. This would include deep learning (or artificial neural networks), in which algorithms inspired by the human brain perform tasks repeatedly in order to learn and continually improve outcomes. Finally, it is worth noting that many commentators identify an even more advanced level beyond 'strong AI', referred to as 'Artificial Super Intelligence' which describes capability that not only mimics human intelligence, but surpasses it. Whether and when we might reach this level of complexity remains unknown.

The implications of this are significant. As the complexity (and in some cases, opacity) of AI solutions develops, understanding their impact within the development field will similarly require new / more advanced methods for monitoring and evaluating, with an emphasis on identifying those who are benefitting and, crucially, those who are not. Attention should be paid to broader, secondary effects of introducing AI solutions into systems, which might include impacts on employment, human rights, inclusive growth, and many other areas. Developing monitoring and evaluation approaches that respond to the complexities of AI systems may involve, amongst other things:

i. Frameworks for assessing the quality of - and potential biases inherent in - the datasets used by AI systems, the performance of AI models, and the level of confidence in the results they generate;

ii. Robust approaches to interpreting data/analysis generated by AI and how to use it for decision-making, including understanding the potential cost of errors; and

iii. The use of mixed methods including qualitative, participatory approaches in order to validate / invalidate findings.

## 1.4 Current and emerging AI capabilities

The table below draws on publications by McKinsey and Deloitte to summarize some specific AI / machine learning capabilities, their level of maturity, and their limitations.

| | Current capabilities | Emerging capabilities | Cross-cutting limitations |
|---|---|---|---|
| **Computer vision** | • Identify and classify image and video data of people/faces, objects, and written characters<br>• *E.g. Analyzing medical scans for signs of disease* | • Accurately recognize emotions | • Reliance upon extremely large training data sets<br>• Need for substantial human input to label / categorize data before it can be used in a model<br>• Limited ability to transfer models / learning from one use case to another, or to multitask<br>• Inability to detect or mitigate against biased data<br>• Inability to explain outcomes / decisions |
| **Content generation** | • Create short-form text content<br>• Summarize longer documents<br>• *E.g. Creation of news articles, personalized emails* | • Generate video and audio content<br>• Generate long-form original / creative content | |
| **Natural language processing** | • Identify people/authors through text or speech<br>• Translate language<br>• Scan bodies of text (documents, websites) for certain information<br>• *E.g. Smart devices (Alexa, Siri, Google Assistant)* | • Analyze sentiments conveyed through text<br>• Understand abstract concepts<br>• Understand ambiguous language<br>• Sustain coherent dialogue | |
| **Robotics** | • Automatically perform physical functions<br>• *E.g. Drones collect images to map areas affected by natural disaster* | • Adapt to perform multiple different tasks | |

| | | | |
|---|---|---|---|
| **Expert (rules-based) systems** | • Capture and use expert knowledge to provide answers to problems<br>• *E.g. Provide treatment recommendations for patients* | • Adapt decision-making processes to new information and contexts | • Inability to make 'moral' or common-sense judgments |
| **Speech and audio processing** | • Verify individuals' voices<br>• Automatically convert speech to text<br>• Recognize sounds<br>• *E.g. Telephone assistance services* | • Recognize emotions<br>• Process different languages and accents with accuracy | |

While the above is not an exhaustive list, it nonetheless demonstrates the wide variety of functions that AI is able to perform, many of which are already being deployed in a development context (see Section 2.2 for examples). Key drivers behind the introduction of these technologies are often broadly described in terms of their ability to either **accelerate** processes through automation, and/or **augment** processes by providing deeper or more accurate information, or indeed drive efficiencies by enabling humans to dedicate more time to the interpersonal and creative aspects of work which – at least currently – cannot be fulfilled by AI.

### 1.5 How are governments responding?

It is only over the last 18-24 months that a number of national governments (predominantly from the Global North) have released AI strategies and/or committed funding for the development of AI. Several, including Australia, Canada and the United Kingdom, have announced significant financial commitments to advance their agendas in this rapidly emerging field. The strategies are varied in scope, with some governments focusing more on research and development, others on policy, legal and regulatory frameworks, some on digital infrastructure and others on education and skills. It is notable that only a few Global South countries have targeted AI agendas, with India and Kenya among the first to announce their plans to harness this technology. India has expressed particular focus on leveraging AI for social inclusion, with its 'AI for All' initiative.

