

IN PURSUIT OF
AUTONOMY :



AND NATIONAL STRATEGIES

SAMIR SARAN • NIKHILA NATARAJAN • MADHULIKA SRIKUMAR

In Pursuit of Autonomy: AI and National Strategies

Authors: Samir Saran, Nikhila Natarajan & Madhulika Srikumar

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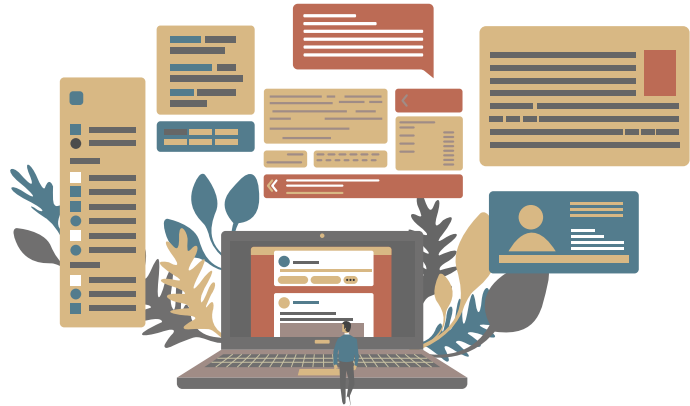
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In Pursuit of Autonomy: Examining Twelve National A.I. Strategies

BRIEF

Industry leaders and politicians the world over are scrambling to lead the development and use of artificial intelligence (AI) for the power and value it accrues. However, AI promises to implicate more than just politics and economics. It poses fundamental questions on how societies and communities will be organised in the future—capable of radically transforming workforce and work-life as we know it.

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If governments are unable to foresee changes in the jobs landscape that the technology will bring about—and fail to deliver on its responsibility of providing opportunities for its people, especially the youth—they will have to bear the political backlash

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In the last 24 months alone, more than a dozen countries have devised national strategies on AI; many of these tomes run into several hundred pages. This publication examines 12 of these national strategies: the US, UK, EU, Germany, South Korea, Singapore, India, France, China, Canada, UAE and Japan.

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This publication examines 12 of these national strategies: the US, UK, EU, Germany, South Korea, Singapore, India, France, China, Canada, UAE and Japan.

While some countries are beginning to explore the competitive advantage across the full spectrum of AI deployment; others are studying the potential benefits that this predictive technology can offer.

Even as governments may be unaware of what the full connotation of AI might be, they are determined to drive the debate and deployment around this new suite of technology and life. If governments are unable to foresee changes in the jobs landscape that the technology will bring about—and fail to deliver on its responsibility of providing opportunities for its people, especially

THE MOTIVATIONS

The ongoing AI race - often likened to the Sputnik launch in 1957 and the resulting space rivalry between erstwhile USSR and the US - signals a new reckoning in technological progress and, consequently, economic and military superiority. The Soviet Union's Sputnik launch was met by the US with redoubled investments in science and technology, which would eventually lead to the moon landing in 1969. Likewise, AlphaGo's triumph over Lee Se-dol - the South Korean master of board game Go, caused the world to begin taking note of the massive potential of AI.

Indeed, AI is no longer in the horizon; it is here. Kai-Fu Lee, a renowned expert in the subject remarked, "We're not in the age of discovery, we're in the age of implementation."ⁱ

From Apple's voice assistant Siri, to Amazon's smart speaker Echo, and Tesla's self-driving cars - Big Tech is busy making good on the promise of "intelligent machines". And these are only the AI applications which can be seen. Companies world over are rushing to leverage AI to power their back-end production in addition to transforming their products.

By one estimate, the global GDP in 2030 will be higher by 14 percent, i.e. an additional US\$ 15.7 trillion, as AI contributes to rapid productivity gains. The highest economic gains from AI are expected to be realised by China, with a 26 percent growth to their GDP by 2030, and the US with 14.5 percent.ⁱⁱ

As was the case with the Cold War-era space race, the increasing development, and imminent deployment of AI by states in civilian and military domains will threaten the current global order - even reshaping how states and businesses operate and succeed. While some countries like the US, China and Russia have a considerable head start in terms of talent, investment and research, no government wants to be perceived as being complacent. The fear of job loss due to automation, concerns around algorithmic bias, safety of AI systems, and the emergence of autonomous weapons further provoke the involvement of the state in steering the conversation.

From the sectors poised to become the early adopters, to the unique value propositions that each state can offer - governments are fighting to grab a share of the AI pie. Early leadership in the field of machine learning, natural language processing and other related areas will not only determine who captures value in the supply chain but also establish their "autonomy" in the AI race.

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A.I. NOW

Strip away the hype surrounding AI, the core of the technology is a natural progression in computational efficiency. The technology empowers any individual, organisation or government to find and fill missing information—gaps in knowledge that were previously addressed within the remit of traditional statistics.

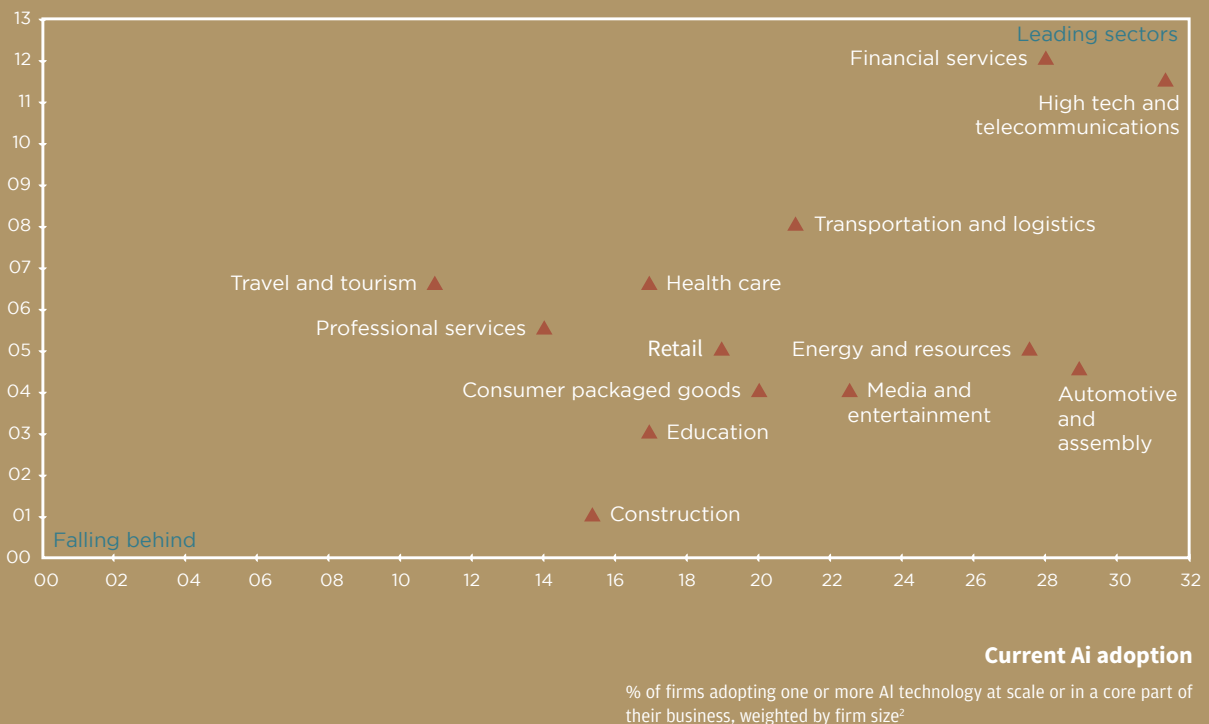
Machine learning—which is an application or subset of AI—has become powerful in recent years by providing the tools to learn automatically without being explicitly programmed. While machine learning has been around since the late 1950s, its recent success is attributed to complex algorithms, increased availability of data used to “train” such algorithms, and powerful computing.

