

# The Impact of Advances in Technology such as Data Sciences and Artificial Intelligence on Addressing Socio-Economic Issues: An In-Depth Study

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**Abstract:** *Research has indicated that there is a huge potential for AI technology to address various economic issues and improve the lives of marginalized members of society, for example, through provision of education that helps skilling them in the right sphere for future livelihoods and employability. Further, AI data indicates exactly where the lacuna is, creating an opportunity for the government to address specific issues that would further enhance the quality of lives of its citizens. But along with this, there exists the reality that the spread of this technology might lead to retrenchment. Care needs to be taken to address both these issues in an efficient manner.*

**Keywords:** AI technology, economic issues, marginalized communities, education and skills, employment challenges

## 1. Research Question

An attempt would be made to research the manner in which technology has advanced in analyzing statistical and other types of data to address various issues that face an economy. The type of issues would be dependent on whether the economy of the nation in question is developed or developing. The recent rise of artificial intelligence (AI) has impacted how these issues are addressed. To what extent will they be addressed for developing economies? As the socio-economic issues are different for both sets of economies, to what extent will the new advancement in technology help government policy address them.

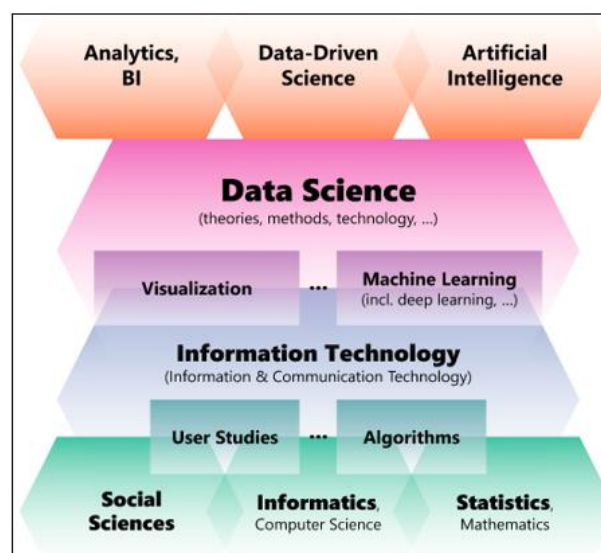
This research attempts to answer these and other such similar questions.

## 2. Introduction

Data science is compared to a new resource by various

leaders, authors, scientists, mathematicians etc. and very often it has been stated, "Data is the new oil," which signifies how valuable data is in this digital age. Unlike oil, however, data is everywhere and everyone is generating it without realizing it. This could be from smart watches, Google search, any and every click that generates data. Given the immense amount of data that is available, it is imperative that it is effectively utilized. The collection, utilization and productive usage of this is known as 'Data Science'. Scientists have the skill and knowledge to transform this massive amount of raw data into useful information and insights.

There is so much raw data that is available, but not all of it is useful for everyone. It is important that the data scientist is in a position to extract only that portion which he or she thinks is meaningful to their research. It is like discovering hidden treasures. A data scientist interprets the data and is in a position to extract meaningful information from it such that it is possible to make predictions about the future.



**Figure 1:** Diagrammatic representation of data science

Source: <https://www.uib.no/en/cedas/132628/research-data-science>

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The explosion of data sciences in recent years has led to it being utilized in every sphere of life:

- Solving business problems.
- Understanding and developing new products; companies use this field to gain a competitive advantage as they are in a position to understand their customers, introduce and refine products according to their requirements.
- Helping in better decision making.
- Automation of routine tasks so that employees focus on important critical thinking for their company; money can be saved by reducing costs and efficiently allocating resources.
- Streaming services like Netflix, Amazon Prime etc. that improves user engagement and retention.
- Discover new insights and opportunities.
- Growth of artificial intelligence.
- Used in healthcare industries along with AI to improve patient diagnosis.
- Identifying and mitigating risks to predict potential issues before their occurrences.
- Automation and streamlining of work flows helps businesses to increase productivity and efficiency.

The above indicates that data science is changing the world through the use of 'predictive analytics'. What this really means is that with the aid of all these tools, a large amount of data can be easily analyzed. This is an advantage for various sectors of the economy as organizations can gain valuable insights into future trends and thus make more informed decisions.