At the international level, there is substantial activity around the topic. Examples include the European Union's AI Alliance; a Memorandum of Understanding between the UAE and India to establish a partnership on AI; and an international study group on inclusive and ethical AI led by Canada and France.

## 2. AI and the sustainable development agenda

### 2.1 Applications of AI across the Sustainable Development Goals

AI demonstrates significant potential to solve some of the most pressing issues facing society, by automating or augmenting human inputs in order to make processes more efficient or effective. The ability to collect and analyze vast amounts of data rapidly, and generate deeper insights to inform decision-making is already having a transformative effect on the development sector, with the significant advantage of shortening the feedback loop between monitoring and implementation to achieve better results. But, while the development and application of AI is gathering pace in the Global South, the field is currently dominated by a small number of countries and technology companies from the Global North. This creates risks around inequitable distribution of benefits, and perpetuating biases and social marginalization. A PwC analysis published in 2017 estimated that China and North America will benefit from 70% of the global economic gains generated through AI by 2030.

Recent research highlights a number of sectors in which technological innovations using AI are currently demonstrating great potential to achieve positive development outcomes. In healthcare AI is helping to generate surveillance and predictions based on population health data, and providing expertise to health workers and clinicians to diagnose and treat illnesses. In agriculture, AI is helping farmers to better understand critical conditions such as soil quality, climate and crop health in order to increase productivity and respond to risks that might compromise their harvests. In the education sector, AI is playing an important role in three key areas: learner-facing technologies (such as personalized

delivery models and adaptive learning platforms), teacher-facing technologies (including automated assessment tools) and sector-level analyses (for instance, using data from across schools to predict school inspection performance).

In addition, while government lags behind the private sector in terms of integrating emerging technologies, there is significant potential for AI to improve the way that public services are delivered, for instance through automating complex assessment/application procedures, personalizing services, and streamlining citizen engagement/response systems. Finally, many in the Global South are heavily reliant on the informal sector, which is expanding at pace and, given the low barriers to entry (in terms of capital and skills), driving inclusive economic growth in many countries. Digital platforms such as those for mobile money and e-commerce show great promise to boost efficiency and productivity in these informal markets, and indeed provide links with, or routes into, the formal sector.

Below are a few examples of specific AI applications currently being implemented to improve development outcomes:

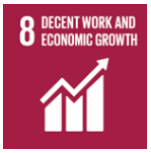

Kimetrica is using **facial recognition** technology to detect malnutrition in children aged 0-5 during humanitarian emergencies. An algorithm to analyze facial curvature and other non-traditional markers is able to estimate a child's body mass index, helping to identify those who need nutrition support much more rapidly than the traditional Mid-Upper Arm Circumference assessment method.


Babylon Health is pioneering AI to make healthcare universally accessible and affordable in Rwanda and the UK. It uses **Natural Language Processing** to transcribe consultations, summarize clinical records and chat with users in a 'human' way. **Machine learning** and **deep learning** techniques are also being used to interpret combinations of symptoms, diseases and risk factors.


Dost's program aims to encourage parents to promote children's cognitive development, socio-emotional skills, and school preparedness. Part of the Dost service includes a parent counseling hotline which uses an AI model to **transcribe and classify voice data** to understand parent requests in real time, **automate issue resolution**, and refer parents to counselors.


Springster has developed a **chatbot**, called Big Sis, to provide **expert advice** in response to girls' questions about sexual health. The platform, which operates through Facebook Messenger, provides opportunities for girls to access information confidentially, in contexts where it is often impossible to discuss sexual health and relationships due to social stigma and/or girls are given unhelpful or incorrect information.


Alto Analytics and the World Economic Forum used **AI-powered image recognition** on photographs of toilets all over the world to estimate the number of people globally impacted by unsafe sanitation conditions.




Tala has developed an innovative approach to credit scoring using **machine learning** on huge numbers of non-traditional data points from mobile devices in order to generate credit scores for the previously unbanked. Their smartphone app allows users to apply for loans and receive instant **decisions**, regardless of their financial history.


Livox is an alternative communication software that enables non-verbal people with disabilities to communicate and learn. **Machine learning** and **Natural Language Processing** enable users with disabilities to communicate up to 20 times faster, and the technology adapts to each user's individual abilities. It is currently implemented in Egypt, Jordan and Brazil.