Current artificial intelligence, however, does not invoke the Hollywood depiction of a trans-human or superintelligence. Instead, AI applications that are built to perform a single task, or narrow AI, are well within the realm of the possible. Experts project that rapid progress will continue to be made in narrow or specialised AI including speech and image recognition, computer vision, and natural language processing. AI can even surpass human intelligence in some cases. Since DeepMind’s AlphaGo defeated a World Champion in 2016, the second, more superior iteration of the software, AlphaGo Zero, is self-taught and no longer relies on human input.^{iiiv}

Sectors leading in AI adoption today also intend to grow their investment the most

Future AI demand trajectory¹

Average estimated % change in AI spending, next 3 years, weighted by firm size²



1. Based on the midpoint of the range selected by the survey respondent.

2. Results are weighted by firm size. See Appendix B for an explanation of the weighting methodology.

SOURCE: McKinsey Global Institute AI adoption and use survey. McKinsey Global Institute analysis^v

Figure 1: AI Adoptions by sector

Experts argue that AI can be added to the club of future General Purpose Technologies (GPTs) like the steam engine or electricity, which can spawn a wide array of additional innovations and capabilities over the long term.^{vi} Since the advent of earlier GPTs, societies that made complementary investments in building skills, resources, and infrastructure thrived during the ensuing transition.

Given this reality, almost every country strategy calls for a better understanding of how machine learning will affect the performance of specific tasks since it will ultimately impact economic growth.

States are embracing at least four key responsibilities:

- Put in place policies that will help the workforce thrive in a more automated economy
- Mitigate the negative impact of workers' displacement from familiar roles
- Create jobs in entire sectors that are emerging
- Build data ecosystems that feed back into domestic innovation

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- **Creating jobs in entire sectors that are emerging**
- **Building data ecosystems that feed back into domestic innovation**

PIECE OF THE AI PIE

Several states seek to leverage their strengths to emerge as drivers of innovation in the AI age. Japan, for one, plans to build on its success in robotics – creating the same impact in business and standards-setting internationally as they do in technology. South Korea, Germany and Singapore lead the field in their zeal for curriculum reform, lifelong learning, occupational training and workplace flexibility. Given the comparative resource constraints, the UK is preparing to play a role in the scholarly high ground and forge a role for itself as a “pioneer in ethical AI.”

USA	Take advantage of military clout; train the next generation of workforce
UK	Develop AI in diagnostic health; become leader in ethical AI
EU	Propose a values-based AI; utilise AI to prepare for socio-economic changes
Germany	Reimagine work in the AI age; enriching work-life balance
Singapore	Build AI capabilities that are beneficial to people; “grow our own timber” i.e., groom domestic talent
South Korea	Lead global AI R&D investments
China	Drive military-civil fusion i.e. knowledge sharing; establish global technical standards in AI
Japan	Build on success in robotics; reinvigorate productivity through AI
India	Use AI for inclusive growth; archive AI relevant data and make it accessible
France	Safeguard French and European strategy; make AI environment-friendly
Canada	Leverage leadership in AI research; attract global talent
UAE	Cut government costs and boost government performance through AI

The current US government’s approach is a stark departure from the urgency of the landmark AI policy from the Obama era—the first meeting of its AI Select Committee took place only at the end of June 2018, a full two years after Trump came to power.^{vii} The Chinese government, on the other hand, is committing extraordinary resources to its AI push; calling for homegrown AI to match Western capability within three years, for China’s researchers to be making “major breakthroughs” by 2025, and for Chinese AI to be the envy of the world by 2030.

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India is the latest country to announce a national AI initiative highlighting its ambition to become an “AI garage” or solutions provider for 40% of the world.

Europe, meanwhile, is defined by a more cohesive purpose with European values and ethics at the core of their AI vision. French President Macron earlier this year announced that the state is pumping in US\$1.6 billion in funding to establish AI research centres, data-sharing platforms and ethical guidelines.

India is the latest country to announce a national AI initiative highlighting its ambition to become an “AI garage” or solutions provider for 40% of the world.

Although most countries are taking an “all of the above” approach to their AI strategy, they are also singling out certain prerogatives; some do it implicitly, others boldly.

DAWNING AMBITIONS

Most, if not all, strategies seek to preserve national interest and pluralism in the face of increasing US-China bipolarity. To be clear, the pursuit of AI is more than an arms race, and these dual use technologies ultimately rely on R&D conducted in universities and within the private sector. However, it is undeniable that whether it is in DC or Beijing, an AI ecosystem thrives either with the patronage of the defence industrial complex or state-owned enterprises.

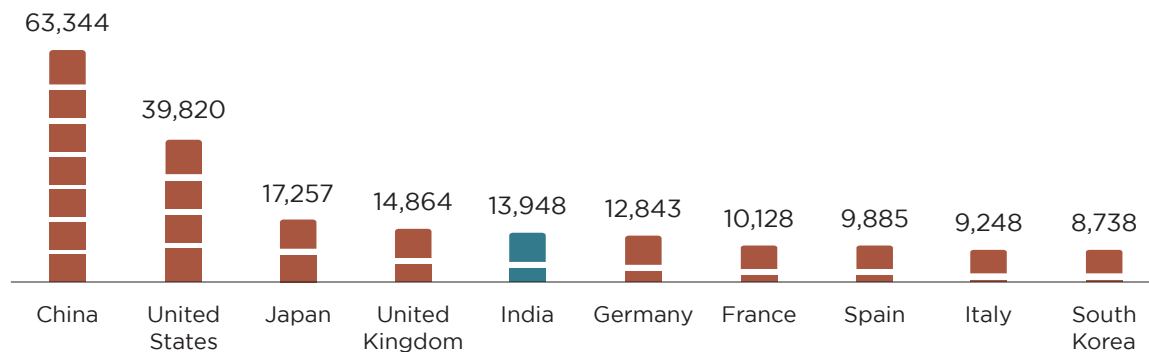


Figure 2: China Leading in number of AI research papers cited

Source: Scimago Journal and Country Rank (SJR)^{viii}

In 2014, China overtook the US in the number of research papers both produced and cited on the subject of deep learning.^{ix} An analysis of the number of research citations on AI conducted by Elsevier and The Nikkei in 2017, ranked the China Academy of Sciences above both Carnegie Mellon University and the Massachusetts Institute of Technology.^x China’s AI success is attributable to efforts by the government as well as the easy availability of data, aided by weak privacy protections. In contrast, breakthroughs in AI in the US are largely driven by the pioneering efforts of Big Tech and the startup ecosystem.

The US’ populist and protectionist posture has led to both tightening of its domestic R&D budget and increasing scrutiny of Chinese investments^{xi} – neither is going to prevent China’s dominance. Even as these two states battle it out, experiences of the last 200 years carry the lesson that an unlikely nation may very well emerge as a leader.

The US- China duopoly has left the rest of the world scrambling to discover their priorities and role in the global value chain. President Emmanuel Macron noted that while maintaining international cooperation and open architectures are crucial, his goal is to “recreate a European sovereignty in AI.”^{xii} This is borne not just out of the US’ declining normative leadership but also the realisation that values that drive the growth of AI cannot come from an oligopolistic private sector or from within the Chinese Firewall.

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Even as China and the US battle it out, experiences of the last 200 years carry the lesson that an unlikely nation may very well emerge as a leader.

This motivation is central not only to the European vision but other geographies, too. In a world dominated by data collection and analytical capabilities of Silicon Valley - two billion-user ecosystems have emerged across the Atlantic. The Baidu-Alibaba-Tencent (BAT) supercluster has proven to be as competitive as Silicon Valley. On the other hand, India's digital identity programme, Aadhaar, has successfully made data of more than a billion people part of the public infrastructure. A parallel, decisive expression of sovereign control on the digital economy has emerged not from the US or China but from the EU in the form of the GDPR.

