

# **National Strategy for Artificial Intelligence Bangladesh**



**Information and Communication Technology Division  
Government of the People's Republic of Bangladesh**

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## EXECUTIVE SUMMARY

Artificial intelligence alludes to the capacity of machines to perform psychological errands like reasoning, seeing, learning, critical thinking and basic leadership. At first, considered as an innovation that could imitate human insight, AI has developed in manners that far surpass its unique origination. With extraordinary advances made in information accumulation, handling, and calculation control, astute frameworks would now be able to be conveyed to assume control over an assortment of assignments, empower network and improve profitability. As AI's capacities have significantly extended, so have its utility in a developing number of fields.

Bangladesh is embracing Artificial Intelligence (AI) for the digitalization of the nation. The digitization process started a decade earlier. Now AI would work as an accelerator. Our Honorable Prime Minister Sheikh Hasina declared, "Five G (5G) will be on run within 2023. Future technologies like artificial intelligence, robotics, big data, blockchain, and IoT will be widespread." This is the seed for this AI strategy paper. This is the inspiration for the coming years. Technology is a necessity. The future depends on it. Future technology is a promise. Bangladesh is committed to walking through the path. Our slogan to address AI is "AI for Innovative Bangladesh".

In this paper, there is a concise discussion of the present technological circumstance of Bangladesh. Aiming to transform Bangladesh with vision 2021 into a technologically-advanced nation by the following decade and leverage ICT as a tool for sustainable development. The ICT export earning of Bangladesh was a mere \$26m in 2008 which has now reached about \$1 billion. Bangladesh hugely invested nationwide infrastructure including 16 Hi-Tech Park, 7 (Seven) Technology Park, 12 IT Training & Incubation Center, and Tier-IV Data Center. By the launching of Bangabandhu-1, which is countries' first satellite, the country has entered into the space arena in 2018.

Artificial Intelligence has a great impact on the economy as well as it offers substantial benefits. This is the time to invest strategically in different types of AI applications for the countries. If repetitive tasks and the role of human will be automated, this will increase GDP gain and improve labor productivity. As per Accenture research in 12 developed economies countries, AI has the power to double annual economic growth rates in 2035 changing the nature of work and creating a new relationship between man and machine. Labor productivity can be increased by up to 40 percent by enabling people to make efficient use of their time. PWC said that 45% of total economic gains by 2030 will come from stirring customer demand and product modification.

With more than 163 million of the population in 1, 47,570 km<sup>2</sup> area has more than 40 million students, Bangladesh is facing significant challenges with employment issues. The fear factor for AI is losing job opportunities. AI will replace human skills. As a result, heavily populated countries with mostly low-level skills like us might find it difficult to survive. According to the world economic forum, AI and Robots would create many jobs than they displace. Because of AI

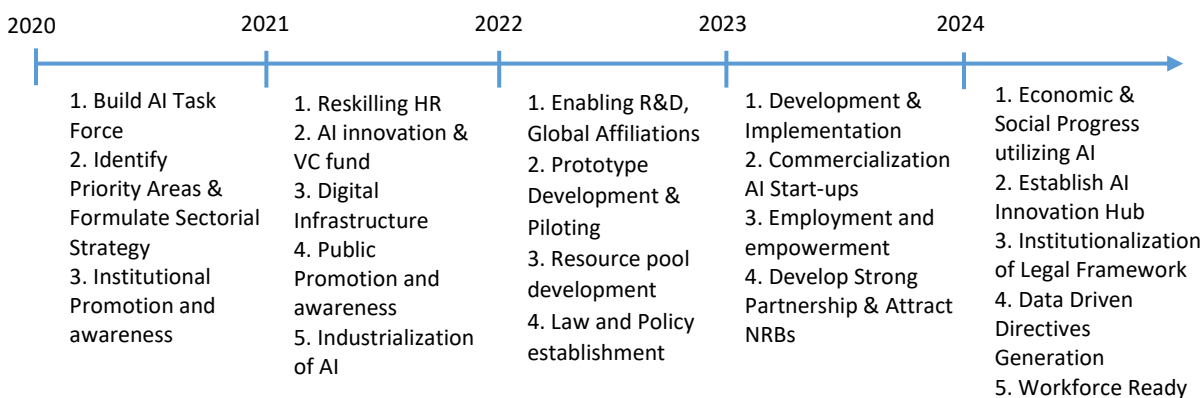
and related technologies, economic growth will boost up than ever before and create many additional job opportunities. The fourth Industrial Revolution is expected to create 133 million new roles. 75 million jobs are supposed to be displaced by 2022. If we can reskill our population in the right direction, we can join the new era of the fourth industrial revolution successfully. We need to engage higher academic graduates to innovate next-generation capital machinery and change Bangladesh's labor-intensive manufacturing strategy to knowledge-intensive ecosystems.

Bangladesh integrated the 2030 Agenda in its seventh Fiscal Year Plan (2016-2020). This is a good opportunity to execute the 2030 agenda while mirroring the needs of the SDGs in the national plan. Getting to the next level will require some decisive action by the Bangladesh government, NGOs, philanthropists, tech companies, and organizations that collect or generate a significant amount of data. Two major problems that will be needed to be solved: accessibility of data and shortage of talent who can improve AI capabilities, improve models, and implement solutions. AI can play crucial roles to address SDGs' challenges. McKinsey Global Institute has identified about 160 cases of SDGs where AI can be instrumental to solve problems. Bangladesh is committed to solving the most pressing problem of SDGs with emerging Artificial Intelligence.

To comprehend the forthcoming difficulties of artificial intelligence it is essential to have an ideal procedure for applying AI in different sectors. We have set 7 national priority sectors. They are - public service delivery, manufacturing, agriculture, smart mobility and transportation, skill & education, finance & trade, and health. For each of the sectors, we have identified scopes and recommended actions to be taken. Summing up all the recommendations of different sectors and challenges we have identified 6 strategic pillars for AI, Bangladesh and come up with development roadmap for the pillars to establish a sustainable AI Ecosystem in the country.

Six strategic pillars of AI, Bangladesh consists of i) research and development, ii) skilling and reskilling of AI workforce, iii) data and digital infrastructure, iv) ethics, data privacy, security & regulations, v) funding and accelerating AI start-ups, and vi) industrialization for AI technologies. In each of the strategies, other than a strategic brief, we have included a road map, action plan, related stakeholders and lead ministries.

By accumulating all the strategy brief and action plans, we have developed a summary roadmap. In that summary roadmap, anyone can see the broader strategy steps planned for Bangladesh in the next five years. While creating the road map, we have considered our current readiness in terms of infrastructure, awareness, resource pool, social and legal challenges and other pertinent issues. The summary road map is given on the next page.



It is a common phenomenon that many types of challenges have to be faced for starting a new technology. In the challenges section, there is a deep portfolio analysis of the possible challenges for applying artificial intelligence in different vital sectors of Bangladesh. Role of data, technology & infrastructure, Skilled AI resources, connectivity, economic impacts: inequality & technological unemployment, AI safety and fairness, ethics & human rights are the key challenges among all of them.

We need to elevate the numerous approaches to utilize AI in all stages of society to accomplish substantial advancement in society. This strategy expands on areas where no or little use of AI has been made to the potential. Up to and including vision 2021, the ruling government intends to make essential strides for the implementation of the national strategy. It is certain that AI will impact the political plan and that it will transform some debates as it is directly linked with employment. We will concentrate on the structure of national AI ecosystems, information frameworks, and AI applications. If we can ensure good governance in AI strategy implementation from the very beginning, we can make Bangladesh truly innovative land through AI.

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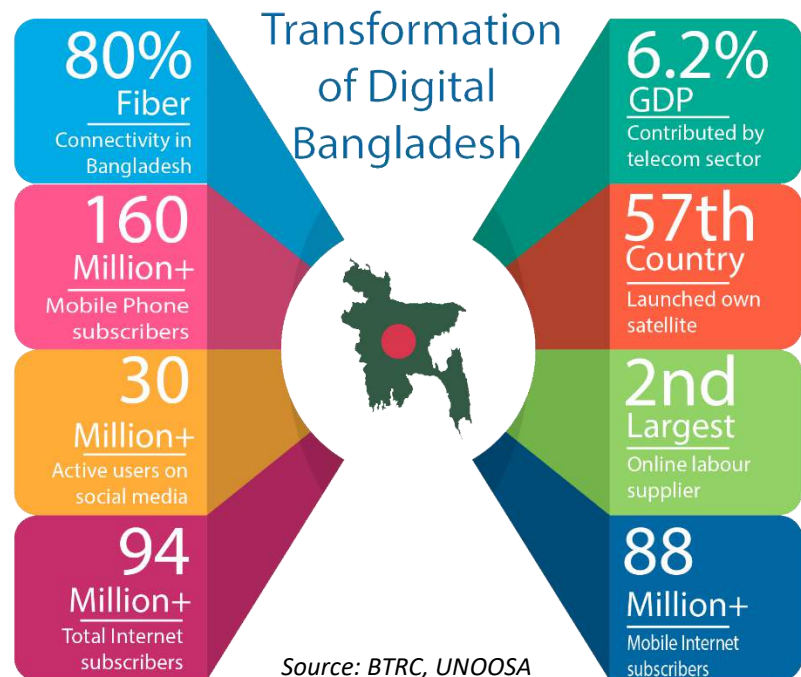
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## CHAPTER 1: DIGITAL BANGLADESH AND ARTIFICIAL INTELLIGENCE

### 1.1 INTRODUCTION

Bangladesh is a South Asian country, with more than 163 million people focused on making a successful footprint in the world as one of the outstanding performers in IT and ITES. We believe that this focus will make Bangladesh one of the world's developing countries into a digitally-developed nation by 2021, which was one of the fundamental constituent vows of the current ruling government. With the vision, titled as "Digital Bangladesh," the little South Asian country, Bangladesh has been recommended by JP Morgan, Goldman Sachs, and Gartner as an extraordinary example for its future in IT and ITES enabled administration industry. Digital Bangladesh illustrates the latest idea of the forceful and valuable application of technology in terms of invoking the



commitments in education, training, health, transportation, poverty reduction, literacy, electricity, wireless, internet coverage, social media services, e-Services, access point, policy making, agriculture, and job placement.

Digital Bangladesh implies a digitally developed society which ensures an ICT driven knowledge-based society where every people get the easy access to information & services online which will be promptly accessible on the web and mobile and where every imaginable undertaking of the administration, semi-government and furthermore private sector will be prepared to utilize the latest cutting-edge innovation. Bangladesh government has intended to leverage Artificial Intelligence for an innovative Bangladesh.

## 1.2 DIGITAL BANGLADESH OVERVIEW

Aiming to transform Bangladesh with vision 2021 into a technologically-advanced nation by the following decade and leverage ICT as a tool for sustainable development, Bangladesh is driven by far-reaching digitization in public and private sectors. To decentralize the delivery of public services and take them to the door steps of millions of underserved citizens, the government has established a countrywide vast network of one-stop information and service delivery access points known as **Union Digital Centers(UDCs)**. There are currently 5838 digital centers in the country have already served 422 millions of services to the citizens.

Country's WSIS award winning **National Portal** is serving 46K+ govt. offices from ministry to root level. The portal contains about 5+ millions of contents from different government offices at different level and about 60+ millions of citizens availing information and services per month from the portal. This portal is playing a vital role to transform Digital Bangladesh into next level. To decrease dependency on paper, 5000 offices from ministry to sub-district level using e-filling, serving purpose as Paperless Offices Solutions.

**EkSheba Citizen**, an online integrated platform which is connecting all govt. services so that citizen can avail all services of Government of Bangladesh at a one stop access point using their single identity. The govt. has taken initiatives to analyze and identify all the services delivering from different govt. offices and has identified 2800+ govt. services. **EkSheba Sorkar**, another integrated platform connecting all govt. service delivery systems. Govt. officials can access all the govt. systems in the platform using single identify and process services for the citizens of Bangladesh.