AI is considered as the fourth industrial revolution. The first being the replacement of animal power to the steam engine which started in Britain at the beginning of the 18th century. The second started with the expansion of electricity, steam industry and petroleum industry and other scientific achievements that led to mass production. The third, which was around the 1950s, began with the invention of computers and digital technology allowing the manufacturing sector to be automated. Various scholars such as Schwab (The Fourth Industrial Revolution. What it means and how to respond, 2016), Ooi et al (Cloud computing in manufacturing: The next industrial revolution in Malaysia, 2018) believed that the current revolution in AI is the fourth industrial revolution. The foundation of this revolution is defined by Schwab as:

“The blurring of boundaries between the physical, digital, and biological worlds. It is also viewed as the fusion of advances in AI, robotics, the Internet of Things (IOT), 3D printing, genetic engineering, and quantum computing. The fourth revolution is the collective force behind various products that are fast becoming indispensable to modern life through the application of AI and machine learning.”

### 3. Definition

It is necessary to understand what is involved and what are the areas in both AI and Data Science and how the two can be linked together to solve various socio-economic aspects.

### Data sciences

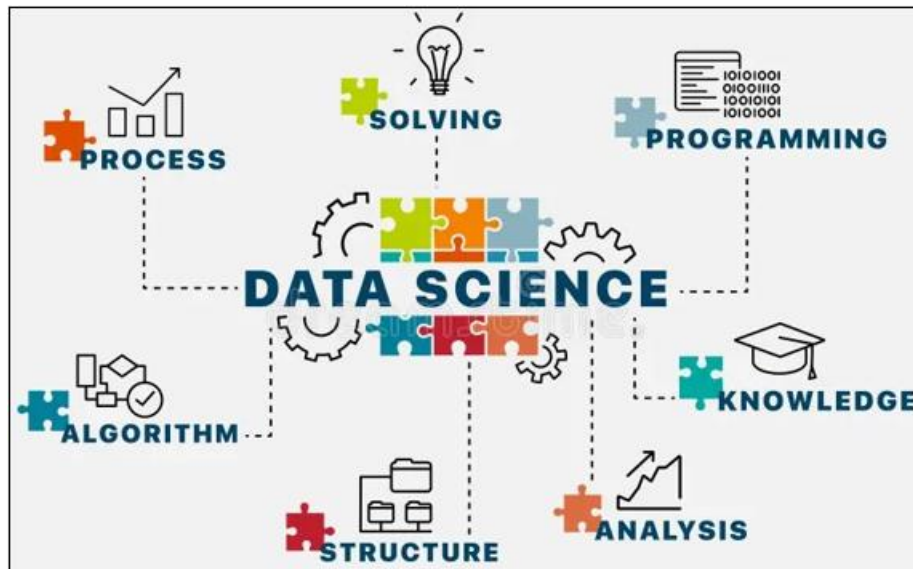
It is the advent of digitalisation of the world that has led to the expansion of data science. This area is precisely the study of data to extract meaningful insight for every sphere of life. It involves a knowledge of mathematics and statistics, specialized programming, advanced analytics, artificial intelligence (AI), and machine learning (ML), along with specific subject matter expertise. This is important to uncover certain 'actionable' insights hidden in the data. It is this insight that can be used to effectively guide decision making and strategic planning.

This is one of the fastest growing fields across all industries as all organizations whether in the private or in the government are increasingly relying on them to interpret data. The recommendations which arise from the data helps to improve business outcomes. A data science project undergoes the following stages:

- 1) Data ingestion; This is the first step which begins with data collection. All of the data that is collected is 'raw' data which could be structured or unstructured from all relevant sources using a variety of methods. These methods include:
  - Manual entry
  - Web scraping
  - Real time streaming data from systems and devices

Structured data is generally dealing with customer data; this, along with unstructured data like log files, video, audio, pictures, Internet of Things (IoT), and social media.