Leadership in technology has been thrown wide open. If the size of the market determines technology dominance then EU, US, China and India have all begun exhibiting the ability to mould policy debates. In many ways, it is this multipolarity that has motivated the selection of the 12 national strategies examined in this report.

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SCOPE OF THE REPORT

In the past two years over 20 countries have established committees or task forces to create national AI strategies or deliberate on related policy goals such as future of work. While some have already launched their initial strategies, others are due to launch theirs in the coming year.

Not all strategies look the same. Canada, for instance, which was the first country to release an AI strategy, launched a C\$125 million plan focused only on strengthening research and talent.

Other strategies have taken a broad view and weighed in on different elements: research and development, skilling and education, public and private sector adoption, data collection and sharing, and ethics and regulations. The purpose of this report is to provide the reader with an overview of what countries have proposed in each of these elements. This study is not an exercise in “rating” countries since comparing ambitions is futile - of chief importance is whether they put their money where their mouth is. Compared to other advanced economies, China, for instance, has the proven track-record of implementing large-scale projects and getting things done. The US, on the other hand, with a change in government and political disposition is feared to have dropped the ball on AI.^{xiii} The radial graphs at the beginning of each country profile, therefore, indicate the relative strengths or focus areas of each country's national AI strategy.

There are countries that have released national AI strategies that this version of the report does not address, including Mexico, Sweden and Taiwan. Then there is Estonia that has already made remarkable strides towards completely digitising their society, currently debating if robots should receive legal recognition.^{xiv} In the coming months, Estonia, Tunisia, Kenya and Germany are expected to release their national AI strategies. AI, like other emerging technologies, also ties into existing flagship initiatives that states have already unveiled and will increasingly feature in bilateral engagements. To that extent, studying the evolution of AI from a geopolitical point of view poses challenges as the landscape becomes more complex. As a result, this report will be revisited in time to incorporate crucial developments in the space.

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United States of America



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Focus on Economic Growth and Jobs, National Security and Government Reform

The US government's stated AI plan spins around three pivots: economic growth and jobs, national security, and government reform. "Artificial Intelligence for the American People", the official policy document published in November 2017ⁱ, lays out the broad framework of the country's AI strategy:

- Prioritising funding for AI research and development
- Removing barriers to AI innovation
- Training the future American workforce
- Leveraging AI for government services
- Achieving strategic military advantage

Improve Federal Administration

The US is prioritising use of automation software to improve efficiency of government services and maximise federal data sharing with the American public.

Defence Applications

The national defence strategy is committed to investing in military applications of autonomous systems, AI and machine learning. Other elements include priority for information ecosystems from tactical level up to strategic planning; capabilities to gain and exploit information and deny competitors the same advantages and enable the US to defend against and hold accountable state or non-state actors during cyber-attacks.ⁱⁱ

Building the Fastest Super Computers

In June 2018, the US Department of Energy unveiled a new supercomputer, Summit, which can beat China's fastest machine to take the title of world's most powerful supercomputer.ⁱⁱⁱ Summit is the first supercomputer designed from the ground up to handle machine learning, neural networks and other AI applications.

DATA ECOSYSTEM

Prudent about Data Sharing

The US government is prepared to release any data that might help fuel AI research. "Anything that we can do to unlock government data, we're committed to", Michael Kratsios, Deputy US Chief Technology officer, told a tech conference on 6 June 2018.^{iv} However, no specific details were given about what kind of data would be released or who would have the access to such data. The overall tone of Kratsios suggested prudence in the government's approach.

The US policy on AI is less public than many other governments. The idea of more informed policymakers and citizenry and the ability to articulate the advances better between the government and public is gaining currency.

SKILLING FOR THE AI AGE

Ensure Well-being of Workers

The well-being of the American worker is the focal point of the White House's AI agenda. The 2017 AI strategy points out that a four-year educational degree may not be the right choice for everyone in this economy and may not be a practical possibility for more experienced workers. The strategy notes that policies must instead "... reflect the fact that people learn not just in lecture halls and libraries but on factory floors, in offices and out in the field".^v

At least USD\$200 million per year "must go" to funding STEM (Science, Technology, Engineering and Math), specifically computer science education and expansion of apprenticeship programmes, work-and-learn models and their proper credentialing. This has been matched by private industry commitment of US\$ 300 million.^{vi}

Push for Apprenticeship Expansion

The AI strategy document is connected to the Trump government's apprenticeship push,^{vii} with industry-recognised apprenticeship programmes asked to expand traditional work-and-learn models. The US government recommends that apprenticeship certifications should incorporate core components of the most successful work-and-learn models, including:

- Blended Learning (combine online and offline education)
- Paid work experience and advancement opportunities
- Portable, industry recognised credentials, programme completion certificates and/or degrees with demonstrable labour market value
- Make technical instruction more affordable for apprentices and employers

ETHICS AND REGULATION

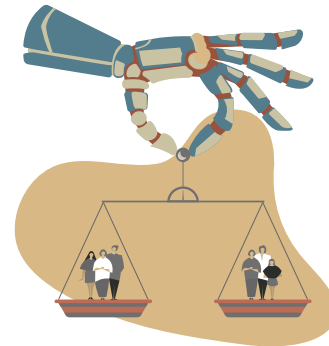
Light Touch Regulation

The US lawmakers believe that the subject of privacy and ethics in the field of technology is a matter of “national discussion” because the US is “culturally different” on privacy from other countries. The White House AI chief’s remarks cement the view that the US government is seeing its role as a light touch regulator, except in matters of AI in national security.^{viii}

The White House has assured America’s top companies that they will have the greatest possible latitude to develop AI. The Deputy US Chief Technology Officer, Michael Krastios, addressing a gathering in May, 2018 remarked, “We didn’t cut the lines before Alexander Graham Bell made the first telephone call...In the private sector, we will not dictate what is researched and developed. Instead, we will offer resources and the freedom to explore.”^{ix}

The Department of Transportation, for instance, released an update to the 2016 Federal Automated Vehicles Policy to enable integration of self-driving cars onto the American roadways.^x

Easing the pressure on drones’ regulation is big ticket item. Currently, it is illegal to fly commercial drones in the US over people or beyond visual line of sight, so the government is testing out regulatory sandboxing this year.



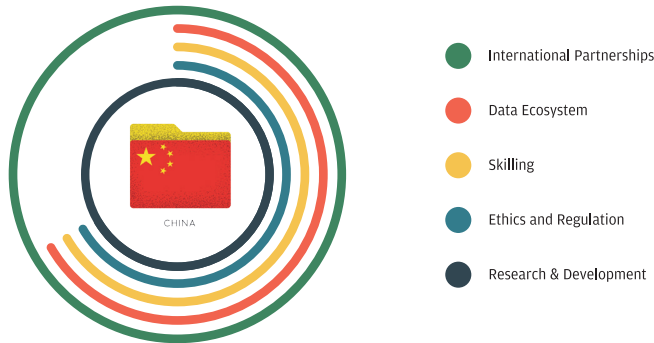
RESEARCH AND DEVELOPMENT

Priorities for Machine Learning and Autonomous Systems

Investment in R&D for AI and related technologies has grown by over 40 percent since 2015 but sector-wise teasing these numbers is tricky - the White House has not earmarked the funding for AI in military. The US government invested USD\$1.1 billion on unclassified R&D for AI systems in 2015 and an estimated US\$ 1.2 billion in 2016. In a first anywhere in the world, President Trump’s FY2019 Budget Request designated AI and autonomous and unmanned systems as a funding priority in R&D. Following are the highlights for research and development activities pertaining to AI in the US:

- The Department of Defence is working to deliver AI-driven algorithms to war fighting systems. The goal is to rapidly turn data into decision-quality insights.
- The National Institute of Health is using high performance computing to drive cancer research.
- The Food and Drug Administration (FDA) approved the first ever AI-based device for medical diagnostics to detect diabetic retinopathy, the leading cause of blindness among working-age Americans.
- Defence Advanced Research Projects Agency (DARPA) in September, 2018 announced an investment of US\$ 2 billion in AI research over the next five years. The programme titled, AI Next, will focus on ““enhancing the security and resiliency of machine learning and AI technologies, reducing power, data, performance inefficiencies and [exploring] ‘explainability’” of these systems”.^{xi}

China



OVERALL STRATEGY¹

Become AI leader by 2030 through Informatisation and Intelligentisation

China has launched a three-year action plan from 2018 to 2020 to step up industrial development, deployment and integration of AI across sectors.ⁱⁱ It intends to pursue a ‘first-mover advantage’ to grow into the world’s “primary AI innovation centre” by 2030. The government has further stated that AI will not only be a priority but the backbone of the country’s “industrial upgrading and economic transformation” as laid out in the Made in China 2025 plan.