The development of internet availability, cell phone usage, IT export income, and utilization of ICT in training and openness of administrations, turned Bangladesh as an emerging country for ICT outsourcing. The total ICT market size in Bangladesh was a mere \$26m in 2008 which has

### ICT Education

**75,000**

ICT professionals being trained by Government

**170,000**

educational institutions to have multimedia labs

**24,122**

teachers being trained on ICT equipment

### ICT Export Earnings



**\$300**  
Million  
in 2016

### ICT Sector Earnings

**\$600**  
Million

**\$26**  
Million  
2008

2015



**Budgetary  
Allocation for ICT**

2016 **\$205.4**  
Million

2008 **\$25.6**  
Million

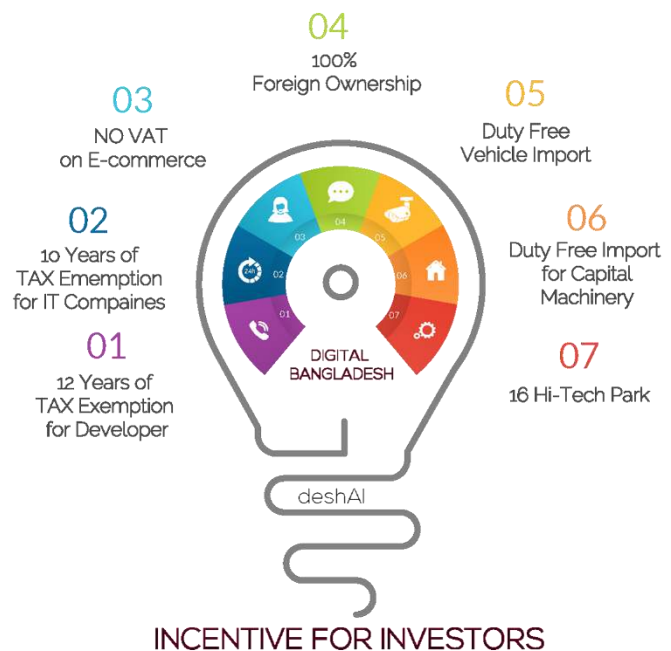
now reached about \$1 billion. Bangladesh hugely invested nationwide infrastructure including 16 Hi-Tech Park, 7 Technology Park, 12 IT Training & Incubation Center, and Tier-IV Data Center. By the launching of Bangabandhu-1, which is countries' first satellite, the country has entered into the space arena in 2018. The government has

taken steps to launch 5G in the country by 2023 to offer faster speeds and more reliable connections.



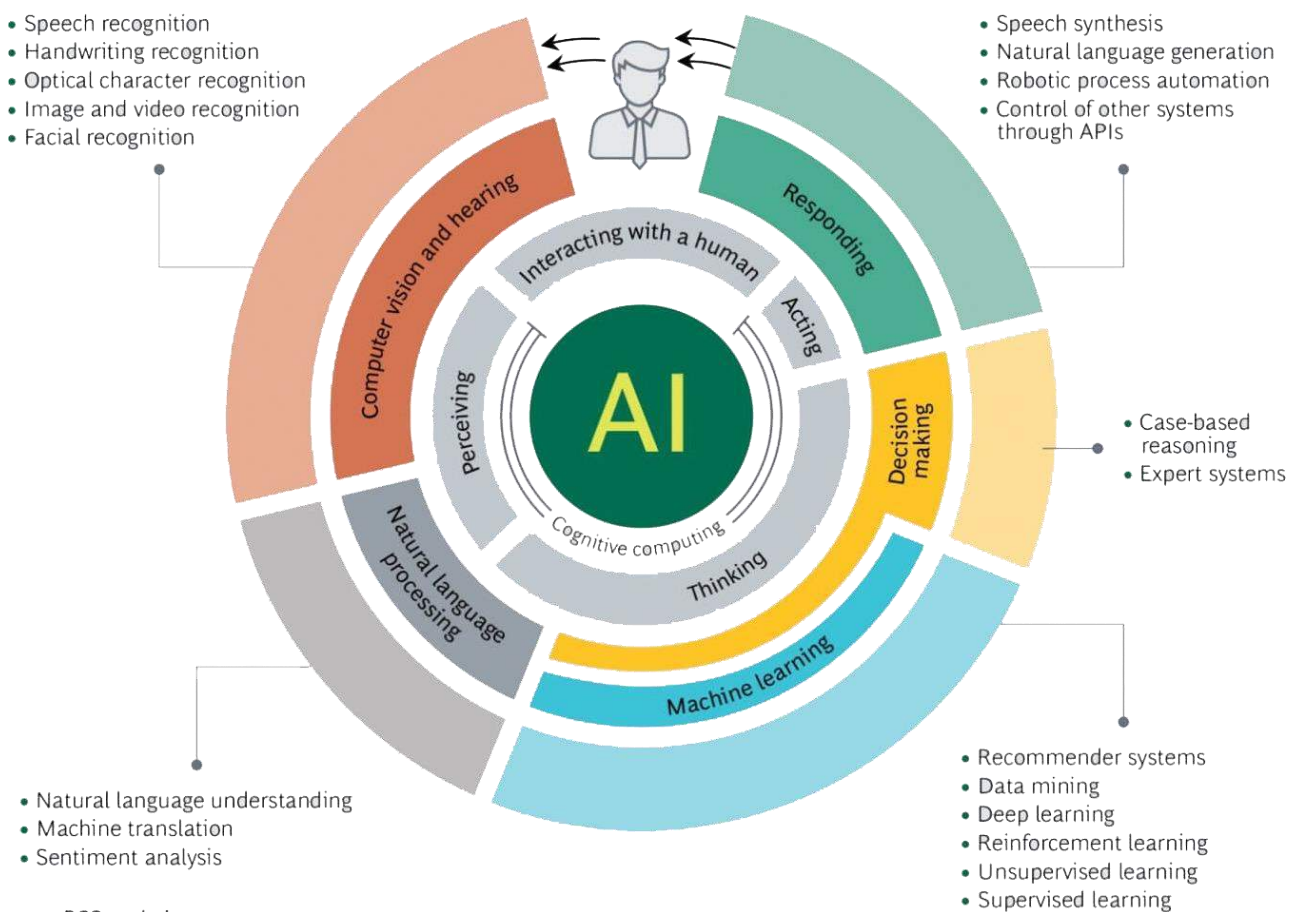
The objective & policy of Digital Bangladesh is to create ICT frameworks, foundation and human resources for fortifying the vital developmental sectors to have a direct constructive outcome on the key of social and economic indicators.

Digital Bangladesh has provided significant number of incentives for investors i.e. 12 Years of TAX exemption for the developers, 10 years for IT Companies, No VAT on E-commerce business, 100% foreign ownership, importing duty free capital machinery and vehicle and access to all 16 Hi-tech Park in any geo-location of Bangladesh.



### 1.3 WHAT IS ARTIFICIAL INTELLIGENCE?

**Artificial Intelligence (AI)** is the simulation of human intelligence processes by machines, especially computer systems<sup>1</sup>. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. Particular applications of AI include expert systems, speech recognition & machine vision.



#### GOALS OF ARTIFICIAL INTELLIGENCE -

- ❖ TO CREATE EXPERT SYSTEMS- The system which exhibits intelligent behavior, learn, demonstrate, explain and advises it's user.
- ❖ TO IMPLEMENT HUMAN INTELLIGENCE IN MACHINE- Creating systems that understand, think, learn and behave like humans.

<sup>1</sup> "What is AI (artificial intelligence)? - Definition from WhatIs.com," *Search Enterprise AI*. [Online]. Available: <https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence>.

Artificial intelligence is a combination of science and technology which is based on Mathematics, Psychology, Computer Science, Biology, Engineering, and Linguistics. Generally, A.I. falls within three categories —

#### NARROW:

Narrow A.I. (sometimes called “weak A.I.”) is focusing on executing a single task but it has limitations of interaction. Checking weather reports, controlling smart home devices, or giving us answers to general questions pulled from central database are some of the examples of narrow AI.

#### GENERAL:

We are still in Narrow AI - but scientists believe they are making progress towards General AI. It learns from experience and has the ability to understand the data and make a decision based on data.

#### SUPER:

In near future, A.I. may become intellectually superior to humans in every way. A.I. robots would probably have a problem-solving attitude, accomplish awareness, and work with no human association, maybe at the directions of another A.I.

#### WHY IS IT IMPORTANT?

1. It converts repetitive process into automatic and discovers insights from data.
2. It finds patterns and sequences in data for acquiring skill of algorithm.
3. AI performs high-volume, frequent, computer based tasks frequently and without weakness.
4. AI can add intelligence in a product, process or in a system.
5. AI can improve efficiency of resources.

## 1.4 WHAT GOOD CAN AI BRING?

Artificial intelligence has revolutionized in many areas. It has the uncountable number of benefits and AI can offer better human life. As follows-

**CROSSING HUMAN LIMIT:** When it is difficult for human to go, AI has ability to reach places to help human. For instance, exploring space to greater extents where it could be dangerous for humans but AI can reach there. Another example, in Deep Ocean where humans might not survive but AI can.

**PREDICTIVE ANALYSIS:** Every day the world produces lots of data. Medical and financial sectors have much potential than any another domain. AI is being used there to organize and manage data. It can analyze data to find patterns, and based on these patterns it arrives at predictions. This predictions can ensure better and faster decision making.

**AI IN HEALTHCARE:** Improving patient outcomes and minimizing costs are the biggest consequence of AI in healthcare. Health monitoring, remote diagnosis especially in disease diagnosis, and in suggesting primary medication, AI has performed significantly.

**AI IN BUSINESS:** To reduce repetitive tasks, robotic process automation plays a significant role. To draw insights from data on how to deal customers better, machine learning algorithms are applied to CRM and analytics platforms, process innovation.

**AI IN EDUCATION:** AI can automate grading system. AI enabled tutors can do assessment, requirement adaptation,

support and ensuring them to stay on the right track. It has potential to change

learning environment and replace teachers.

AI adoption is the greatest in sectors that are already strong digital adopters.

High AI Adoption	<ul style="list-style-type: none"><li>• High tech/telecom</li><li>• Automotive/assembly</li><li>• Financial services</li></ul>
Medium AI Adoption	<ul style="list-style-type: none"><li>• Retail</li><li>• Media/entertainment</li><li>• Consumer packaged goods</li></ul>
Low AI Adoption	<ul style="list-style-type: none"><li>• Education</li><li>• Healthcare</li><li>• Travel/tourism</li></ul>

**AI IN FINANCE:** Turbo Tax is disrupting innovation in finance arena. By collecting personal data, these applications can provide financial advices. Ping An (an insurance company) is using AI to automate settlement process of insurance claims in China.

**AI IN LAW:** Documents finding can be automated by AI to use more efficiently than ever before. AI has potential in predictions of legal outcome, research documents and review etc. to assist judges in trial process.

**AI IN MANUFACTURING:** Manufacturing sector is the pioneer in incorporating robots into the workflow. AI in supply chain such

as chatbot for operational procurement, ML for warehouse management etc. is a huge

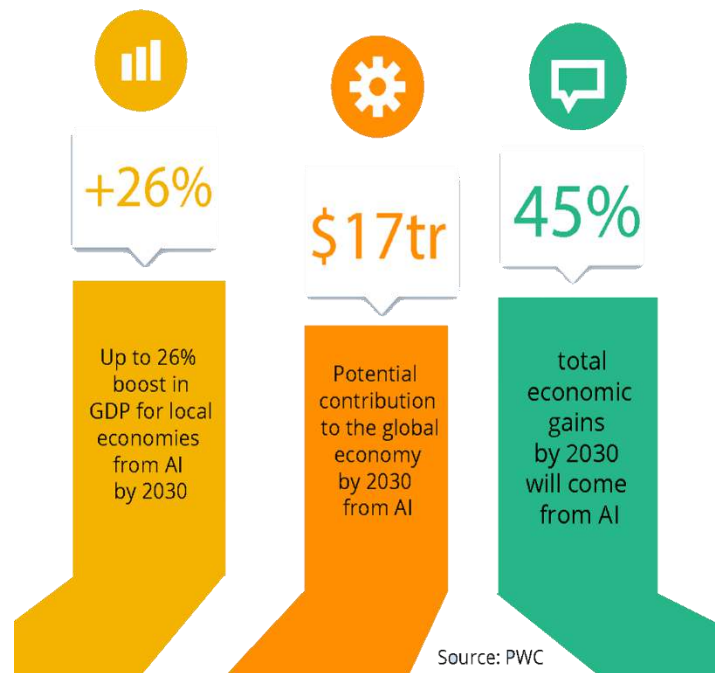
opportunity.

## CHAPTER 2: LEVERAGING AI FOR SOCIAL AND ECONOMIC GROWTH

### 2.1 ARTIFICIAL INTELLIGENCE TRANSFORMS THE ECONOMY

Artificial Intelligence has a great impact on the economy as well as it offers substantial benefits. The AI technologies have a wide range of opportunities to boost up productivity levels and elevate GDP growth momentum.

This is the time to invest strategically in different types of AI applications for the countries. If repetitive tasks and the role of human will be automated, this will increase GDP gain and improve labor productivity.



PWC said that 45% of total economic gains by 2030 will come from stirring customer demand and product modification. Product variation with increased customization, attractiveness and affordability over time could be possible by AI. China and North America are hoping that AI would bring the greatest economic development by boosting GDP 26% of china in 2030 and 14.5% of North America which is accountable for almost 70% of the global economic impact.

“The impact of AI could **double annual economic growth rates in 2035** by changing the nature of work and creating a new relationship between man and machine. The impact of AI technologies on business is projected to increase labor **productivity by up to 40 percent** and enable people to make more efficient use of their time”<sup>2</sup>.

- **Accenture Research** in 12 developed economies countries.