- 2) Data storage and data processing; As data have different formats and structures, all organizations need to consider different storage systems based on the type of data that needs to be captured. It is here that analytics, machine learning and deep learning models are used. It also includes:
  - cleaning data
  - Deduplicating
  - Transforming and combining data which used ETL (Extract, Transform, Load) Data preparation is important to promote data quality before it is loaded into a data warehouse, data lake or other repository.
- 3) Data analysis; it is here that data scientists conduct an exploratory search of the data to examine biases, patterns, ranges, and distribution of values within the data. This involves exploration for hypothesis generation and allows analysts to determine the relevance of the data within various models. The models that are used are for prediction and they use machine learning and or deep learning techniques. Depending on the model's accuracy the organization becomes dependent or reliant on these insights for business decision making that is helpful in driving scalability of their operation.
- 4) Communicate; insights are presented as reports and other data visualizations to chart out the path of their impact on business. It is presented in a way that makes it easier for business analysts and other decision makers to understand. Some examples of data program languages are R and Python.



**Figure 2:** Understanding of data science

Source: <https://iabac.org/blog/what-is-data-science>

### 1.1 Artificial intelligence

AI refers to computer systems that are capable of performing complex tasks that historically only a human could do, e. g., reasoning, making decisions and solving problems. AI describes and powers many of the services and goods that we use today. This is the theory and the development of computer systems to perform tasks that historically were only done by human intelligences such as recognizing speech making decisions and identifying patterns. This word encompasses machine learning, deep learning and natural language processing. In spite of questions whether “true” intelligent machines exist, there has been a wide range of machine learning power technology. This has been effectively used in various tasks, ranging from generating written content, to steering a car, or analyzing data.

Examples of AI are humanoid robots, which are associated with *Star Trek: The Next Generation* and *Terminators T800*, but these in reality do not exist as yet. At the simplest level, machine learning uses algorithms trained on data sets to create machine learning models that allow computer systems to perform tasks like making song recommendations, identifying the fastest way to travel to a destination, or translating text from one language to another.

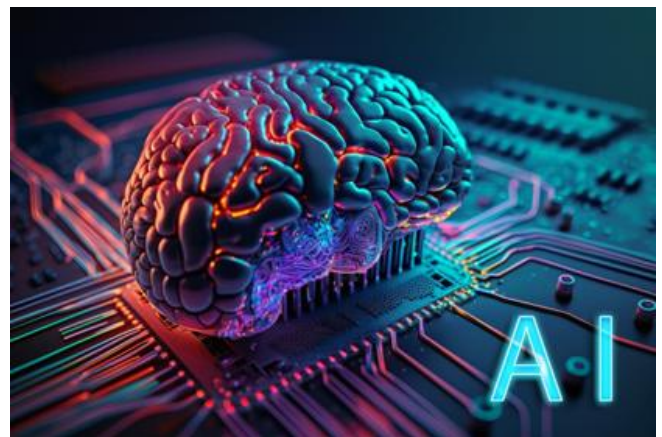
**Netflix**, for e. g., uses machine learning algorithms to create personalized recommendations based on the person's previous viewing history

**Tesla** uses computer vision to power self driving features on their cars

**Google translate** uses deep learning algorithms to translate text from one language to another AI in the **finance industry** is used to detect frauds. It is also capable of analyzing large amounts of data.

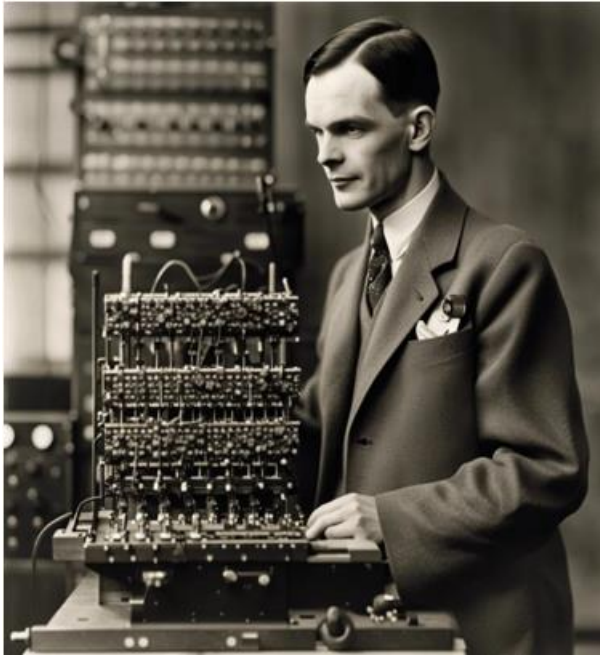
In the **healthcare industry**, robotics that are powered by AI support surgeries that are close to delicate organs or tissues to reduce blood loss and risk of infection