As experts have noted, the three-year plan is an extension of China’s informatisation agenda - of moving towards a knowledge economy driven by the tech sector.ⁱⁱⁱ The national strategy emphasises on closely integrating AI in all sectors of the Chinese economy or “intelligentisation”. The focus sectors include manufacturing, agriculture, logistics, finance, commerce and household goods. China has additionally announced a plan to utilise AI to increase energy efficiency of the manufacturing sector by 10 percent.

Leveraging “International Innovation Resources”

China is encouraging its domestic AI enterprises to leverage international resources by developing cooperation with foreign universities and research institutes. This approach, termed as “going out”, drives the Chinese companies towards international partnerships through overseas mergers and acquisitions, equity investments and venture capital. Additionally, the approach calls for Chinese companies to set up research and development centres abroad while encouraging foreign companies to put down their roots in China. China will also rely on the “One Belt, One Road” initiative to build joint research centres to study AI.

Use of AI in Governance

China intends to lay out the infrastructure for a “smart society” by transforming not only cities and manufacturing but also governance through AI. The government is looking to re-imagine government services, such as social security and pension management, which will make service delivery more efficient. China is also keen to take advantage of AI to control threats through intelligent monitoring and mechanisms for early warnings.

Knowledge Sharing between Military and Civilian Use

According to China's strategy, AI advances will be shared between the civilian and military establishments by increasing communication and sharing among universities, companies and the military. China is looking to utilise AI as a "powerful support to command decision-making, military deduction, defence equipment and other areas".

DATA ECOSYSTEM

Open Source and Open Approach

China calls for an "open source and open approach" and creation of "AI innovation clusters" to leverage collaboration between industry and academia. This framework would rely on the creation of open source platforms for sharing the entire spectrum of applications like hardware, software and design tools for creation of AI systems.

SKILLING FOR THE AI AGE

Incentivise Scientists in Strategic Domains

The Chinese government, to build formidable local AI talent, will institute education reforms including introducing a new AI discipline, degree programmes and specialised courses in universities. China has also planned a recruitment plan called "Thousand Talents" to incentivise scientists in strategic domains to pursue their research in China.

ETHICS AND REGULATION

Laws and Ethical Frameworks for Healthy Development

China sees the development of laws, regulations and ethical norms as both ushering the development of AI as well as ensuring the safety and security of these systems. China's strategy calls for research ethics to create a "moral multi-level judgment structure" building machine and human integration.

Further, the AI strategy asks for more clarity on the relationship between AI and legacy legal frameworks. It correctly identifies that issues like criminal liability, privacy protection and property ownership will need to be resolved as AI is deployed across sectors.

R & D

The total output value of artificial intelligence industries should surpass 1 trillion yuan (US\$ 147.80 billion). The plan prescribes a high level of government investment in theoretical and applied AI breakthroughs.

Financial Support Mechanisms

China's strategy intends to complement existing modes of market-funding with other investment modes to support research into fundamental and advanced AI, especially those that would serve a public purpose.

Focus on “AI 2.0” Technologies

China’s three-year action plan for promoting development of a new generation AI industry (2018-20) calls for development of “AI 2.0” technologies, such as swarm intelligence and hybrid systems that achieve human-machine integration. A specific focus of China’s approach is achieving breakthrough in systems that can transform the sector. These range from “quantum-accelerated machine learning” to self-adaptive systems akin to artificial general intelligence. It sets out specific benchmarks for 2020 in a range of AI products and services, including smart, inter-connected cars, and intelligent service robots.

Setting Global Technical Standards

Academics, industry researchers and government experts gathered in Beijing November 2017 to discuss AI policy issues. The resulting document, published in Chinese recently, shows that the country’s experts are thinking in detail about the technology’s potential impact. Together with the Chinese government’s strategic plan for AI, it also suggests that China plans to play a role in setting technical standards for AI going forward.

France



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Target Key Sectors and Use AI to Support Ecological Transition

France's US\$ 1.8 billion strategy¹ for development of AI focuses on four strategic sectors: health, mobility, environment and defence. Besides improving economic performance through the use of AI, the strategy highlights public interest as a policy goal. For instance, France has committed to supporting those working in social action field such as dependency, health, social action and solidarity. The strategy clearly outlines the role of the government by stating, "the state will not steer the movement of these sectors except to provide resources, unite various ecosystems around pooling platforms and allow experimentation".

Recognising that the growth of AI and digital technologies would contribute to negative environmental impact, Paris has prioritised the use of AI to support ecological transition. Some of the crucial recommendations include implementing a platform to measure environmental impact of smart digital tools; supporting ecological transition of the European cloud industry; and liberating ecological data. Under the latter recommendation, the strategy notes instances where drones can be used to carry out reforestation and mapping of living species through image recognition technology.

Build and Test Sector-specific Platforms

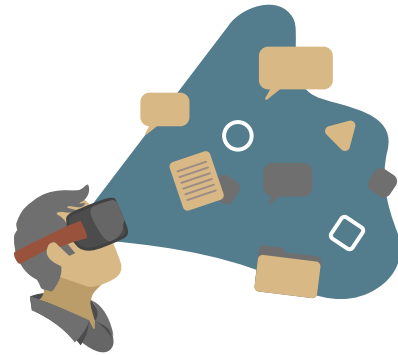
France is set to establish sector-specific commissions responsible for identifying how AI can meet challenges in their respective areas, publicising and running activities for their ecosystems. Some of the challenges recognised in the strategy include early detection of pathologies, P4 medicine and zero-emission urban mobility. Further, the AI strategy calls for establishing sector-specific platforms to compile and capture relevant data; provide access to large-scale computing infrastructures; facilitate innovation by creating controlled environments for experiments and enable development, testing and deployment of operational and commercial products. These platforms will bring together diverse stakeholders like researchers, companies and public authorities.

Institutionalise Innovation Sandboxes

France has proposed implementing testing areas or sandboxes to support innovation in AI. As per the strategy, these are the following attributes of an innovation sandbox:

- Easing regulatory requirements to help actors test innovations
- Support to help “actors shoulder their obligations”
- Resources to run experiments in “real-life” conditions

The goal of these sandboxes, as recognised by the strategy, is to facilitate “testing, iterative design and deployment” of AI technologies in line with the requirements of future users.



Promote Diversity in AI and Increase Women Participation

Since there is threat of digital technologies perhaps reinforcing and exacerbating social and economic inequalities, the French strategy looks to AI to reduce these inequalities in societies. To increase female participation, France will work towards ensuring that 40 percent of those enrolled in computer engineering courses are women by 2020 through an incentive policy.

DATA ECOSYSTEM

Encourage Public and Private Sectors to Share and Pool Data

France has outlined a clear strategy where the government in addition to opening up its own data can also incubate a data sharing platform for businesses that are willing to free up their data. The data can either be made widely available or made accessible only to the government.