According to McKinsey Global Institute, all the technological advances will be jumped up due to digitalization. They showed a comparative economic growth of different countries<sup>2</sup>.



Source: wesrch.com

Annual growth rates in 2035 of gross value added (a close approximation of GDP), comparing baseline growth in 2035 to an artificial intelligence scenario where AI has been absorbed into the economy.

<sup>2</sup> “Future of Artificial Intelligence Economic Growth | Accenture.” [Online]. Available: <https://www.accenture.com/us-en/insight-artificial-intelligence-future-growth>.

## 2.2 SDG-ASSISTED ACCELERATION & PROGRESS

Bangladesh has a motivating story to tell as it has earned numerous worldwide awards for its accomplishments in MDGs. Bangladesh integrated the 2030 Agenda in its seventh Fiscal Year Plan (2016-2020). This is a good opportunity to execute the 2030 agenda while mirroring the needs of the SDGs in the national plan. Artificial Intelligence brings a great opportunity in human history. The outcome of it is still to be determined. When many might see the development of AI as potentially more threatening than beneficial, researchers and innovators around the world are trying to make sure that the scenario is the opposite.



Already, AI capabilities are being used in various ways to further societal goals. McKinsey Global Institute has collected about 160 cases of AI's actual or potential uses for the noncommercial benefit of society and can see considerable potential for computer vision, natural language processing, even deep learning applied to traditional databases, as well as other AI capabilities, to make a very sizeable difference.



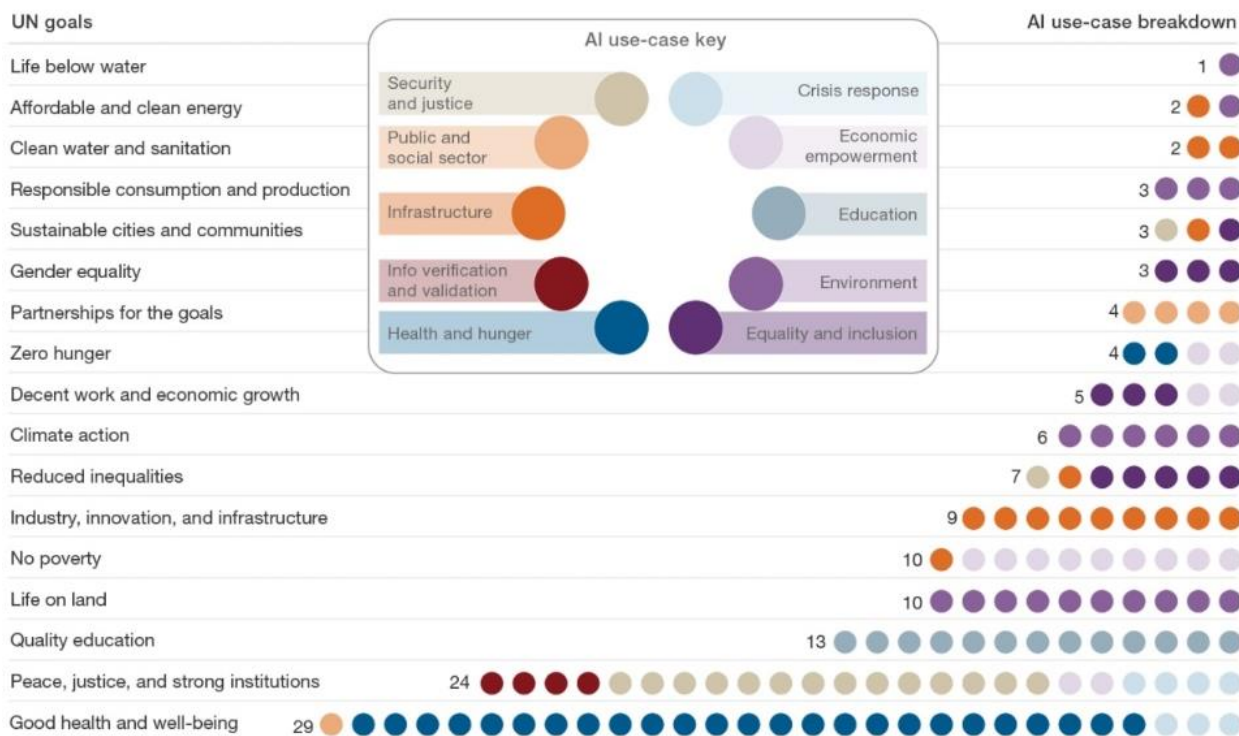
Source: [sdg.gov.bd](http://sdg.gov.bd)

implement solutions. Bangladesh is committed to solving the most pressing problem of SDGs with emerging Artificial Intelligence.

The evolving library of cases already touches on all 17 goals of the SDGs. Getting to the next level will require some decisive action by the Bangladesh government, NGOs, philanthropists, tech companies, and organizations that collect or generate a significant amount of data. Two major problems that will be needed to be solved: accessibility of data and shortage of talent who can improve AI capabilities, improve models and



Many Artificial Intelligence (AI) use cases support the most frequently cited societal challenges.



Source: McKinsey Global Institute Analysis

This chart reflects the number and distribution of use cases and should not be read as a comprehensive evaluation of AI’s potential for each sustainable development goals (SDG); if an SDG has a low number of cases, that is a reflection of the library rather than of AI’s applicability to that SDG. The chart also does not reflect all use cases in the library, more than 20 of which do not map to any SDG. These mainly focus on effective management in the public and social sectors, or belong to the issue types of disaster response and search and rescue in the crisis-response domain.

‘Chart is a partial list of use cases, as 21 of the 156 identified use cases do not target any of the UN’s sustainable development goals.

2.3 HOW BANGLADESH CAN GAIN ECONOMIC BENEFITS FROM AI?



Bangladesh - Asia's poorest to a 'tiger' economy - according to the World Economic Forum, It has been proved over the decade by showing constant and vibrant GDP growth and the digital revolution. Bangladesh is one of the pioneers within all hundreds plus under developing countries for e-Govt. and e-Citizen digital services. Bangladesh's economy is the 42nd largest economy in the world by GNI and the 31st largest by PPP. It has also been classified among the next eleven emerging market and frontier five.

According to the IMF, Bangladesh economy is the 2<sup>nd</sup> fastest growing economy with rate of 7.1%, and expected impact of AI economy of Bangladesh could boost 45% of gain.

Artificial intelligence is anything but a solitary innovation yet a group of advances. Some general classifications of AI innovations: **Natural Language Processing, virtual assistants, Computer Vision, and Robotic Process Automation.** The role of artificial intelligence (AI) in business and the worldwide economy is an interesting issue. Bangladesh is one of the quickest developing economies in the world with its exponential GDP Growth 8.13 (FY19).

The question is How Bangladesh would be able to quicken its socio-economic changes by adopting AI and being a fast mover of 4IR? The right strategy and proactive actions can dramatize the economic growth of Bangladesh by AI for digital innovations, is globally demonstrated to build crop yields, diminish farmers' costs and boost profits.

transformation in all possible landscape including Citizen Services, Manufacturing, Agriculture, Health, Mobility & Transportation, Finance and Trade and so on.

Bangladesh needs to expand on this further, and enhance the specialized ability and a lively start-up ecosystem to grasp cutting-edge innovation arrangements that stimulate and continue socio-economic development. The innovation in the spotlight today is AI. It will do as such by expanding work efficiency and development, driving development through intelligent automation, human-machine collaboration and innovation diffusion. A portion of these is now in play as smart factories where people and machines are beginning to work one next to the other to improve the results. In the insurance sector, machines are doing monotonous assignments, enabling people to concentrate on progressively mind-boggling, judgment-based preparing and client administration. New opportunities are likewise made through development overflows. For example, Google Maps is helping drive the growth of Uber, Shohoz and Pathao, altering individual transport and making employment for an extensive number of individuals. Artificial intelligence, utilized in robotics, Big Data investigation, Internet of Things (IoT) and Genomics, could likewise improve the lives of our farmers. Solutions to traditional difficulties, for example, the unpredictability of climate change or soil conditions, or the expanding expenses of farm labor are being utilized widely in a few parts of the world and precision farming, empowered by this

Though AI concept has emerged for a decade, yet full-pledge effects have not been felt and results are yet to come in a complete package. Sooner, AI technologies will bring so many products and processes, which would unavoidable if we want to stay sustainable and relentlessly progressive in business ecosystems and societal context. AI would ensure that people get proper support in education and opportunities for their livelihoods.

Global research firms have claimed that within the next ten years, Bangladesh's economy will get doubled, and Bangladesh would be the role-model and trend-setter for developing nations by ensuring benchmarks through continuous innovations.

## 2.4 HOW AI CAN ADDRESS JOB-FILLED ECONOMIC GROWTH FOR BANGLADESH?

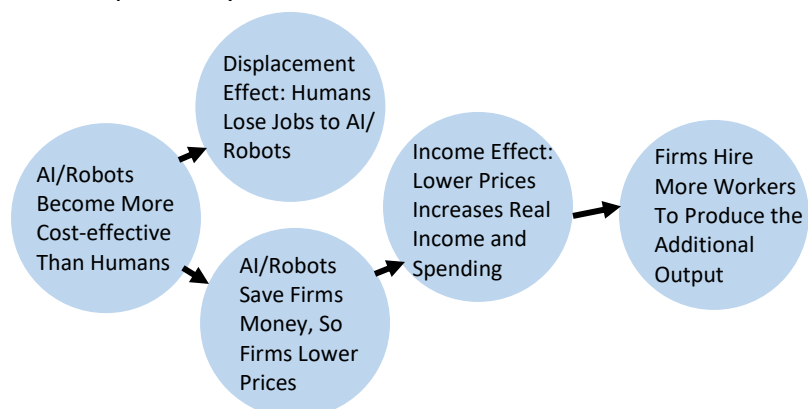
With more than 163 million of the population in 1, 47,570 km<sup>2</sup> area has more than 40 million students, Bangladesh is facing a significant challenge with an employment issue. The govt. should define an effective strategy to address job-loss threats due to emerging technologies intervention.

When technology introduced in the industry due to 4IR adaption, then the total number of jobs will be deflated. So some job loss will take place and those who would survive, they might need reskilling. When we'll develop local innovation capacity to build our technologies and manufacturing equipment, then the cost of that equipment will be lower compared to the global market. This will provide some advantages in capital manufacturing as the expansion of industries will happen at a faster rate than that of the current rate and this will create a capacity to absorb the employees who are in the risk of job loss. So, industrial expansion capacity will be increased because of cost reduction

in capital machinery that purchased from the local market rather than import from abroad.

So far the Bangladesh's manufacturing strategy is to import capital machinery, technologies and adding labor locally. So the import duty rate on capital machinery is set lowest at 1% which is very harmful to Bangladesh as this is not providing any incentive to create knowledge-intensive jobs in Bangladesh. We need to make Bangladesh fit and competitive in the global market by changing the current strategy and developing our capacity to introduce technological innovation in manufacturing industries.

Although, according to the world economic forum<sup>3</sup>, AI and Robots would create many jobs than they displace. Because of AI and related technologies, economic growth will boost up than ever before and create many additional job opportunities. The Fourth Industrial Revolution are expected to create 133 million new roles. 75 million jobs are supposed to be displaced by 2022.



How AI can both destroy and create jobs through the displacement and income effects (this is a simplified analysis – in practice there will be a more complex range of economic effects at work as captured in our detailed modeling) – PWC Statistics shows, most of the emerging technology from

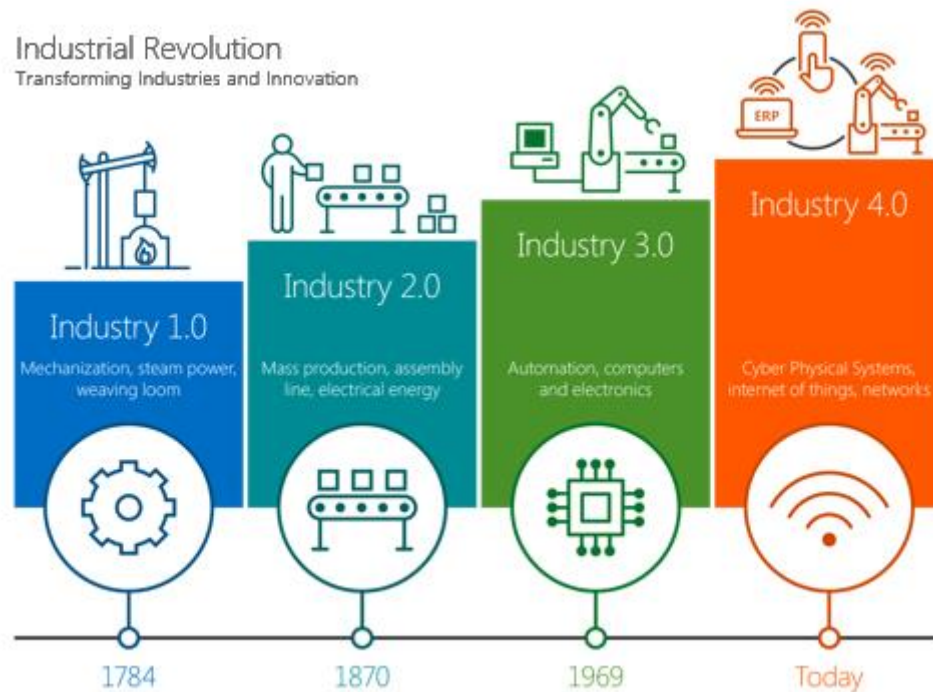
<sup>3</sup> "AI and robots could create as many jobs as they displace," *World Economic Forum*. [Online]. Available: <https://www.weforum.org/agenda/2018/09/ai-and-robots-could-create-as-many-jobs-as-they-displace/>.

steam engines to computers, displaced some existing job but also created new jobs and large productivity gains. According to PWC, in order to “**displacement effect**” of AI, government should invest more in STEAM—(Science, Technology, Engineering, Art and Design, and Mathematics) education. Govt. should also encourage workers to update and adapt their skills according to new technology on a continual basis.