The Radiant Earth Foundation provides users access to free **geospatial and machine learning tools** which simplify the discovery and use of **satellite, aerial and drone imagery** in order to guide climate-positive practices. For example, one application uses satellite imagery to map areas affected by deforestation and predict sites that are vulnerable to future deforestation.


WeRobotics specializes in building local capacity for using **AI-enabled aerial and underwater robotics**. Their EcoRobotics program supports local communities in a number of developing countries to generate better data in more effective and efficient ways to support with sustainable farming and fisheries practices.


BarefootLaw uses social media, websites and SMS to connect lawyers to individuals and small businesses seeking legal advice who are traditionally underserved. **Machine learning** is helping **identify trends** in legal needs (e.g. land conflict incidents increasing in specific areas or at particular times of year) and AI-enabled **response-automation systems** are being developed to provide quick answers to simple legal questions.


Organizations including GRID3 and Facebook are using satellite imagery and census data combined with machine learning to **map populations, settlements and infrastructure** with unprecedented accuracy. This technology could help improve development outcomes, with more granular information on population distribution enabling, for example, more targeted, efficient disaster response or vaccination distribution.

McKinsey's 2018 discussion paper Applying AI for Social Good mapped use cases for AI against the SDGs. The exercise indicated that certain SDGs appear much better served by emerging technologies than others. The SDGs which appeared to have most support included Good health and wellbeing; Peace, justice, and strong institutions; and Quality education. On the other side of the spectrum, very few of the use cases targeted Life below water; Affordable and clean energy; or Clean water and sanitation.

The examples above demonstrate the vast range of ways in which AI can be applied in development programming. Of course it is also vital to consider the depth of impact they could achieve, and this includes consideration of whether AI can provide the optimal solution to a given development challenge, weighing up the costs and benefits of AI-based options in comparison to more traditional approaches. There is also a risk of 'AI washing', whether claiming AI capability is being used or is core to an approach when it is not, or shoehorning more complex AI solutions into projects where simpler alternatives would suffice or indeed be more effective. This is already frequently observed in business contexts and will likely also affect the public sector as demand and funding for AI grow more rapidly than the capacity to supply AI solutions and fully understand their impacts.

It is also important to consider how certain sectors that are more resilient to the impacts of AI and automation present significant opportunities for inclusive growth. The Pathways for Prosperity Commission describes how, for instance, service sectors and certain roles within agriculture and manufacturing require skills such as empathy and judgment, which AI is not currently able to supply, and that the relatively low wage costs in developing countries mean that they are well-placed to export these labor-intensive services.

Having outlined above how a number of development programs are leveraging AI, it is also important to note that there are many opportunities for development agencies to streamline their internal operations using the same technologies. As just one example, UNDP developed a system to automate their Rapid Integrated Assessment (RIA), which is used to evaluate the extent to which national development priorities are aligned to the SDG targets. Typically, this would have involved manual review of thousands of pages of documentation over the course of several weeks. Instead, a system based on natural language processing was able to complete the process in a matter of days, including identifying alignment between national strategies and SDGs that were not picked up by experts in the manual review process.

## 2.4 Where to find more case studies and examples

- The IDIA AI Landscape Map contains a list of key global actors in AI for development, and examples of the application of AI in development innovation (both specific development initiatives using AI and AI solutions that could be leveraged on development programs to accelerate or increase their impact).
- The UN's International Telecommunication Union (ITU) launched a Global AI repository following the first AI for Good Global Summit. This database contains AI related projects, research initiatives, think-tanks and organizations that are using AI to accelerate progress towards the SDGs.
- The UN's Global Pulse Initiative works through a network of regional innovation labs and has developed more than 75 data innovation projects and tools for sustainable development.

## Resources

In addition to those linked directly in the text, the following resources were consulted in the development of this paper:


- Anyoha, R (2017) The History of Artificial Intelligence http://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/
- Cheney, C (2018) The promise and pitfalls of artificial intelligence for global development https://www.devex.com/news/the-promise-and-pitfalls-of-artificial-intelligence-for-global-development-91881
- Marr, B (2018) The Key Definitions Of Artificial Intelligence (AI) That Explain Its Importance https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/#6a9af0fa4f5d
- Pres, G (2016) A very short history of artificial intelligence (AI) https://www.forbes.com/sites/gilpress/2016/12/30/a-very-short-history-of-artificial-intelligence-ai/#4f4a8ef66fba