The data sharing platform or exchange would be established with the support of French data protection authority and the Direction Général des Entreprises (General Directorate for Enterprises) who can guide the industry on best practices and standard contracts. The data can be shared in the form of APIs and specifically in the case of automated vehicles, crash data can be shared. EU reforms in the pipeline such as the directive on re-use of public sector information and EU copyright rules that can authorise text and data mining, can facilitate better access to data. European sovereignty takes centerstage as France seeks to leverage the high standards of protection found in the EU General Data Protection Regulation (GDPR) and data portability laws to control data transfers.

SKILLING FOR THE AI AGE

Set up a Public Laboratory on Future of Work

France proposes the setting up of a unique “public laboratory” to study the impact of AI on labour and future of work. An index measuring complementarity between humans and machines will be developed to aid businesses to facilitate better transition to future jobs. The strategy recognises the need to devise new funding methods to sponsor vocational training and to test it through social dialogue.

ETHICS AND REGULATION

Instil Human Accountability in Ethical Issues of AI

The strategy calls for a better understanding of how algorithms operate and how best they can be audited to prevent discrimination - designing a “discrimination impact assessment” in the same vein of privacy impact assessments. The civil society must be empowered to carry out these assessments on their own. Specifically, the potential harmful use of predictive algorithms in public services, especially law enforcement has been highlighted.

Further, training in ethics for AI engineers and researchers has been proposed. Additionally, an ethics committee consisting of experts in the subject will be convened to raise awareness and discourse on the subject.

RESEARCH AND DEVELOPMENT

Make AI Research Attractive

France - with the aim of reducing the gap in its research capacity in comparison to the AI powers - plans to make careers in AI research more attractive and lucrative to both local and foreign talents. The strategy lays out the approach to achieve this - increase salaries of researchers, create interdisciplinary AI institutes and strengthen partnerships between academia and industry. The strategy plans to allocate resources to build a supercomputer designed for AI applications in partnership with manufacturers.

United Kingdom



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Prepare for the Fourth Industrial Revolution through Foundational Reform

UK's broad priorities in AI are outlined in the Industrial Strategy White Paperⁱ which builds upon a previous independent report released titled, "Growing AI Industry in the UK"ⁱⁱ. Some of the main action areas highlighted in the strategy include:

- Find ways to use data and AI for prevention, early diagnosis and treatment of chronic diseases by the year 2030, especially for cancer diagnosis.
- Lead the world in safe and ethical use of data and AI and offer citizens and businesses more confidence and clarity in the subject.
- Use automation to do extreme jobs which endanger human life.
- Help people develop the skills needed for the future jobs.

In April 2018, the UK Government released its AI Sector Deal which makes concrete commitments to "five foundations of the Industrial Strategy": ideas, people, infrastructure, business environment and places.ⁱⁱⁱ The government earlier this year announced an AI investment worth £1 billion comprising of almost £300 million in private sector funds and the rest in government funding to boost research, skilling initiatives and build a new Centre for Data Ethics and Innovation.

DATA ECOSYSTEM

Open to Data Sharing

The AI Sector Deal emphasises the need for critical data infrastructure to meet its AI ambitions. The government has proposed opening up more datasets, improving machine readability and managing trust and access to sensitive data.

SKILLING FOR THE AI AGE

Upgrade Math, Digital and Technical Skills

The UK government is committed to bring pride and respectability back to math learning and STEM - the country has pledged to raise investment by £406 million in math, digital and technical skills. The investment also includes £84 million over the next five years to improve the teaching and increase participation in computer science.

UK's plan includes upskilling 8,000 computer science teachers, setting up a new National Centre for Computing Education and investing £30 million to test the use of AI in EdTech. The UK's AI White Paper calls for two hundred more positions in AI at leading UK universities, attracting candidates from diverse backgrounds and from around the world.

ETHICS AND REGULATION

Safe and Ethical Use of Data and AI

The government is investing £9 million in a new Centre for Data Ethics and Innovation - an area of particular interest because the country is unable to compete on total AI spends against the giants. The House of Lords Select Committee on AI recommended in April 2018 that a cross-sector AI code be established which can be adopted internationally. The committee suggested the following five principles for the code:

- AI should be developed for the common good and benefit of humanity.
- AI should operate on principles of intelligibility and fairness.
- AI should not be used to diminish the data rights or privacy of individuals, families or communities.
- All citizens should have the right to be educated to enable them to flourish mentally, emotionally and economically alongside artificial intelligence.
- The autonomous power to hurt, destroy or deceive human beings should never be vested in artificial intelligence.

R & D

Build on Research Momentum in AI

The UK is currently ranked fourth in the volume of academic papers published on AI, behind China, the United States and Japan with almost 15000 papers published between 2010 and 2016. The country over the past few years has focussed on building a strong research infrastructure to support the creation of intelligent systems.

The Alan Turing Institute, founded in 2015 as a joint venture between five of the country's most respected universities, has been established as UK's primary national research institute for data science and AI. The Institute was set up with a grant of £42 million. UK's Engineering and Physical Sciences Research Council (EPSRC) supports 143 relevant research grants under one of its key objectives: deliver intelligent technologies and systems.

The AI Sector Deal pledged to commit £20 million to a Next Generation Services Industrial Strategy Challenge to encourage academic and industrial research. The deal pledged an additional £20 million to a "GovTech Fund" which will enlist tech businesses to help provide innovative AI solutions for public services.

Canada



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Leverage Existing Global Research and Talent Leadership in AI

The Canadian AI strategy, unlike its counterparts, is not a detailed or lengthy document.¹ Instead, Canada has chosen to throw their weight behind their existing leadership in AI research by focussing on training, attracting and retaining the best talent. The Canadian Institute for Advanced Research (CIFAR) is leading the government's US\$ 125 million Pan-Canadian Artificial Intelligence Strategy, working in partnership with three just-established AI institutes - Alberta Machine Intelligence Institute (AMII) in Edmonton, Vector Institute in Toronto and MILA in Montreal.

The CIFAR, a government funded institute, has been tasked with administering the grouping since it is credited with making early strides in ML research and hosting prominent thinkers from all over the country. Canada is keen to build on this "home advantage" by continuing to recruit and retain international talent in Canadian universities, private sector and government or private AI labs. One of the top priority areas include using AI to tackle public health challenges through interdisciplinary research.

Become the Preferred Destination for Public-Private Partnership and AI Labs

With the country firmly in the driver's seat in theoretical and scientific research, the government is geared towards creating more jobs in the sector. In its 2017 budget, the government launched a proposal to accelerate innovation through public-private partnership with business-led super-clusters. For instance, the Quebec based Supply Chains Super-cluster will, bring retail and other sectors together to "build intelligent supply chains through AI and robotics." The initiative, amongst other objectives, seeks to gain a global advantage by participating aggressively in international standard-setting fora to embed Canadian IP and approaches into new standards. The country over the past years has also fast grown into one of the most preferred destinations for investors, start-ups and privately funded AI labs. Google's DeepMind, Facebook and Samsung, to name a few, have funded and established research labs in the country.

SKILLING FOR THE AI AGE

Attract Best Talent and Train Researchers to Ensure Sustained Leadership

Building on the Canadian Institute for Advanced Research (CIFAR)'s earlier success with training schools in AI, the Canadian government proposes to host a National AI programme to support and advance existing research and collaboration. The programme includes an annual meeting of CIFAR's newly set up academic chairs in AI - approximately 50 chairs - which will be appointed across three recognised institutes, with over 50 percent expected to be recruited from outside Canada. CIFAR has announced its International Scientific Advisory Committee which will oversee the Pan-Canadian Artificial Intelligence Strategy. The CIFAR chairs will recruit top academic researchers and fund their research, train students and interact with the industry. Canada looks to recruit and retain leading talent in deep learning and reinforcement learning.