We need to engage higher academic graduates to innovate next-generation capital machinery and change Bangladesh’s labor-intensive manufacturing strategy to knowledge-intensive eco-systems.

## 2.5 FOURTH INDUSTRIAL REVOLUTION (4IR)

Due to the Internet of Things (IoT), cyber-physical system and Internet of systems, the **Fourth Industrial Revolution (4IR)** changes the way we live, work and relate to one another. Implementing emerging technologies in our workplaces and factories, inter-connected machines will interact, visualize the entire production chain and make decisions faster and independently.



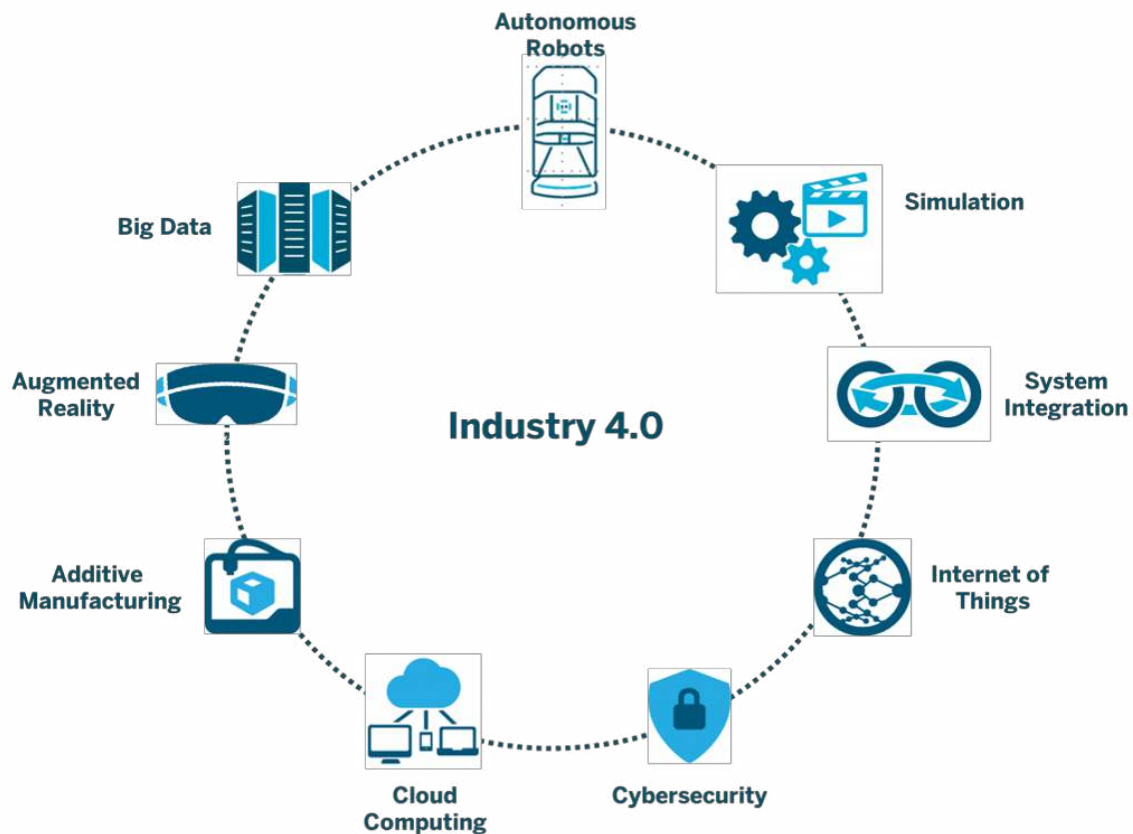
Source: The Guardian

The fourth industrial revolution has an impact on all stages of our society, economy & Industry. This revolution is considered as an extension of the 3rd Industrial Revolution which was known as the Digital Revolution. The Fourth Industrial Revolution is disrupting pretty much every industry in every country and making huge changes at extra-ordinary speed. The first industrial revolution, in the 18th and 19th centuries, associated with the change from mostly agrarian societies to greater industrialization as an outcome of the

steam engine and other technological advancements. The next technological age, the second industrial revolution, was driven by electricity and included extension of industries and large scale manufacturing as well as technological advancement.

The Fourth Industrial Revolution's technologies, such as artificial intelligence, augmented reality, genome editing, 3-D printing and robotics are rapidly changing the way humans create, exchange, and distribute values. As occurred in the previous revolutions, this will profoundly

transform institutions, industries and individuals.



Source: aethon.com

More importantly, this revolution will be guided by the choices that people make. Today, the world in 50 to 100 years from now will owe a lot of its character to how we think about, invest in, and deploy these powerful new technologies.

Creating an impact on human identities, communities, social and political structures, new technologies are being developed and implemented at an increasingly rapid pace. As a result, our responsibilities to one another, our opportunities for self-realization, and our ability to positively impact the world are intricately tied to and shaped by how we engage with the technologies of the Fourth Industrial Revolution. This revolution is not just happening to us—we are not its victims—but rather we have the opportunity and even responsibility to give it structure and purpose.

## CHAPTER 3: AI FOR DIFFERENT SECTORS OF BANGLADESH

### 3.1 AI ENVISIONED NATIONAL PRIORITIES OF BANGLADESH



*Inspired form: [www.eventbrite.com](http://www.eventbrite.com)*

Driving this AI, R&D Strategic Plan is a cheerful vision of a future world in which AI is securely utilized for critical advantage to all individuals from society. By fulfilling the three conditions to be a developing country, in March 2018 Bangladesh has crossed over from the list of least developing countries (LDCs) and recognized as a developing country by both economically and socially. Utilizing Artificial Intelligence in economic, research, industry, agriculture and the medical area will help our country to be the fastest moving country among South Asia. We have set 8 national priority sectors. They are as follows:

- AI for public service delivery,
- AI for manufacturing,

- AI for agriculture,
- AI for smart mobility and transportation,
- AI for skill & education,
- AI for finance & trade, and
- AI for health

According to our GDP contribution and basic needs for people, sectoral priority is set. From concept AI + X (Anything), more sectors, the industry will be added on the stack step by step. Further advancement in AI could upgrade prosperity in almost all areas of society including expanded financial thriving, health, agriculture, education, etc.



## 3.2 AI FOR PUBLIC SERVICE DELIVERY

Bangladesh Govt. has developed Eksheba Citizen which is a one-stop service access point of Bangladesh for all govt. services by which citizens can avail of any services online by using their single identity. The Govt. has taken initiatives to analyze and identify all the services delivering from different govt. offices and has identified 2700+ govt. services. According to Bangladesh Economic Profile 2018, the service industry contributes 56.5% of the total GDP in our economy. Government offices can use the applications of Artificial Intelligence. The existing citizen services use cases relate to citizen inquiries and information. AI in government and citizen services can reduce administrative burdens, help to inform all government services to the citizens, take on a significantly complex task, etc.



Artificial Intelligence-based applications are being tested by govt. offices around the world.

SCOPE OF AI FOR PUBLIC SERVICE DELIVERY	RECOMMENDATIONS
<ul style="list-style-type: none"> <li>• Intelligent National Digital Information &amp; Service Assistant</li> <li>• AI-Based Recruitment &amp; Evaluation System</li> <li>• Paperless Office</li> <li>• Virtual Service Location Assistant</li> <li>• AI-Based Integrated Service Delivery Platform</li> <li>• AI-Based Predictive Monitoring System</li> <li>• AI-Based Training</li> <li>• Life Event Service Delivery Platform</li> </ul>	<ul style="list-style-type: none"> <li>➤ Engage Citizens and Civil Society for Selecting an AI-Based Priority Service, Defining the Problem, Reforming or Taking Initiative</li> <li>➤ Scope Out and Understand the Context and System in Which AI-Based Reform or Initiative Will be Applied</li> <li>➤ Engage Media, Civil Society Organizations, Social Movements and Other Groups to Raise Awareness of the Reform or Initiative, and Mobilize Citizens to Participate.</li> <li>➤ Work With Academics and Multilateral Partners to Evaluate the Impact of the AI in Citizen Service Delivery</li> <li>➤ Communication Channel between human and Artificial Intelligence Platforms</li> </ul>



### 3.3 AI FOR MANUFACTURING

The manufacturing sector of Bangladesh is estimated to increase by 13 percent and this increased rate is doubted by many observers. The index of large and medium manufacturing has been growing at 11 percent per annum over the past four years; the output of large and medium industries for the first four months of the financial year increased more than 20 percent over the previous year. According to the Bangladesh Economic Profile 2018, the Manufacturing industry contributes 29.2% of the total GDP in our economy.

Artificial Intelligence (AI) and Machine Learning have ignited the fourth industrial revolution. Adopting new technologies into manufacturing sectors along with data and predictive analytics will minimize raw materials, improve effectiveness and optimize supply chains. Smart Manufacturing includes overall equipment effectiveness (OEE), custom, and adaptive manufacturing.

There are some issues that hindrances the maximize the growth of the manufacturing sector. Predictive demand and supply system, re-skilling, up-skilling, brain gain, AI enable technology production, production data analysis for decision-making process could solve some problems in the manufacturing sector.

SCOPE OF AI FOR MANUFACTURING	RECOMMENDATIONS
<ul style="list-style-type: none"><li>• Predictive Maintenance</li><li>• Smart Quality Control</li><li>• Human-Robot Collaboration</li><li>• Generative Product Design</li><li>• Optimized Supply Chain</li><li>• Improved Customer Service</li></ul>	<ul style="list-style-type: none"><li>➤ Identify Scopes for AI-Based Manufacturing</li><li>➤ Introduce AI in Business Process Optimization</li><li>➤ Introduce Predictive Demands and Supply System</li><li>➤ Adopt Reskilling /Up-Skilling/Brain Gain</li><li>➤ Need Production Analytics for Decision-Making Process</li><li>➤ Need Policy Reform to Inspire Local Innovation in Capital Manufacturing</li><li>➤ Need to Establish I2I(Innovation to Industry) in Manufacturing</li><li>➤ Need Strong Local Collaboration such as Govt. to Industry (G2I), Govt. to Academia (G2A), Industry to Academia (I2A) &amp;Industry to Industry (I2I)</li><li>➤ Skills Supervision of IoT based Machines</li></ul>

### 3.4 AI FOR AGRICULTURE

Agriculture has a significant role in the development and strength of the economy of Bangladesh. More than three-quarters of the total population in rural areas derive their livelihood from the agricultural sector and became food sufficient nation in 2009. There are 245 agriculture information centers to help the farmers to grow crops, the Central Bank has initiated a bank account service for farmers by Tk. 10 only (\$0.124).

The govt. opened krishi.gov.bd portal and hotline (3331) to support farmers. According to Bangladesh Economic Profile 2018, the agriculture industry contributes 14.2% of the total GDP in our economy.

Many activities are ongoing based on technology such as digital agriculture platform generating base data for AI, IoT for crop field conditions, behavior analysis of cow, fish feeding, etc. , crop stage mapping using satellite image processing, hydroponics & vertical agriculture for moving towards building plant factories and big data for prediction mapping. Thus, it requires regular adjustment with different planning and development programs. The country has much potential to solve some challenges by AI like Dynamic soil topology Map, diseases forecast team system for a single crop, harvesting prediction automation, image-based disease recognition, and health monitoring, etc.