For the precise meaning of AI, the most famous approach that is used is the *Turing Test*, which is also known as the Imitation Game. It was an experiment that was first outlined by an influential mathematician, computer scientist and cryptanalyst Alan Turing in 1950. He described a three player game in which a human interrogator is asked to communicate via text with another human and a machine and then judge who composed the response. If the interrogator could not reliably identify whether the response was from the human or the machine then the machine was stated to be intelligent.



**Figure 3:** Image of AI

Source: <https://incubator.ucf.edu/what-is-artificial-intelligence>



**Figure 4:** Image of Alan Turing

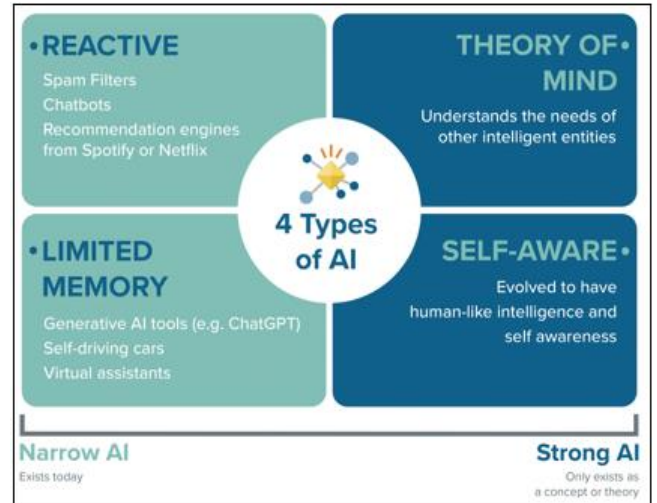
Source: <https://creator.nightcafe.studio/creation/gIRWzipNXmf9E4YYUptQ>

There are different types of AI:

**Strong AI** - This is capable of human level general intelligence

**Weak AI** - refers to the narrow use of widely available AI technology like machine learning or deep learning to perform very specific tasks like playing chess, recommending songs or even steering cars. This is the type of AI that is used daily. Researchers have outlined 4 types of AI:

- 1) Reactive machine: these are the most basic type of AI. They do not possess any knowledge of previous events but 'react' to what is before them in a given moment. Due to this, they can only perform certain advanced tasks within a very narrow scope like playing chess and they are incapable of performing tasks outside the limited context.
- 2) Limited memory machines: Machines with limited memory possess a limited understanding of past events. They interact more with the world around them than the reactive machines can. A real life example is that self-driving cars use a form of limited memory to make turns, observe approaching vehicles and adjust their speeds. These machines with limited memory cannot form a complete understanding of the world because their recall of past events is limited and only used in a narrow band of time.
- 3) Theory of mind machines: these machines possess a 'mind'. This is an early form of artificial general intelligence. Not only are they able to create representations of the world; they also have an understanding of other entities that exist in the world.
- 4) Self aware machines; These are the most advanced types of AI that possess an understanding of the world, others and itself. Presently this is a far-off reality.



**Figure 5:** Different types of AI

Source: <https://www.litmus.com/blog/the-4-types-of-ai>

The early stages of AI were used in carrying out complex tasks such as discovering proofs for mathematical theorems, playing chess, etc. but none of these matched full human flexibility. The recent use of AI has been found in applications such as medical diagnosis, computer search engines, voice and handwriting recognition and chat bots. It is the effective use of inferences that has to be performed by AIs. Deductive reasoning is common in mathematics and logics but drawing inferences relative to the solution is the hardest problem confronting AI.

Applied AI or cognitive simulation, this is a part of strong AI that aims to build machines that think. *The ultimate ambition is to produce a machine whose overall intellectual ability is indistinguishable from that of a human being*

### 3. AI and Socio- Economic Issues in Developed Countries

AI has significant potential to boost economic growth and productivity, but at the same time it could create serious risks of job market polarization, rising inequality, and structural unemployment. With the spread of AI it is possible that capable humans will see a drastic change in their socio economic status. There would be a redistribution of wealth towards that segment of society who owns these models and are in a position to control large positions of the economy.