ETHICS AND REGULATION

Understanding Future Implications of AI on Society

The Canadian strategy has dedicated funding to understand how advances in AI will have profound implications for the economy, government and society. The strategy will fund policy-relevant working groups to examine these implications, publish their findings and inform the public and policy-makers. The Montreal Institute for Learning Algorithms, for instance, has recognised increasing equality and diversity as a priority to create AI that is beneficial for all.

Promoting Inclusive and Human-Centric AI

Canada, in partnership with France, is leading an international study group to promote a vision of human-centric artificial intelligence grounded in human rights, inclusion, diversity, innovation and economic growth.ⁱⁱ The group will consist of experts from government, industry and civil society and be mandated to become the global reference on issues related to artificial intelligence. The group will analyse the scientific, technical and socioeconomic information needed to gain a better understanding of technological developments in artificial intelligence and to identify the consequences of their use.

Canada and France will establish a task force, which could include other interested parties, in order to make recommendations on the scope, governance and implementation of the international study group. By the end of the year, the task force will submit a report on the implementation of the international study group, the results of which will be shared within the G7.

R & D

Capacity Building in Deep Learning and Reinforcement Learning

Canada's strategy is to fund three AI institutes in Edmonton, Montreal and Toronto for deep learning and reinforcement learning research.

These three AI Institutes are expected to liaison with the industry and other stakeholders to provide the "critical mass of research and innovation excellence". The government funded Vector Institute in Toronto, for instance, has the backing of tech giants like Google to assist startups with obtaining funding for their ongoing work. The Montreal's Institute for Learning Algorithms (MILA) facilitates and democratises access to talent and research for applied AI in the business sector. The institute is said to be one of the largest public deep learning labs world-wide.

South Korea



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

A “Human-Centered Intelligent Information Society”

The Ministry of Science, ICT and Future Planning (MSIP) of South Korea released its main thought paper on AI, “Mid to Long Term Master Plan in Preparation for the Intelligent Information Society” in July 2017.ⁱ A year later, South Korea announced an ambitious national plan to invest US\$ 2 billion by 2022 to strengthen its AI R&D capability and close the gap with the US.

South Korea is currently a global leader in researching and adopting emerging technologies. It has topped the Bloomberg Innovation index and EIU rankings for intelligent automation readiness with high scores on innovation environment, labour market and education policies.ⁱⁱ Among its big innovators is tech titan Samsung, which has established AI labs in South Korea, Canada, US and Russia; and with 3,188 AI patents over the last 12 years, catapulted South Korea to third place in global AI patent rankings.ⁱⁱⁱ

The South Korean AI strategy pins its priorities in accordance to different actors - business, government, citizens and research community. It is one of the few strategies worldwide that lay out cost savings that would accrue from AI adoption across nine sectors until 2030. The objectives are the following:

- Big data: Create a national public database, which would include adequate protections such as blockchain.
- Investment in AI R&D: Support basic and applied science research in universities and research centers.
- Infrastructure: Develop network infrastructure - including 5G - to permit rapid transmission of and easy access to data.
- Integrate AI in public services: This would include law and order, social security, and public transport.
- Foster a business environment conducive to innovation
- Education and workforce training in basic IT skills
- Social security net and other preventive measures for societal changes that may occur as a result of AI

DATA ECOSYSTEM

Create a Data Exchange Data Portal

South Korea plans to create an open data platform based on existing databases that can serve as a data exchange. This would be compounded with the launch of free data zones to allow businesses to experiment with various data formats. The K-MyData portal would also allow businesses to exchange data with other businesses with the consent of their customers.

South Korea will categorise private data into identifying information covering demographic data and non-identifying information that could cover more private information like health data.

SKILLING FOR THE AI AGE

Overhaul Education System and Working of Labour Market

South Korea wants to move beyond rote learning to a system centred around problem-solving and critical-thinking. Its national AI plan proposes to operationalise an intelligent platform that tailors educational activities for students based on their interests and capacity. In the process it wants to create 50,000 prodigies that would specialize in software development, IT and data analysis. Korea also wants to award 3000 new masters and doctoral degree holders that specialize in intelligent IT systems.

To account for changes to its existing workforce, South Korea is analysing patterns in job-seeking behaviour, services, education and training. It is also extending financial aid to job seekers and developing new standard labour contracts for workers that will work in a non-regular capacity.

ETHICS AND REGULATION

Laws and Institutions for Intelligent IT

South Korea believes it is “necessary to reform existing laws and institutions” to ensure safety of IT systems and to allow individuals and businesses to use them optimally. It plans on revising existing legislation and introducing new legislation to recognise the rights and responsibilities of “electronic persons”.

It is planning on creating a Charter of Ethics aimed at developers of intelligent IT and its users to reduce the misuse of advanced technologies. A central aspect of this would be recognising data ownership as the equivalent of owning movable and immovable assets and applying same rules of access, use and liability.

R & D

Collaboration with European Union

South Korea ranks among the world’s top countries in R&D expenditure, however it has concerns about R&D investment not translating into commercial products fast enough and/or at scale. Ministry of Science and ICT set aside close to US\$ 150 million in 2017 for funding AI-related R&D conducted by public and private-sector organisations.

South Korea assesses its own R&D/innovation push on similar lines as European Union’s Horizon 2020 project. In line with this thinking, South Korea and the EU have jointly begun a 90 billion won programme across the entire R&D cycle, which includes joint research and commercialisation goals.

Singapore



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Grand Challenges: Healthcare, Fintech and Urban Transport

Singapore is one the leading incubators of AI investment and research, and is home to a number of government-funded initiatives and private firms looking into AI applications in sectors ranging from telecommunications to retail and healthcare. The government launched its national AI programme titled AI.SG in May, 2017.ⁱ AI.SG involves partnerships with four other key government arms across digital, economic, media and health information verticals.ⁱⁱ

Singapore is aware of the challenges presented to the country's growth by labour shortage. As a result, the country is undertaking measures to foster AI talent as well as create a business environment that is conducive to innovation.

In an effort to synchronise efforts across sectors, Singapore's National Research Foundation (NRF) announced a S\$ 150 million initiative geared towards enhancing the country's AI capabilities over the next five years.

Singapore's AI initiative announced "grand challenges" to launch and implement multidisciplinary research in AI. The "grand challenges" fall under 3 broad categories - healthcare, fintech and urban transportation - aligned with the country's priorities and ministerial plans.

AI in health is Singapore's first grand challenge. The current focus, identified by the strategy, is carrying out research on stopping or slowing disease progression by 20 percent in five years. Some of the goals earmarked by Singapore include, 1. Use AI to addresses challenges in society and industry including easing traffic and improving elderly healthcare, 2. Investing in "explainable" AI systems "exhibiting more human-like learning abilities and next generation computing architectures."

SKILLING FOR THE AI AGE

Provide AI Skills to all 25 years and Above

Singapore has instituted one of the most novel models for society wide upskilling. Every citizen 25 years of age and over is eligible for a payout of S\$ 500 (US\$ 370) to establish an “individual learning account”. Funds can be used to pay for courses at any of the 500 government-sponsored training providers.

Singapore has launched a nine-month full-time training programme, titled “Growing our own timber”, which comprises of

- Three months of AI coursework conducted via online classrooms and mini-projects;
- Six months of on-the-job training on a real-world AI problem and
- A stipend of S\$ 2000 to S\$ 3500 a month for 9 months for every apprentice.

The training content for the course includes design and implementation of “production-ready AI systems” and ML tools and techniques for common industrial uses. The programme also provides a clear pathway for jobs with potential recruitment as an AI engineer, developer or consultant.

ETHICS AND REGULATION

Research on Governance of AI and Data

Singapore established an ethics and standards council in June 2018 to advise its government on AI development and use. Set up by the Info-communications Media Development Authority (IMDA), the council has a mandate to work with ethics boards of businesses. IMDA has further introduced a five-year research programme focusing on ethical, legal and governance issues in AI.