SCOPE OF AI FOR AGRICULTURE

RECOMMENDATIONS

- Crops, Soil and Livestock Monitoring
  - Sowing Advisories
  - Diseases Forecasting System for Crops
  - Dynamic Soil Topology Map
  - Picture Based Diseases Prediction & Medication
  - Agricultural Robots
  - Herbicide Optimization
  - Reducing Farm Workload
  - Precision Farming
  - AI Sensors to Detect and Target Weeds While Deciding Which Herbicides to Apply Within the Right Buffer
  - AI Solutions to Monitor and Suggest for Measurements for Crops, Soil, and Livestock
  - Predictive Analysis Using AI for Real-Time Advisories to Farmers
- Identify AI Scopes in Agriculture Engaging Agriculture Experts and Farmers and Develop Plan Initiatives
  - Adopt Precision Agriculture and Automation Solutions to Close Yield Gaps and Prevent Environmental Damages
  - Apply Data Intelligence for Better Food Inspection to Address Food Waste Challenges and Improve Early Warning Systems for Post-Harvest Plant Diseases and Pest Outbreaks
  - Develop Solutions Reducing Trade Intermediating Between Small Farmers and Buyers to Reduce Inefficiencies and Increase the Profit of Farmers
  - Predictor for Agro Business and Marketing
  - Production in controlled Environment

### 3.5 AI FOR SMART MOBILITY & TRANSPORTATION

Bangladesh has seen a communications revolution with the fastest development of roads, bridges, flyovers, culvert, etc. There are total of 3,813 km highways, 12, 91,707 meters bridges/culverts and 368.62 km four-lane highways till the year 2016. To achieve vision 2021, the



Source: viatech.com

current government in Bangladesh has embarked on constructing a number of mega projects such as Padma Multipurpose Bridge (Once complete to transform lives of 30 million southern people), Payra Deep seaport (country's third seaport), Dhaka Metro Rail, Dhaka-Chittagong elevated expressway, Dhaka elevated expressway, Karnafuli underwater tunnel, Bus rapid transit in Dhaka etc.

There are so many obstacles in this sector but by using AI Data analysis of road, vehicles, weather, infrastructure, driver behavior, vehicle behavior, speed limit, turns, speed breakers, the record of transport in apps to avoid harassment, robbery, smart signing and law enforcement problem can be solved.

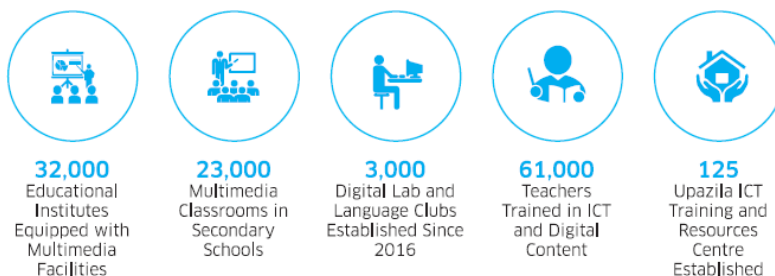
SCOPE OF AI FOR SMART MOBILITY & TRANSPORTATION	RECOMMENDATIONS
<ul style="list-style-type: none"> <li>• Data Analysis, Data Readiness and Development of Advanced Traffic Management Solutions</li> <li>• Traffic Congestion Reduction Analyzing Streamlined Traffic Patterns</li> <li>• Transport Record System to Avoid Harassment, Robbery</li> <li>• AI-Based Speed Management System</li> <li>• Public Safety Improvement by Tracking Real-Time Crime Data</li> <li>• Driver's Behavior Analysis Tool in License Issuance Process</li> <li>• Transport Decision-Making Tools Designed and Run by AI</li> <li>• Intelligence Port Management (River, Sea, Airport, Rail Station)</li> <li>• Energy Efficient Car and Transportation Autonomous Vehicle</li> <li>• Smart Public Transport and Route Management</li> </ul>	<ul style="list-style-type: none"> <li>➤ Sensitize Policy Makers Regarding AI Opportunities in Smart Mobility and Transportation</li> <li>➤ Engage Media and Civil Society in Creating Awareness of AI Intervention</li> <li>➤ Ensure Data Readiness, Sensing System &amp; Fast Computing Devices</li> <li>➤ Establish Policy</li> <li>➤ Establish Infrastructure to Implement Smart Analyzing and Automatic Vehicles</li> <li>➤ Conduct Research in Transportation to Identify Scopes Where AI Interventions are Needed to Enhance Service Quality</li> <li>➤ Establish Effective Management and Coordination of Road Safety Activity</li> <li>➤ Develop an AI-Based Application for Urban Database to Analyze and Understand the Problem</li> <li>➤ Develop an AI-Based Integrated Citywide Multi-Sector Road Safety Program</li> <li>➤ Implement Speed Management AI-Based System and Other Measures to Reduce Risk</li> </ul>

### 3.6 AI FOR SKILL & EDUCATION

As per the World Bank's report, Bangladesh has made remarkable achievements over the past decade by ensuring access to education at all levels and especially for girls. The

country's net enrollment rate at the primary school level increased from 80% in 2000 to 100% in 2015. Bangladesh has achieved gender parity in access to primary and secondary level. The overall adult literacy rate is 72.3% up to the year 2016.

Bangladesh, like many other countries, is investing greatly in the education system considering as one of the core strategies to alleviate poverty and facilitate development including raise the ICT skills of Bangladeshis and move towards the information society. There are some problems regarding the skill and education sector. AI-driven future skill development, capacity building of teachers, the establishment of AI lab, implementation of predictive intelligence system, the formation of AI-supported legal can solve the problem.



2.3 billion Free books are distributed since 2011. There are approximate 37 million total students in Bangladesh whereas 17 million students received scholarship and stipends. There are 32,000 educational institutes with the multimedia classroom.

SCOPE OF AI FOR SKILL & EDUCATION	RECOMMENDATIONS
<ul style="list-style-type: none"> <li>Personalized Learning Using Adaptive Learning Tools</li> <li>Interactive Tutoring Systems</li> <li>Predictive Tools Using AI to Inform Pre-Emptive Action for Students and Learners</li> <li>Adaptive Learning Tools for Customized &amp; Personalized Learning</li> <li>Employment and Skill Reallocation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Need Initiatives for AI-Driven Future Skill Development</li> <li>➤ Include AI in Secondary and Higher Secondary Education Curriculums</li> <li>➤ Establish AI Research Lab in Academia</li> <li>➤ Enhancing the Capacity Building of Teachers</li> <li>➤ Formation of AI Supported Legal Framework</li> <li>➤ Need Based AI Training</li> </ul>

### 3.7 AI FOR FINANCE & TRADE

The financial services industry was one of the first to adopt Artificial Intelligence (AI) in the early 80s. The complexity of the markets led to significantly larger data sets than found in other sectors and, along with the need for improved customer experience and efficiency, meant financial services as a sector were more willing than others to adopt the emerging technology.

Historically, decision-making in traditional trading was based on human intuition and extensive knowledge of finance and economics. The electronic banking system has become the main technology-driven revolution for conducting financial transactions. According to the Bangladesh Bank (BB) guideline, commercial banks are categorized as Category-1 and Category-2. Category-1 means Centralized ICT Operation for managing core business application solution through Data Center (DC) with backup assets for continuation of critical services including Disaster Recovery Site (DRS)/Secondary Data Center to which all other offices, branches, and booths are connected through WAN with 24/7 attended operation. Category-2 stands for decentralizing ICT operation for managing distributed business application solution hosted at DC or operational offices/branches with backup assets for the continuation of critical services connected through WAN or having the standalone operation.

NLP Bot based RSD-will save work hour/cost/eliminate tech/education divide, AI-based credit management-will eliminate fraud/enhance credit availability/enhance economy, centralized KYC automation-improve service dealing, RPA in trade and e-government-will eliminate duplicate, AI for G2B single point service delivery.

SCOPE OF AI FOR FINANCE & TRADE	RECOMMENDATIONS
<ul style="list-style-type: none"> <li>• AI-Based Credit Management System for Fraud Detection &amp; Prevention</li> <li>• Credit Decision to Reduce Risk in Loan Sanction Process</li> <li>• AI-Based Risk Management Solutions</li> <li>• Personalized Banking Solutions</li> <li>• Financial Process Automation</li> <li>• Virtual Customer Support Assistance</li> <li>• Shell Banking Monitoring</li> <li>• Predictive and Personalized Insurance Solutions</li> </ul>	<ul style="list-style-type: none"> <li>➤ Engage Financial Experts to Identify Scopes Where AI Can Intervene to Better Financial Service Delivery</li> <li>➤ Ensure Centralized KYC Automation to Improve Service Dealing</li> <li>➤ Engage Financial Experts and Policy Makers to Take Step for Democratization of Financial Opportunities for All</li> <li>➤ Develop AI Supported One-Stop Access Point for All Financial Services</li> <li>➤ Develop AI-Driven G2B Single Point Service Delivery</li> </ul>

### 3.8 AI FOR HEALTH

The healthcare sector industry in Bangladesh has always struggled to provide quality services often being too understaffed, underfunded, etc. Old practices and models became obsolete and desperate for digital transformation to nourish efficiency and consistent quality. The people of Bangladesh are suffering from the most common non-communicable diseases such as diabetes, heart attack, hypertension, liver diseases. Around 60% of health care cost is usually borne by the patients themselves. The projection is that Bangladesh will have the seventh-largest diabetic population in the world by 2030. According to the world health organization, there are an esteemed 3.05 physicians per 10,000 population and 1.07 nurses for 10,000 population (estimates based on MoHFW HRD 2011).

The expanding accessibility of Healthcare data and the fast improvement of huge information scientific strategies have made conceivable the ongoing fruitful utilization of AI in medicinal services. There are some problems regarding the healthcare sector to provide quality services. Central connected health registry, wearable IoT devices, decision support systems, portable health care, health AI networks can solve some of the health care sector problems.

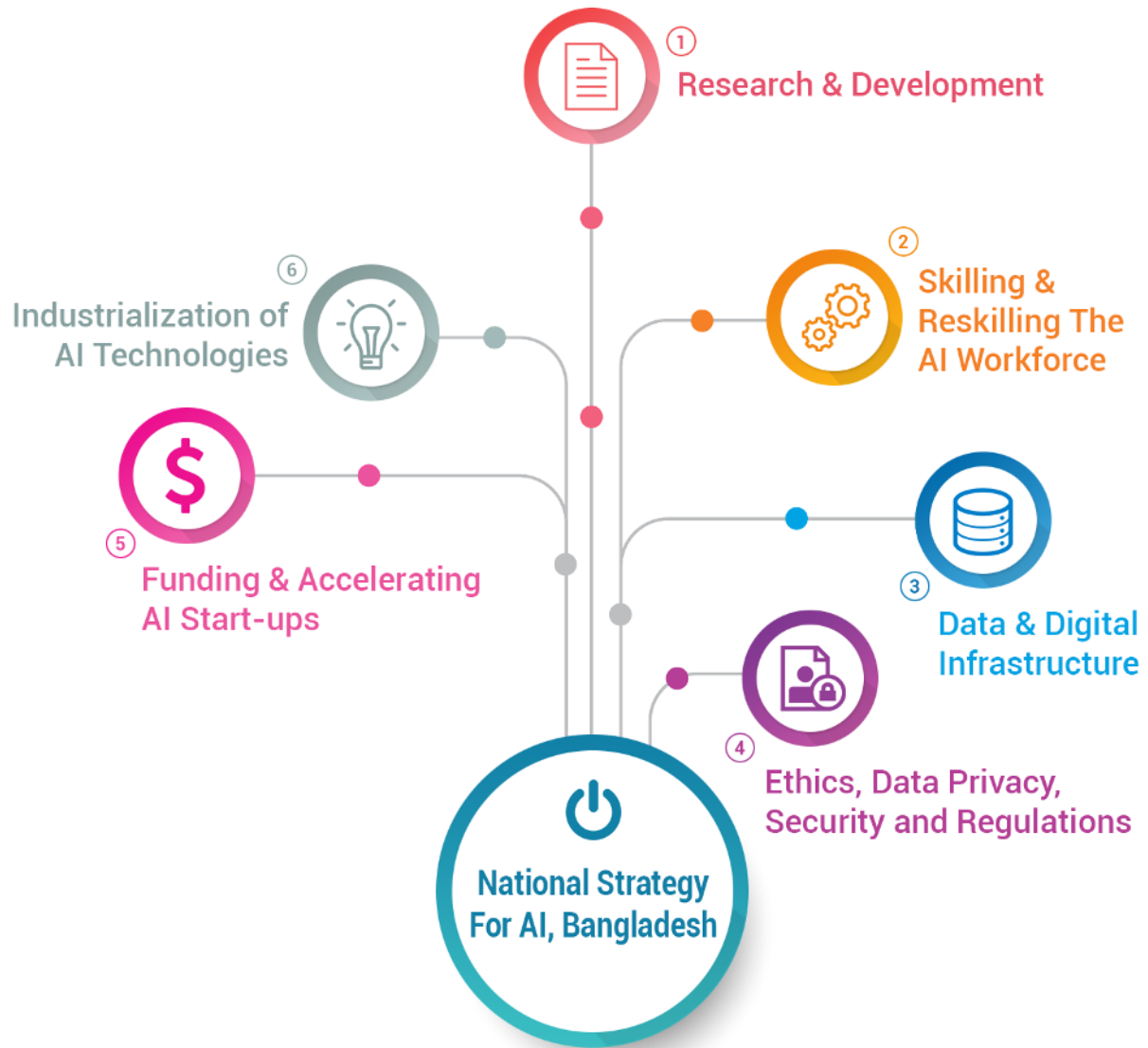
SCOPE OF AI FOR HEALTH	RECOMMENDATIONS
<ul style="list-style-type: none"> <li>• Doctor Appointment and Smart Queue Management</li> <li>• Right Doctor Selection Based on Trained System</li> </ul>	<ul style="list-style-type: none"> <li>➤ Establish a Central Connected Health Registry</li> <li>➤ Ensure Arrangement Structures Support and Encourage Innovative Work of AI in</li> </ul>