There could be 2 possible futures of this growth:

- 1) Allow corporate artificial intelligence research to continue in an unbridled fashion.
- 2) Enact strong government regulations immediately in an attempt to control the upcoming destruction.

If there is an unbridled free market growth of this sector without any regulations, it would automatically be the dominant choice for any knowledge based industry as it would increase its profitability. The expense is only in building the model thereafter it becomes:

- Less expensive to implement
- Better than human intelligence

- Capable of running 24/7 while humans still need to eat, sleep and need time for leisure activities

The most likely scenario is that every knowledge-based company including software development firms, creative agencies, publishing houses and media conglomerates will shift to producing most of their output with the help of AI. The ratio of AI work to human work will increase steadily and market-based economists will lead to a gradual reduction in the employment of the lower level human employees. At the same time, workers who are in the higher executive positions and have keen decision-making skills that integrate multiple diverse knowledge fields would be an extremely essential part of management and would earn a higher and higher salary.

In developed economies it is likely in the next 2 decades that a large number of white collared employees who were in high esteem due to their intelligence and technological acumen may be out of work and forced to look for those jobs that have yet to be automated.

The growing number of “unskilled” (with respect to the spread of AI technology) will lead to lower compensation increasing the wealth divide.

The socio economic impact would be:

- Unrest
- Pressurizing world governments to regulate the use of AI as unemployment increases
- Democratic economies would look for ‘quick fixes,’ and elections of strong armed populist leaders will result
- Strong lobbying by artificial intelligence companies and trade off with respect to extreme anti rich sentiment will eventually force the government's hand.

In advanced economies, the negative impact would definitely be on loss of jobs and increasing inequality.

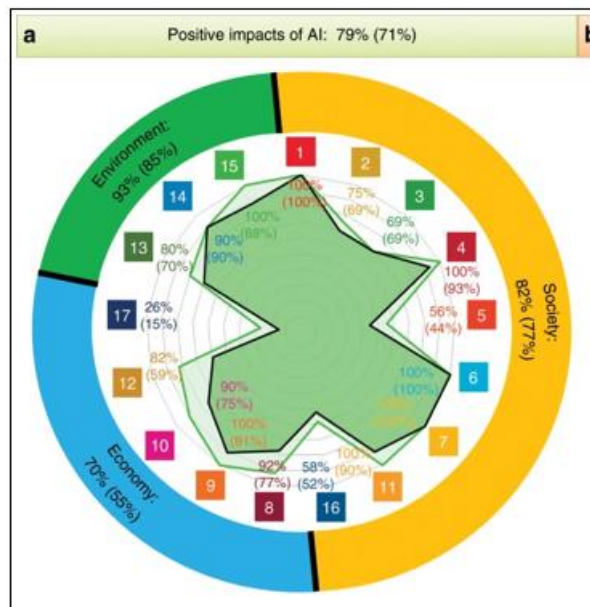


Figure 7: Positive impacts of AI on society  
Source: <https://www.nature.com/articles/s>

The most important positive aspect of AI technology will be the higher worker productivity that results. Besides this, the major thrust is towards health diagnosis, new forms of drug discovery and better decision making. The areas that have the maximum impact at the moment are in health care, business and daily interaction. The technology's ability to analyze data, recognise patterns and make independent decisions has and will continue to reshape society.

#### 4. AI and Socio- Economic Issues in Developing Countries

The use of AI technology has indicated results that will be effective towards achieving sustainable development goals, especially poverty reduction in emerging economies. Besides this, AI technology would lead to an increasing improvement in the certainty and reliability of infrastructure which increases the growth prospects of emerging economies.

AI revolutionizes the collection of poverty related data, helping the government in provision of concentrated poverty reduction projects. Besides this, there would be an advantageous impact on agricultural education as well as financial inclusion. All the above encompass the underprivileged sections of the economy. Improvement in this sphere would have a direct bearing on the growth of GDP of the economy.