R & D

Research Focus on Singapore’s “Small Country” Needs

Singapore’s other flagship programme titled 100 Experiments (100E) brings forth projects that can explore gaps in AI research - each project sponsored by a different organisation. The programme highlights research that can be easily implemented and have a meaningful social impact. Singapore’s “small country” needs take precedence such as tailoring machine learning to extrapolate from lesser data while instilling explainability of AI systems.

Germany



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Global Excellence in Research, Development and Ethical Use of AI

Germany's AI strategy is scheduled to be released at the Digital Summit in Nuremberg in December 2018. In the interim, two policy papers have highlighted key goals and priorities. First, a Ministry of Labour and Social Affairs White Paper on the future of work, "Reimagining Work 4.0", outlines the challenges of an automation-led future.ⁱ Second, a policy brief from the government on an AI Strategyⁱⁱ ahead of the Nuremberg release highlights Germany's key ambition: to build and establish itself as a global AI leader and become the prime destination for AI research and investment.

A broad outline of the national strategy is being worked out by a government-led collaborative platform on AI, led by Germany's Ministry of Education and Research. It consists of seven working groups, with a total of 200 experts who are defining the parameters for developing self-learning systems and using them responsibly. The platform develops scenarios, recommendations, design options and roadmaps from the results.

Germany's goals

Germany's ambition to become a leader in research and development of AI is based on the transference of its research findings into applications and its own institutional structures.

It has expressed a commitment to European values not just in its data models but also in innovation in AI. Germany hopes to build AI systems that carry the same seal of quality that other German-manufactured products carry.

DATA ECOSYSTEM

Business model-led Approach to Data Sharing

Germany brings a business model-led approach to data sharing where new businesses operate on cooperative networks with other businesses. This data sharing capability is expected to traverse businesses of varying sizes across different sectors.

It aims to increase the quantity of data available for analytics without compromising on rights of data holders. It aims to open up data held by the public sector and academic communities for both commercial and non-commercial use. To enable this, Germany will analyse to what extent existing rules on access to data need to be revised.

SKILLING FOR THE AI AGE

Provide AI Education at All Levels

Germany's future of work strategy focuses its attention on maintaining individual employability. For this to happen, the education system at all levels must accommodate changes. Germany explains, in its future of work strategy, that "good work" for its people and the country's prosperity are tied intimately to how successfully people adapt to self-learning systems.

To prepare its future workforce Germany is planning on funding AI specific chairs at select universities. The country simultaneously wants to incentivise the inflow of young scientists from Germany and overseas to conduct their work in the country and at the same time create a policy environment that addresses the brain drain of talent from Germany. At a more fundamental level it wants to introduce AI in curricula that integrates academics with vocational training.

ETHICS AND REGULATION

Human-Centered Development and Use

Germany's view expressed by the working groups on the government led AI platform is: When self-learning systems take over tasks or make decisions that have societal or ethical dimensions, they also take on the responsibility for meeting relevant societal and ethical requirements.

Germany is considering how society can have a say in the ways in which self-learning systems are used. Protecting people, rather than property or animals, will be the priority under the pioneering new legal guidelines for the operation of driverless cars, the transport ministry has said. Germany is home to the world's first set of ethical guidelines for automated driving.ⁱⁱⁱ

On the human resource side, a lot of attention is being paid to clock time and work-life balance. The German legislation is bound by the provisions of the European Working Time Directive. The directive stipulates that the average working time for each seven-day period, including overtime, may not exceed 48 hours. In addition, every worker is entitled to a minimum daily rest period of 11 consecutive hours every 24-hour period. The Act is, therefore, based on the principle of an eight-hour day and six working days per week. All of this is coming into question and being given new meaning.

R & D

Expanding German and European Research in AI

As part of its overarching goal to make Germany as well as Europe the locus of global AI research, the German federal government's policy brief proposes the following:

- Creating a collaborative R&D mechanism with France.
- Instituting a regional cluster fund for AI research.
- Provide support to SMEs and start-ups to research innovative AI applications.

European Union



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Developing and Using AI for Good and for All

The EU set its vision for AI in its communication, “Artificial Intelligence for Europe”, published in April 2018,ⁱ outlining how AI that is beneficial to all can be developed and the role of the Union’s role therein - especially leveraging the continent’s digital single market and common rules on data protection.

A significant focus here was modernising education and introducing social protections in anticipation of changes to the labour market.

The EU is looking at transport, healthcare and manufacturing sectors to lead the way in AI adoption. Europe faces the challenge of a very small fraction of companies adopting digital technologies in their operations and wants to encourage SMEs to adopt technologies like AI.

The European AI Alliance was set up in 2018ⁱⁱ to involve all relevant stakeholders to gather input, exchange views, develop and implement common measures to encourage the development and use of AI.

DATA ECOSYSTEM

Open and Easier Sharing of Data

The European Commission is taking measures to make data sharing easier and open up more data for re-use. This includes data from the public utilities, environmental as well as research and health data.

SKILLING FOR THE AI AGE

Future-proof Skills

The EU views the jobs that AI may transform as a “shift” to be managed and wants to help people develop “future-proof” skills. The European Commission launched a comprehensive plan for the evolving labour market titled, “A New Skills Agenda for Europe” in 2016. Its 2018 plan mandates that the member countries do detailed analysis of changes that will occur in the labour markets and publish their findings. This would then be followed by retraining of workers in those sectors that are likely to be automated. The European Social Fund would provide financial support for this retraining. In addition to existing labour, this technological adoption would also be extended to students and new graduates through “Digital Opportunity Traineeships.”

The European Institute of Innovation and Technology – research and development agency of the European Union – will integrate AI across curricula in the education courses it supports to create a talent pool for AI in Europe.

ETHICS AND REGULATION

Ethics, Values and Fairness

Ethics, values and fairness are at the soul of the EU strategy on AI. In the immediate term, there are plans on developing draft AI Ethics Guidelines within the year. These guidelines would address social inclusion, fairness, algorithmic transparency and future of work generally. Guidelines will also factor in impact on fundamental rights, privacy, dignity, consumer protection and non-discrimination. A superstructure will be built on the existing knowledge pool of the European Group on Ethics in Science and New Technologies.

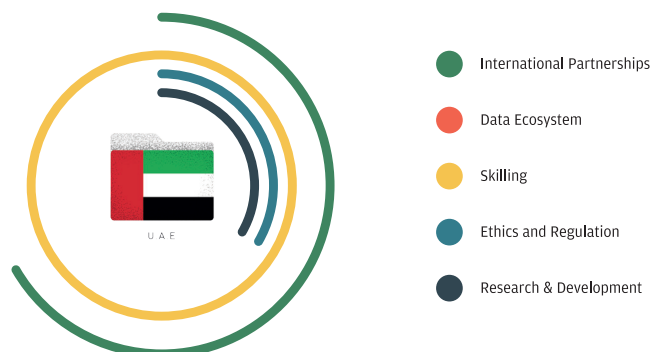
R & D

Heavy on Robotics

The EU increased investments up to 700 million Euros for 2014-2020 plus 2.1 billion Euros of private investments in robotics. EU’s Horizon 2020 research and innovation programme has invested nearly 1.1. billion Euros in AI research. This targets specific objectives such as big data analytics, research into health systems, transport and rehabilitation. In comparison to Asia and North America, however, private sector investment in AI in Europe remains low.

The European Commission is increasing investments in AI to around 1.5 billion Euros by the end of 2020 (average of 500 million Euros a year). Under the existing public-private partnerships in robotics and big data, this investment is expected to trigger an additional 2.5 billion Euros of funding.