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Future Disease Prediction Based on Health Record</li> <li>• Virtual Health Assistant for Doctors for Primary Projection and Medication for Diseases</li> <li>• Personal Health Care &amp; Virtual Assistant</li> <li>• Aid Clinical Judgment or Diagnosis</li> <li>• Wearable IoT Devices and Advance Technologies in Early Disease Detection and Prevention</li> <li>• Health Decision Support System</li> <li>• Portable &amp; Virtual Health Care to Ensure Last Mile Health Care</li> <li>• AI Health Network for Doctor Referral</li> <li>• Forecasting the epidemics before happening in National Level</li> </ul> | <p>Healthcare</p> <ul style="list-style-type: none"> <li>➤ Use Risk-Based Ways to Deal With Guarantee The Utilization Of AI In Medical Services has Perceived Norms of Security, Adequacy and Equity</li> <li>➤ Require the Plan of AI Frameworks in Medical Services to be Educated by Real-World Work Process, End-User Needs, Human-Focused Structure and Use Cases</li> <li>➤ Ensure AI Frameworks are Available and Reasonable</li> <li>➤ Create a Suitable Harmony Between Human Care, Leadership and Enlarged Capacities from AI-Empowered Advancements and Devices</li> <li>➤ Support Training for the Progression of AI in Health Care</li> </ul> |
|---|--|

## CHAPTER 4: AI STRATEGY& DEVELOPMENT ROADMAP

Every country has different strategies to tackle the Artificial Intelligence challenges worldwide according to their national conditions and overall scenario. But some of the strategies are almost the same for every country. Bangladesh has set some pillars to beat AI challenges as well as development roadmap. The following 6 pillars are portrayed below.





## STRATEGY 01: RESEARCH & DEVELOPMENT

The R&D strategy is the plan for accomplishment in the years ahead. It organizes the objectives and advancements that locate the most encouraging and recognizes approaches to amplify efficiency. Research and development are a standout amongst the most vital fields. Bangladesh sees itself thriving significantly in creating world-class research and advancement in most innovation fields, especially in AI. It is obligatory that AI ought to be embraced or connected in the Research and development as well as other divisions to leverage the potential application of AI.

### STRATEGIC BRIEF

1. Accumulate ideas for R&D from Industry-Academia-Government collaboration through different workshops and promotions.
2. Selection of fast-moving research areas and priorities them.
3. Budget allocation for R&D projects through government funding, public-private partnerships, and local & foreign investment.
4. Establish National AI Research Center for R&D.
5. Collaboration among government, academia, and industry.
6. Commercialization of AI research

## ROADMAP



Actions					
	Formulate National AI R&D Strategy	Establish National AI Research Center for R&D	Prioritize Potential Research Sectors	Partnership Development with International Research Centers and Academia	Establish Open National AI Research Platform
Stakeholder	<ul style="list-style-type: none"> <li>Ministry of Education</li> <li>Ministry of Science &amp; Technology</li> <li>ICT Division</li> <li>Ministry of Industries</li> <li>Ministry of Planning</li> <li>Academia</li> <li>Industry</li> </ul>	<ul style="list-style-type: none"> <li>Ministry of Science &amp; Technology</li> <li>Ministry of Posts, Telecommunications &amp; Information Technology</li> <li>Ministry of Industries</li> <li>Ministry of Planning</li> <li>Academia</li> <li>UGC</li> </ul>	<ul style="list-style-type: none"> <li>Ministry of Science &amp; Technology</li> <li>ICT Division</li> <li>Ministry of Industries</li> <li>Ministry of Education</li> <li>BCSIR</li> <li>Atomic Energy Commission</li> <li>UGC</li> <li>Industry</li> </ul>	<ul style="list-style-type: none"> <li>National Artificial Intelligence Task Force</li> <li>Ministry of Foreign Affairs</li> <li>Ministry of Posts, Telecommunications &amp; Information Technology</li> <li>Local Academia</li> <li>International Academia</li> <li>International Research Centers</li> <li>Industry</li> </ul>	<ul style="list-style-type: none"> <li>National Artificial Intelligence Task Force</li> <li>UGC</li> <li>Ministry of Planning</li> <li>Ministry of Posts, Telecommunications &amp; Information Technology</li> <li>Ministry of Science &amp; Technology</li> <li>Academia</li> <li>Industry</li> </ul>

Lead Ministry	ICT Division	Ministry of Posts, Telecommunications & Information Technology	ICT Division	National Artificial Intelligence Task Force	Ministry of Posts, Telecommunications & Information Technology

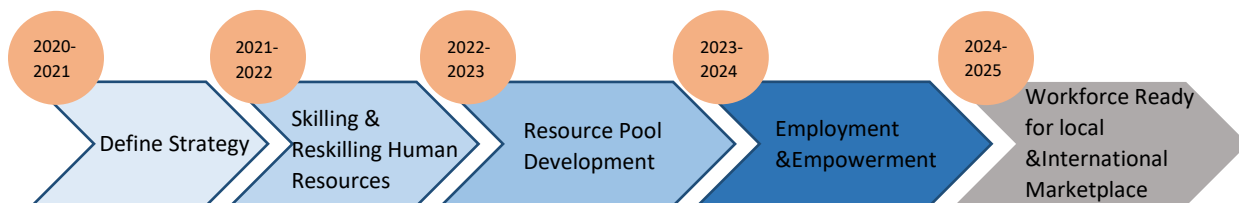
## STRATEGY 02: SKILLING & RE-SKILLING THE AI WORKFORCE

According to the Bangladesh Bureau of Statistics, Labor Force Surveys, 54.1 million male people are employed and 8.3 million female people are employed in the industry in our country. For the imminent 4th industrial revolution in Bangladesh, the Govt. is taking different types of strategies to implement new technologies in various sectors, for instances, Machine Learning, Artificial Intelligence, Internet of Things (IoT), BlockChain and Big Data for producing more opportunities in different sectors in our country. The Govt. has the plan to train initially 50 thousand workforces based on emerging technology skills within the next five years. There are no ways to tackle the 4th industrial revolution specially job-loss issues other than skilling and re-skilling the AI workforce.

### STRATEGIC BRIEF

1. Capacity development of national human resources targeting a country of innovators.
2. The necessity of Innovation on national skill and capacity design to meet the challenge of job diversification due to 4IR and worldwide emerging developments.
3. Develop a culture of adopting advanced technologies and Artificial Intelligence (AI) as basic of organizational capacity to separate themselves in the real world.
4. Facilitate industries for human-machine collaboration to boost incomes and employment.
5. Scale-up new skilling and align resources with imaginative types of reskilling to prepare representatives at all dimensions to work with intelligent machines.

## ROADMAP



Lead Ministry	Stakeholder	Actions	<ul style="list-style-type: none"><li>➤ Establish National AI Training Institute</li><li>➤ Capacity Development of Potential Human Resources</li><li>➤ Appropriate Placement of Existing Human Resources</li><li>➤ Arrange Training for Overseas Employment</li></ul>	<ul style="list-style-type: none"><li>➤ National Skillset Enhancement Program through training &amp; development</li><li>➤ Grassroots Talent Hunt</li><li>➤ Expert Human Resource Accumulation</li><li>➤ Introduce AI in Curriculum</li></ul>	<ul style="list-style-type: none"><li>➤ Establish Local AI Marketplace.</li><li>➤ Curriculum up-gradation based on Market Demand.</li></ul>	<ul style="list-style-type: none"><li>➤ Establish Open AI Marketplace</li><li>➤ Facilitate AI Outsourcing</li><li>➤ Facilitate to Export AI Based Solutions</li><li>➤ Extend Opportunities for Overseas Employment</li></ul>
		<ul style="list-style-type: none"><li>- Ministry of Education</li><li>- Ministry of Science &amp; Technology</li><li>- ICT Division</li><li>- Ministry of Industries</li><li>- Ministry of Planning</li><li>- Academia</li><li>- Industry</li></ul>	<ul style="list-style-type: none"><li>- Ministry of Expatriates' Welfare and Overseas Employment</li><li>- BMET, BOESL</li><li>- Ministry of Labor and Employment</li><li>- Ministry of Industries</li><li>- ICT Division</li></ul>	<ul style="list-style-type: none"><li>- Trade Bodies &amp; Expert Groups</li><li>- Ministry of Industries</li><li>- Ministry of Labor and Employment</li><li>- ICT Division</li><li>- Industry</li></ul>	<ul style="list-style-type: none"><li>- Ministry of Expatriates' Welfare and Overseas Employment</li><li>- BMET, BOESL</li><li>- Ministry of Labor and Employment</li><li>- Ministry of Industries</li><li>- ICT Division</li></ul>	<ul style="list-style-type: none"><li>- Ministry of Expatriates' Welfare and Overseas Employment</li><li>- BMET, BOESL</li><li>- Ministry of Labour and Employment</li><li>- Ministry of Industries</li><li>- ICT Division</li><li>- Ministry of Commerce</li></ul>
		ICT Division	Ministry of Labor and Employment	ICT Division	Ministry of Labor and Employment	Ministry of Labor and Employment

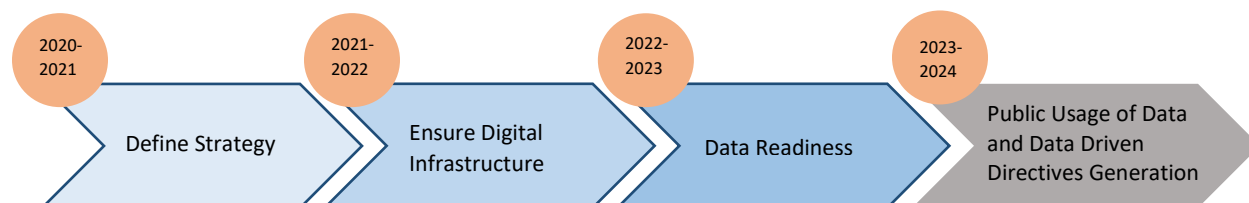
## STRATEGY 03: DATA & DIGITAL INFRASTRUCTURE

Data is the main fuel to the capacity of AI to work. Accordingly, in Bangladesh governments have opened their datasets and created stages to encourage the protected trade of private data. According to the BTRC announcement, the govt. has the plan to launch 5G by next 2020, fostering the transformation into the next stage by implementing the emerging technology. Without the readiness of Data and Digital Infrastructure, it is next to impossible to implement emerging technology.

### STRATEGIC BRIEF

1. Need a robust and flexible data infrastructure to host and maintain national digital initiatives.
2. Need to formulate data guidelines and standards for data harvesting and usage.
3. Need to ensure digital services functioning to produce data following data guidelines and standards.
4. Need to enable national open government data initiatives.
5. Need to establish data labs under National AI Center for Bangladesh to ensure data readiness for AI intervention.
6. Need to prepare training data to advise different AI initiatives.
7. High computational powered devices are necessary to design and develop AI applications.