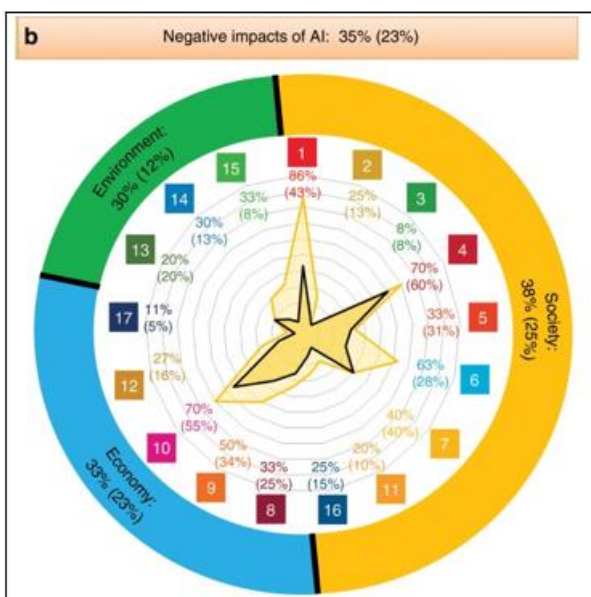


Figure 6: Negative impacts of AI on society  
Source: <https://www.nature.com/articles/s>

The above figure clearly indicates that the major negative impact of the spread of AI technology will be on society. The other negative factors that need to be considered are the economy and environment.



Figure 8: Impact of AI on an economy

Source: <https://aiworldschool.com/research/will-ai-for-economic-growth-ever-rule-the-world/>

**The impact of AI on employment in developing countries**

Generative AI has the potential to revolutionize employment opportunities by addressing language barriers, improving digital literacy, automating tasks and providing cost effective skill development. If some of the above may increase employment there are some which will have a negative impact on employment opportunities. For developing economies, workers that are involved in clerical tasks like data entry, technical support, customer service, etc, which are extremely important positions in the online space, are likely to be replaced by generative AI. In fact, this branch also has the potential to reduce the demand for certain skilled jobs as technology advances.

AI could hinder employment opportunities in developing countries in the following ways:

- AI replacing clerical tasks

- AI reducing demand for jobs requiring human expertise
- AI reduces employment opportunities. But, an AI driven economy can:
  - Reduce poverty
  - Enhance infrastructure
  - Promote economic stability
  - Facilitate international trade
  - Exchange knowledge
  - Promote economic diversity

Developing countries have the potential to become global leaders and experience rapid growth through the development in adoption of AI technology. This requires the establishment of proper infrastructure, investment in resources, education, and implementation of the appropriate policy framework.

By retaining and utilizing information provided by users, AI can assist in various tasks within higher education such as writing, communication, curriculum, and administrative duties; thus, creating significant opportunities in higher education in developing countries by improving writing performances. It also helps in improving research capabilities as well as expediting the research process by sourcing and organizing data. Especially for those students who have limited access to physical libraries and resources, this is an important aspect for the underprivileged rural students in developing economies.

**AI and environmental issues**

AI can also provide solutions for climate change by predicting weather patterns and natural disasters, thus enabling the economies to be better equipped and prepared to deal with the disaster. This technology also has a significant role in helping industries and individuals reduce their carbon footprint and save the environment.

There have been studies to discuss implications on how AI can impact SDGs.



Figure 9: UN SDG goals

Source: [https://commons.wikimedia.org/wiki/File:Sustainable\\_Development\\_Goals.svg](https://commons.wikimedia.org/wiki/File:Sustainable_Development_Goals.svg)

AI can enable smart and low carbon cities encompassing a range of interconnected technology such as electric autonomous vehicles and smart appliances that can enable demand response in the electricity sector. This technology can also integrate variable renewables by enabling smart

grids to absorb maximum when the sun is shining and wind is blowing through solar and wind energy.