## ROADMAP



	Actions	2020-2021				2021-2022				2022-2023				2023-2024			
		Define Strategy to Establish Data & Digital Infrastructure				Ensure 4-Tier Data Center				Ensure E-Services Functioning for Data Harvesting				Establish Environment for Data Driven Service Development			
		<ul style="list-style-type: none"> <li>➤ Enhance National Data Center for AI Intervention</li> <li>➤ Ensure National Cloud Based Shared Infrastructure for AI Stakeholders</li> <li>➤ Ensure High Performance Computing</li> <li>➤ Ensure Best Practices for Disaster Recovery</li> <li>➤ Ensure Countrywide 5G Network</li> </ul>				<ul style="list-style-type: none"> <li>➤ Formulate Data Guidelines and Standards</li> <li>➤ Service Oriented Data Readiness According Data Guideline and Standards</li> <li>➤ Promotion for Data Awareness</li> </ul>				<ul style="list-style-type: none"> <li>➤ Develop Data Driven AI Services</li> <li>➤ Create Awareness &amp; Promotion for AI Service Uses</li> <li>➤ Develop Solutions Providing Directives to Policy Makers</li> <li>➤ Develop National Dashboard Providing Directives to Policy Makers</li> </ul>							
Stakeholder		<ul style="list-style-type: none"> <li>- Ministry of Posts, Telecommunication s &amp; Information Technology</li> <li>- Bangladesh Bureau vof Statistics</li> <li>- Ministry of Planning</li> <li>- BTRC</li> </ul>				<ul style="list-style-type: none"> <li>- Ministry of Planning</li> <li>- SID, BBS</li> <li>- ICT Division</li> <li>- Academia</li> <li>- BTRC</li> </ul>				All Govt. Ministries				All Govt. Ministries			
Lead Ministry		Ministry of Posts, Telecommunications & Information Technology				BTRC				ICT Division				ICT Division			

## STRATEGY 04: ETHICS, DATA PRIVACY, SECURITY & REGULATIONS

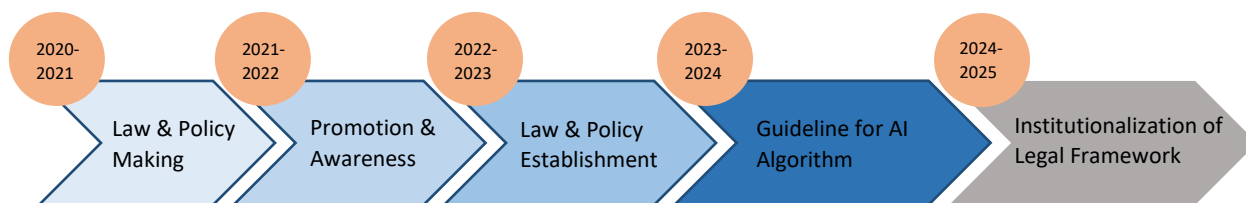
Data security professionals are in critical need of powerful and pragmatic guidance for creating information privacy protection principles. Information privacy protection turns into an essential worry to data security for cutting edge technology. Viewing privacy from the point of view of morals, can help undertakings build up and improve their implicit rules. So the authority should construct robust ethics, data privacy, security and regulations guideline for the usage of emerging technology.

### STRATEGIC BRIEF

1. The national AI strategy will emphasize scientific excellence using the code of ethics, regulations and data privacy.
2. To develop thought leadership on the economic, ethical, policy, and legal implications of AI, and support the national research community on AI.
3. Law and policy formulation to establish an ethical and legal framework of AI.
4. The AI strategy will create a new set of AI ethics guidelines to address issues such as fairness, safety, cyber security, and transparency.

### ROADMAP





Lead Ministry	Stakeholder	Actions	<ul style="list-style-type: none"> <li>➤ Formulate Data Sharing Policy</li> <li>➤ Make Law for Data Ethics &amp; Privacy</li> <li>➤ Make Policy Ensuring AI Security</li> </ul>	<ul style="list-style-type: none"> <li>➤ Organize Inter-Ministerial Seminar, Workshop</li> <li>➤ Promotional Activities For Public Awareness</li> <li>➤ Engage media, civil societies, policy makers for promotion &amp; awareness</li> </ul>	<ul style="list-style-type: none"> <li>➤ Circulate Gazettes And Notices Enabling Laws And Policies</li> <li>➤ Ensure Enforcement Of Laws And Policies</li> </ul>	<ul style="list-style-type: none"> <li>➤ Formulate Guideline For Ai Algorithm</li> <li>➤ Formulate RTE (Right To Explanation) Guideline For Ai Algorithm</li> </ul>	<ul style="list-style-type: none"> <li>➤ Sensitize Policy Makers</li> <li>➤ Form Legal Committee</li> <li>➤ Monitoring &amp; Regulation</li> </ul>
			<ul style="list-style-type: none"> <li>- Ministry of Law, Justice and Parliamentary Affairs</li> <li>- Cabinet Division</li> <li>- Ministry Of Planning</li> <li>- SID, BBS</li> </ul>	All Govt. Ministries	<ul style="list-style-type: none"> <li>- Ministry of Law, Justice and Parliamentary Affairs</li> <li>- Other Ministries</li> </ul>	<ul style="list-style-type: none"> <li>- ICT Division</li> <li>- Ministry of Law, Justice and Parliamentary Affairs</li> </ul>	<ul style="list-style-type: none"> <li>- ICT Division</li> <li>- Ministry of Law, Justice and Parliamentary Affairs</li> </ul>
			BBS	ICT Division	Ministry of Law, Justice and Parliamentary Affairs	ICT Division	ICT Division

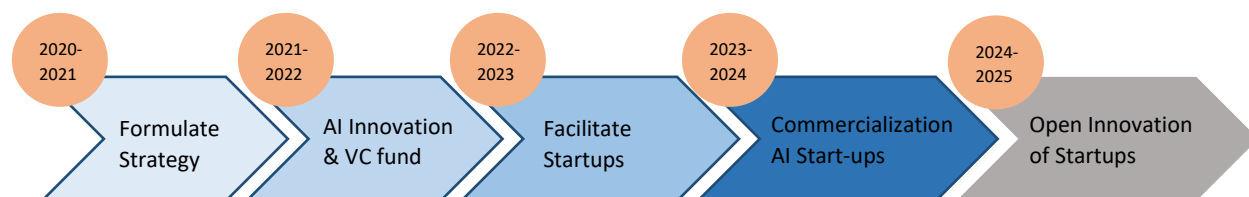
## STRATEGY 05: FUNDING & ACCELERATING AI START-UPS

Bangladesh envisions becoming a major global digital economy by the year 2021. With a vast youth population and increasing access to the Internet and technology, the country is poised and ready to pursue its digital journey. As Bangladesh's journey has just started, it is imperative to lay out the foundations for building a strong, self-sustaining digital ecosystem. In the 21st century, every economy needs dynamic digital start-ups. Across the globe, waves of innovation are creating opportunities and challenges for entrepreneurs and established businesses alike. It's IT software and services sector is growing by about 50 percent per year in revenue terms and now employs more than 70,000 people. About 200 digital start-ups are launched each year in Bangladesh, taking the total, at the end of 2018, to about 1,000 businesses. The Bangladesh govt. is planning to fund and accelerate 1000 AI-based start-ups within the next five years.

### STRATEGIC BRIEF

1. Need a national budget for AI development and implementation
2. Policy formulation to promote and accelerate AI startups
3. Need to develop business-friendly processes for commercial partnerships with AI-based start-ups.
4. Need to provide promotion and implementation support to AI-based start-ups as a part of incubation and acceleration programs.
5. Collaboration with national and international organizations for Artificial Intelligence initiatives.
6. Need to establish incubators and innovation centers to develop and nurture for large scale implementation.
7. By funding & accelerating, AI Eco-System will make a major leap forward fueling socio-economic progress, creating jobs, and boosting exports.

## ROADMAP



Actions	<ul style="list-style-type: none"> <li>➤ Formulate Strategy for Commercial Partnerships with AI Based Start-Ups</li> <li>➤ Formulate Procurement Policy for AI Startups</li> <li>➤ Fund Mobilization</li> </ul>	<ul style="list-style-type: none"> <li>➤ Sensitize Policy Makers</li> <li>➤ Private Public Partnership Building To Mobilize Fund For AI Startups</li> <li>➤ Budget Allocation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Provide Support for Need Assessment of The Startups for Scalability</li> <li>➤ Develop Revenue Model Startup's Sustainability</li> <li>➤ Ensure Legal and Administrative Support</li> <li>➤ Ensure Technological Assistance</li> </ul>	<ul style="list-style-type: none"> <li>➤ Ensure Administrative Support for Startup Commercialization</li> <li>➤ Ensure Financial Support for Scale Up, Roll Out and Commercialization</li> <li>➤ Develop NAIM (National AI Marketplace)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Ensure Promotion to Attract Potential Innovators</li> <li>➤ Facilitate Innovations</li> <li>➤ Support &amp; Promote AI Innovation</li> <li>➤ Industrialization of AI Startups &amp; Innovation</li> </ul>
	<ul style="list-style-type: none"> <li>- ICT Division</li> <li>- Ministry Of Planning</li> <li>- Ministry Of Finance</li> </ul>	<ul style="list-style-type: none"> <li>- ICT Division</li> <li>- Ministry Of Planning</li> <li>- Ministry Of Finance</li> </ul>	<ul style="list-style-type: none"> <li>- ICT Division</li> <li>- Cabinet Division</li> </ul>	<ul style="list-style-type: none"> <li>- Industry</li> <li>- Ministry of Finance</li> <li>- Cabinet Division</li> <li>- ICT Division</li> </ul>	<ul style="list-style-type: none"> <li>- ICT Division</li> <li>- Industry</li> </ul>
	ICT Division	Ministry Of Planning	ICT Division	ICT Division	ICT Division

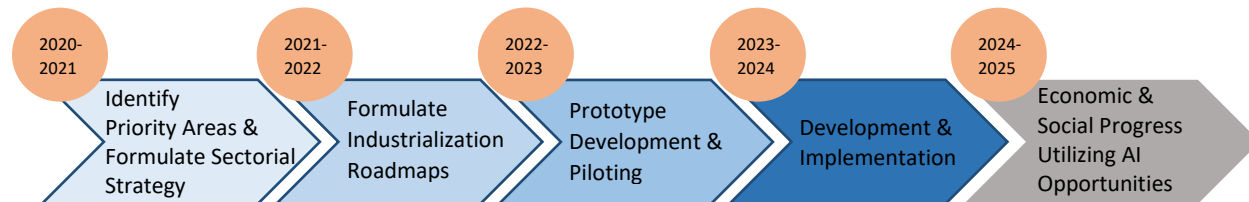
## STRATEGY 06: INDUSTRIALIZATION OF AI TECHNOLOGIES

The term Industrialization means the development of industries in a country or region on a wide scale. The industrial revolution alludes to the extreme improvement of manufacturing and technological advancements that have changed the past situation and set up a new adaptation with a positive move of industrialization. As a vital part of industrialization, Bangladesh needs to go to the 4th industrial revolution to compete and gains its stake from the industrial world. Some of the sectors are in performing level like the RMG sector; some of the sectors are in the growing stage like the Leather and leather goods sector, some of the sectors are the potential to grow like ICT and Outsourcing. The 4th industrial revolution can take off in this kind of situation. That can be possible only to help of AI.

### STRATEGIC BRIEF

1. Need to develop sectorial plans for AI development and implementation.
2. Understand work processes and identify sectorial scopes that can be optimized by simplification or automated completely to deliver business results.
3. Need to train and support human resources to maintain the automation solutions to continue producing business outcomes.
4. Develop and implement a good investment-friendly environment so that foreign direct Investment increases in these sectors.
5. Set up new industrial zones to accelerate local innovation to improve infrastructural facilities.

## ROADMAP



Actions	<ul style="list-style-type: none"> <li>➤ Sensitize policy makers</li> <li>➤ Select priority areas based on economic, social contribution and national importance</li> <li>➤ Sectorial strategy development</li> </ul>	<ul style="list-style-type: none"> <li>➤ Develop Sectorial roadmap different industrial stakeholders</li> <li>➤ Vetting and finalization of roadmap</li> <li>➤ Budget allocation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Sectorial Prototype Development</li> <li>➤ Import advanced devices, parts, modules if necessary to fulfill industrial aspects</li> <li>➤ Capacity Development</li> <li>➤ Piloting and feedback analysis</li> </ul>	<ul style="list-style-type: none"> <li>➤ Large scale implementation</li> <li>➤ Promotion and public awareness</li> <li>➤ Adaptation of AI services amongst mass people</li> <li>➤ Continuous people's perspective analysis and technological adjustment</li> </ul>	<ul style="list-style-type: none"> <li>➤ Assessment of Social and Economic Progress</li> <li>➤ Continuous Evaluation and Modification</li> <li>➤ Continuous Support &amp; Promote Industrialization</li> </ul>
	<ul style="list-style-type: none"> <li>- Ministry of Planning</li> <li>- Ministry of Industries</li> <li>- ERD</li> <li>- Trade Bodies</li> <li>- ICT Division</li> </ul>	<ul style="list-style-type: none"> <li>- Ministry of Planning</li> <li>- Ministry of Industries</li> <li>- Trade Bodies</li> <li>- Ministry of Finance</li> <li>- Respective Ministries</li> </ul>	<ul style="list-style-type: none"> <li>- Respective Ministries</li> <li>- ICT Division</li> </ul>	<ul style="list-style-type: none"> <li>- Respective Ministries</li> <li>- ICT Division</li> </ul>	<ul style="list-style-type: none"> <li>- Respective Ministries</li> <li>- ICT Division</li> </ul>
	Ministry of Planning	Ministry of Planning	ICT Division	ICT Division	ICT Division

## CHAPTER 5: THE CHALLENGES

The challenges to adopting artificial intelligence in Bangladesh is not unique, every country has to go through these tussles. To leverage AI, the government needs to overcome some core challenges. The key lies in utilizing the right opportunities in AI.

### 5.1 ACCOMPANYING THE TRANSFORMATION

As Artificial Intelligence (AI) is both a technological and social innovation, it brings with it all the benefits and complexities that can completely transform the society, including the public sector. Implementation of AI everywhere may often introduce a barrier in the relationship between the users and the institutions. It will be needed to invest the cultural transformation of society to create a sustainable system for simplifying the use of digital, relationship among the technology, the users and the administration.

### 5.2 DATA ECO-SYSTEM

Data is the raw material of artificial intelligence. All the tools and techniques of AI use the high quality and interoperability full data for making interactive and smart systems.



In Bangladesh, the lack of open access to data has been noted as a major obstacle for the data revolution. The administrative data of government ministries and departments are not available online and some data may not be collected in digital format as well. They should set up a mind to open the data available for research, business and for decision making. In this regard, **data.gov.bd** plays as an open data platform for the collection, generation and management of certain types of data.

### 5.3 TECHNOLOGY & INFRASTRUCTURE

There is a lack of technological adoption and infrastructure development for the adoption of AI technologies in Bangladesh. Data handling, storage, compute, scaling, extensibility and security are the main components of infrastructure which are remaining as challenging issues for Bangladesh. Technologies such as big data, machine learning, deep learning, and decision making are not widely available in Bangladesh. Setting up a cloud platform and high computation tool for AI technologies and training up a responsible pool to implement those can mitigate these challenges. This technology can be implemented in both the public and private sectors.

## 5.4 SKILLED AI RESOURCES

As an emerging technology, artificial intelligence (AI) has different familiarity in its usage in professional contexts of the Public Sector. Bangladesh has already started many IT training projects under different schemes. 3 or 6 months of hands-on training on AI technologies can be initially opened for the people who will be responsible for implementing technologies in different govt. organizations. AI professional training projects should be implemented all over the country.

## 5.5 CONNECTIVITY

High speed, low latency 5G networks are needed for AI technologies and the Internet of Things (IoT) which is still a challenge for Bangladesh. Another challenge is to establish LoRa, Sigfox or forms of Narrowband IoT network to wirelessly interconnect low power IoT devices. Bangladesh has scheduled to launch a 5G network by 2023.

## 5.6 ECONOMIC IMPACTS: INEQUALITY & TECHNOLOGICAL UNEMPLOYMENT

According to the World Economic Forum, AI and Robots could create more jobs than they displace. The govt. should focus on how to replace them in an efficient manner. The manufacturing sector is one of the main contributors to our economy where there is the significant number of low-end workers. Because of automation if they lose their

jobs, the govt. need to think about their placement. There should be some initiatives and create opportunities for apprenticeships, free or subsidized training and small loans available for displaced workers to start their businesses or enterprise.

## 5.7 ACCOUNTABILITY, TRANSPARENCY & PRIVACY

The lack of transparency and ability, related to machine learning can bring an overturn. It is very hard to know that why an algorithm deployed on a specific decision-making process, as decision-making is dependent on AI systems, there are no clear rules about who will be responsible for an unwanted inversion. The EU General Data Protection Regulation (GDPR) can be a good solution to this circumstance. There should be a rule of 'right to get an explanation' in each and every process.

## 5.8 HUMAN DIGNITY, AUTONOMY & PSYCHOLOGICAL IMPACT

As we surrender control to machines in different parts of our lives, there is also a concern that people will lose a portion of the importance in their roles. At last, it isn't clear what sort of relationships people will shape with AI frameworks once they are progressively fit for natural language, or how this will affect human relationships and work ecosystems.

## 5.9 AI SAFETY

Artificial Intelligence (AI) Safety is aggregated named ethics that we ought to pursue to maintain a strategic distance from the problem of accidents in AI frameworks and unintended and harmful behavior that may rise out of the poor design of genuine AI systems.

## 5.10 LEGAL & ETHICAL FRAMEWORK

Artificial Intelligence (AI) has progressively improved every aspect of our society, like bank and financial institutions, law enforcement agencies, healthcare, govt. decision-making process, humanitarian work, etc. So, there should have a strong legal and ethical framework on how AI would be implemented in applications. AI ethics should be righteous, fundamentally sound, assessable, reversible and inclusive.



## CHAPTER 6: CONCLUSION

The ongoing whirlwind of AI strategies signals a developing enthusiasm among policymakers around the world. Though none of them have a similar arrangement of strategic priorities. Every strategy is unique. The present government of Bangladesh will take on the task of providing a strategic response to the fast advances in the field of AI and also will utilize the developments activated by the innovation to help society at large. Each is needed to shield outstanding position of Bangladesh and to ensure the aggressiveness of Bangladesh industries. We need to elevate the numerous approaches to utilize AI in all stages of society to accomplish substantial advancement in the society. We will concentrate on the advantages for individuals and the earth, and proceed with the serious discourse with all segments of the society. In any case, Bangladesh at this moment isn't all situated in numerous territories of AI innovation. This strategy expands on introductory and existing areas where no or little use of AI has been made to the potential. Up to and including vision 2021, the ruling government intends to make essential strides for the implementation of the national strategy. We give a wide portrayal of the connection between AI and diplomacy. It is clear that AI is turning into an unmistakable topic on the worldwide agenda because of its wide potential. It is additionally certain that AI will impact the political plan and that it will transform several debates as it is directly linked with employment. We concentrate on the structure of national AI ecosystems, information frameworks, and AI applications. Concrete success indicators will add to value to the citizens. Artificial intelligence needs a clear digital landscape guideline and direction. If we can ensure good governance in AI strategy implementation from the very beginning, we can make Bangladesh truly innovative land through AI.

## ANNEXURE

### LANDSCAPE OF GLOBAL AI STRATEGIES

Bangladesh is the new bee in AI Race, but most of the developed and developing countries are investing heavily in artificial intelligence. It depicts the propelled procedure for a machine to settle on choices depends on logic. Artificial intelligence has officially had a worldwide effect on the making of conversational Chabot's, self-driving autos, and suggestion frameworks. Artificial intelligence is developing in its popularity among business pioneers as a rising resource for the workforce and is directly found in numerous enterprises as of now, changing the manner in which organizations and social orders work.

As indicated by an ongoing report by IDC, Artificial Intelligence represented \$12 billion in market interest in 2017. By 2021, that figure is required to ascend to \$57.6 billion. The organization has anticipated that 40% of advanced change activities will be founded on Artificial Intelligence by 2019. Furthermore, 75% of business instruments will utilize this innovation by 2021.

### NATIONAL STRATEGIC PROFILE

Table 1 shows the nine governments with fully funded AI strategies. Funding varies significantly: Australia's strategy is less than US\$25 million, while South Korea's strategy is nearly US\$2 billion.

**TABLE 1: FUNDED STRATEGIES**

Country/ Region	Release Date	Official Strategy	Funding (June 2019 US\$ exchange rates)	Govt. AI readin ess index	UN E- gover nment Devel opme nt Index	GDP (2018)	Per Capita Income (2018)
Australia	May 2018	Australian Technology and Science Growth Plan	\$21.6 m	11	2	\$1.43 bn	\$57,305
Canada	March 2017	Pan-Canadian Artificial Intelligence Strategy	\$95 m	6	23	\$1.7 bn	\$46,124
China	July 2017	A Next Generation	\$2.1 bn	20	65	\$13.61 bn	\$9,770

		Artificial Intelligence Development Plan					
Singapore	May 2017	AI Singapore	\$91.5 m	1	7	\$364.16 m	\$64,581
Denmark	January 2018	Strategy for Denmark’s Digital Growth	\$11.7 m in 2018, \$19.5 m per year up to 2025)	9	1	\$351.30 m	\$60,595
Finland	Final Report is not published yet			5	6	\$275.68 m	\$49,960
Taiwan	January 2018	Taiwan AI Action Plan	\$1.18 bn	41		\$25.03 m	\$24,971
France	March 2018	France’s Strategy for AI	\$1.75 bn	8	9	\$2.78 bn	\$41,463
United Kingdom	April 2018	Industrial Strategy: Artificial Intelligence Sector Deal	\$1.24 bn	2	4	\$2.8 bn	\$42,491
South Korea	May 2018	Artificial Intelligence R&D Strategy	\$1.95 bn	26	3	\$1.62 bn	\$31,362
Germany	November, 2018	AI Made in Germany	\$3.38 bn	3	12	\$3.99 bn	\$48,195
Japan	March 2017	Artificial Intelligence Technology Strategy	\$5.5 bn annually by private sectors	10	10	\$4.97 bn	\$39,286
India	June 2018	National Strategy for Artificial Intelligence	\$957 bn by 2035	17	96	\$2.73 m	\$2,015
Italy	March 2018	Artificial Intelligence: At The Service of Citizens		15	24	\$2.07 bn	\$34,318
Kenya	The government revealed the formation of an 11-person5 task force in February 2018 to develop a block chain and AI			52	122	\$87.91 m	\$1,710

	strategy.						
Mexico	June 2018	Towards an AI Strategy in Mexico: Harnessing the AI Revolution		32	64	\$1.22 bn	\$9,698
New Zealand	May 2018	Artificial Intelligence: Shaping a Future New Zealand		13	8	\$205.02 m	\$41,966
Poland	The government started consultations for development of its national AI strategy in May 2018.			27	33	\$585.78 m	\$15,424
Russia	In March 2018, they hosted a conference titled, “Artificial Intelligence : Problems and Solutions-2018”			29	32	\$1.66 bn	\$11,288
Sweden	May 2018	National approach for Artificial Intelligence	Invested \$4m in several universities for 2018 & 2019	6	5	\$551.03 m	\$54,112
Tunisia	In April 2018 the government launched the development of a national AI strategy, scheduled to be released in the first quarter of 2019.			54	80	\$39.86 m	\$3,446
UAE	October 2017	UAE Artificial Intelligence Strategy	UAE investment across the last decade reached \$2.5 bn	19	21	\$414.18 m	\$43,004
Malaysia	In October 2017 the government announced that the Malaysia Digital Economy Corporation has been tasked with developing a national framework for AI.			22	48	\$354.35 m	\$11,239
United States	October 2016	The National Artificial Intelligence Research and Development Strategic Plan		4	11	\$20.50 bn	\$62,641

Sri Lanka	The National Export Strategy Advisory Committee announced in August 2018 that the country was working on a strategy with the aim of positioning Sri Lanka as a country with AI capabilities.	105	94	\$88.90m	\$4,102
Malta	Malta's Junior Minister announced in November 2018 that Malta had launched an AI task force, focusing on industrialization and creating the world's first citizenship test for robots	43	30	\$14.54m	\$30,074
Israel	Though AI start-ups are benefitting from Israel's excellent innovation ecosystem, the government does not yet have a targeted AI strategy in place. However, it recently announced five committees to help develop a strategy	21	31	\$369.69 m	\$41,614
Estonia	The government is currently establishing an AI Task Force mandated to define national legal, business/industry, and communications strategies.	23	16	\$30.28m	\$22,927

*Data Source (GDP and Per Capita Income, 2018): data.worldbank.org*

## GLOSSARY

**AI:** Artificial intelligence (AI) is an area of computer science that refers to create an intelligent machine that will understand, think, behave and learn like humans.

**Innovation:** The process of transforming an idea or introduce something new.

**R&D:** Research and development (R&D) mean developing a new service or product or improving the existing service or product.

**ICT:** Information and communications technology (or technologies), is the infrastructure and components that enable actions through telecommunications.

**Digital Bangladesh:** It means ICT driven knowledge-based modern country having an adequate power supply, digital infrastructure, internet usage, e-banking, e-commerce, and e-governance, etc.

**SDGs:** The Sustainable Development Goals (SDGs) are a collection of 17 global goals of the universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.

**ITES:** ITES stands for Information Technology Enabled Services.

**ML:** Machine learning (ML) is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

**Strategy:** Strategy is a set of the plan of actions designed to achieve in a long term way.

**Analysis:** Analysis is a process of breaking anything complex in order to understand its structures.

**MDG:** The Millennium Development Goals (MDGs) are eight goals with measurable targets and clear deadlines for improving the lives of the world's poorest people

**GDP:** Gross domestic product (GDP) is a monetary measure of the market value of all the final goods and services produced in a period of time, often annually.

**IoT:** The Internet of things (IoT) is the extension of Internet connectivity into physical devices and everyday objects.

**STEM:** STEM is an approach to learning and development that integrates the areas of science, technology, engineering, and mathematics.

**NLP:** Natural Language Processing (NLP) refers to the AI method of communicating with an intelligent system using a natural language such as English/Bangla.

**GPUs:** A graphics processing unit (GPU) is a computer chip that performs rapid mathematical calculations, primarily for the purpose of rendering images.

**LoRa:** LoRa is a long-range wireless data communication technology with low power consumption which can transmit more than 10 Km in rural areas.