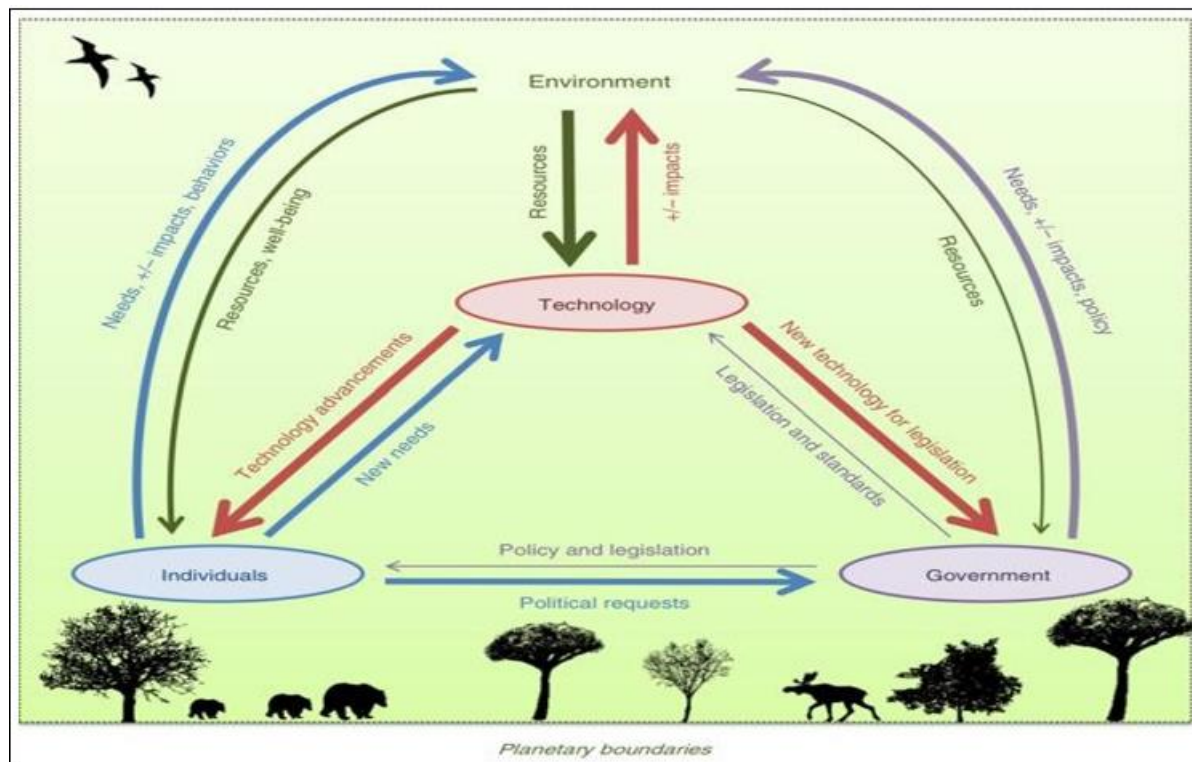
The negative factor of using advanced AI is the high energy requirement and carbon footprint that these facilities utilize.

To circumvent this, it is required that human knowledge and the human brain should be used to train AI models as the consumption of energy by the human brain is minimal.

The other problem that emerges is the access to this technology by the wealthy. For example, AI enhanced agricultural equipment may not be accessible to small

farmers and could result in an increased gap with larger producers both with respect to developing economies and developed economies.

## 5. Interaction of AI and Society



**Figure 10:** AI and society

Source: nature communications| <https://doi.org>

The thick arrows indicate how faster change technology affects individuals through technical developments, which change the way people work and interact with each other and the environment. Individuals would also interact with technology to satisfy new needs. Technology affects the government through new developments that need piloting and testing. Government, in turn, provides the legislature and standard of technology. Environment interacts with technology by providing resources needed for technological development and is affected by the environmental impact of technology. In conclusion, the environment is affected either negatively or positively by the need, impact and choices of both individuals and government, which in turn require environmental resources. Thus, the environment is also an underlying layer that sets the boundaries under which technology can work effectively and efficiently.

## 6. Conclusion and the Way Ahead

As discussed in this paper, there is a huge give and take with respect to AI technology in addressing issues and providing solutions in the socio economic and environmental spheres in developed and developing economies. There are innumerable advantages involved in the adoption of AI. It has been proclaimed to be the fourth industrial revolution, and no country can afford to be left behind in this race in increasing their GDP and other developmental goals. But in

this bargain there are disadvantages that need to be addressed with respect to increasing inequalities, reduction in jobs, and cost benefit analysis that this has on the environment. For this, governments must be vigilant and adopt this technology in the most effective and efficient manner, realizing the extent of trade off that would be required. To reduce the disadvantages and maximize the advantages, appropriate legislation would be required by the government.

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