UAE



OVERALL STRATEGY

Become the World's Most Prepared Country for AI and Boost Government Performance

The overarching theme in UAE's fairly lean national AI strategy¹ is to enhance government performance by saving 50 percent of annual government costs. UAE's proposed "smart government" will be efficient and quicker - reportedly streamlining the nation's 250 million yearly paper transactions which currently require 190 million hours and 1 billion kilometres in travel. UAE holds the special distinction of appointing the first Minister for Artificial Intelligence in the world. One of the responsibilities of the Minister includes carrying out the modernisation of the UAE government.

Boosting government performance is also one of the pillars of the UAE Centennial 2071—a project to make UAE the best country in the world by 2071. The success of the country's AI initiative also ties into flagship government programmes such as Smart Dubai and Expo 2020 - showcasing the country's innovation on an international stage. The country seeks to merge physical, digital and biological technologies and make significant headway in personal genomic medicine, personalised medical technologies and telemedicine.

SKILLING FOR THE AI AGE

Global Hub of Talent and Technologies

The UAE's strategy for the 4th Industrial Revolution has set out the aim to prepare a national talent pool equipped in emerging technologies. The first 500 Emirati citizens are said to soon start their training in artificial intelligence. Oracle has opened a new AI innovation hub in Dubai to drive the implementation of AI in the country across sectors and support skilling initiatives.¹¹

ETHICS AND REGULATION

Values and Ethics, Privacy and Well-being of Citizens

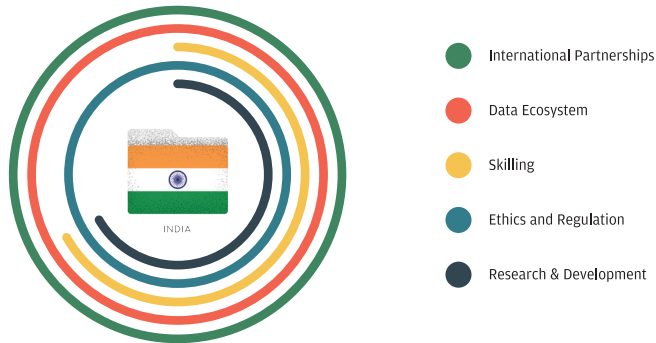
The UAE Council for AI with the Minister for AI at the helm held their first meeting earlier this year where they considered a mechanism to evaluate AI applications titled “UAI”. The mechanism is based on four metrics: ensuring AI is used for good, protection of user privacy, maintaining integrity and security of data and promoting data sharing with relevant authorities. The strategy for Fourth Industrial Revolution also addresses these principles posing UAE not just as a global hub of technologies but also ethics and regulations.

R & D

Global AI Centre by 2030

UAE is persuaded by the economic benefits that AI can deliver to the country and seeks to invest strategically in various sectors to generate a reported annual economic return of AED22 billion by raising individual productivity.ⁱⁱⁱ The UAE Ministry of Economy also found that UAE’s economic output is expected to increase by 26 percent and boost the value of the economy by a total AED335 billion.^{iv}

India



OVERALL STRATEGY

AI for All: Transformation for the Greater Good

From India's point of view, a disruptive technology like AI can enable transformation in the quality and access of services - both public and private - for all, especially those sections of society for whom access to essential services is limited. India's AI strategy - outlined in the Report of the AI Taskforce constituted by the Ministry of Commerce and Industryⁱ and government think tank, NITI Aayog's National Strategy for AIⁱⁱ - revolves around this "AI for All" concept.

The Indian government sees the promise in AI to vastly improve the provision of public services in the country. Public utility services in India are weighed down by inefficiency and outdated systems and AI, data analytics and IoT based systems are a possible means of greatly improving planning and execution of services as well monitoring outcomes. India's strategy further states in unequivocal terms that the country should become the "garage" or AI solutions provider for 40 percent of the world comprising of emerging and developing economies.

India's healthcare system, while attracting millions of medical tourists every year, is overburdened and under-equipped in rural areas. The 2016 Medical Tourism Index ranks India 5th globally as a medical tourism destination.ⁱⁱⁱ At the same time, Lancet's 2018 Global Burden of Disease placed India 145th out of 195 countries^{iv} in terms of quality and accessibility of healthcare. India's AI strategy states that AI can help in:

- Creating electronic repositories of healthcare data for machine learning applications.
- Creating national-scale clinical decision support system to enable management of routine issues by less-skilled providers.

India is also looking to AI and big data to improve financial inclusion and quality of banking services, to drive a new agricultural revolution in order to meet rapidly growing demand and in creating "intelligent transportation systems" to greatly reduce accidents and improve traffic flows.

DATA ECOSYSTEM

Building a Data Marketplace and Enabling Innovation

The two strategy documents identify a shortage of data as well as necessary infrastructure to process and distribute big data securely, as a key challenge India faces in AI development and application. In terms of next steps, they propose:

- Setting up data banks, marketplaces and exchanges to ensure availability of cross-industry data and information.
- Funding a national level survey to identify clusters of clean, annotated data to build effective AI systems.
- Establish “grand challenge” tasks for tagging visual data and craft an incentive system through the data marketplace to aggregate content from participants.

SKILLING FOR THE AI AGE

Improve Higher Education and Create a Robust AI Talent Pool

India sees two major areas in which AI can be applied to skill its workforce: overall improvements in higher education and building a pool of AI talent. The government is keen to retain local talent in the face of increasing brain-drain of domestic researchers.

- Set up training standards for AI and Data Science coursework and provide certifications to qualifying institutes
- Provide incentives for the creation of AI- related jobs and re-training employees with AI skills. These incentives can take the form of tax holidays or inclusion in CSR activities.
- Introduce AI coursework for postgraduates in non-computer science or data science.
- Constitute a standing committee or taskforce to analyse the impact of AI adoption on jobs.
- Create National AI Fellowships to retain AI talent to prevent a drain of domestic researchers as well as attract researchers from foreign universities.



ETHICS AND REGULATION

Responsible Use of AI

India’s AI strategy focuses on taking a granular approach that accounts for the transformative impact such technologies could have on improving the quality of life and access to services for all segments of population. NITI Aayog and the AI Taskforce noted the following:

- Privacy and Security
- Implement the soon-to-be passed data protection law recognising individual’s right to informational privacy and spread awareness among citizens.
- Craft sector-specific guidelines on privacy, security and ethics through a consultative mechanism with key stakeholders in the different industries.
- Establish and further support Centres for Research Excellence (COREs) through Ethics Councils for COREs and

International Centres for Transformation (ICTAIs) to outline standard practices and monitor their adoption.

- Accountable AI Systems
- AI systems must have explainable behaviour and measures to ensure transparency, safety and security
- Rigorous auditing to remove human biases and prejudice

R & D

Forging Public-Private Partnerships and Global Collaboration for Ethical Research

India has outlined its intention to collaborate with international partners and with its own private sector to pursue AI research. Specifically, NITI Aayog has recognised Canada, Germany, Israel, Japan, Russia, Singapore, the UK and US as potential partners to devise AI solutions for the bottom of the pyramid. State governments are also ramping up their efforts with the Government of Karnataka entering into a partnership with the industry association NASSCOM to establish a Centre of Excellence for Data Science and AI. In February 2018, the Wadhvani Foundation set up India's first research institute dedicated to developing AI solutions for social good in Mumbai.

Japan



- International Partnerships
- Data Ecosystem
- Skilling
- Ethics and Regulation
- Research & Development

OVERALL STRATEGY

Japan's New Industrialisation Roadmap

Japan views AI as a service (AIaaS) that can be central to future industrialisation in the country - the country aims to achieve a true AI ecosystem by 2030. Given the country's growing ageing population, Japan seeks to leverage AI to address the issue of its "shrinking workforce". The government is slated to provide 160 billion yen (US\$ 1.44 billion) to a public-private investment fund that will shift its focus to AI and big data.ⁱ

The priority sectors identified in the new roadmap for industrialisation under the AI strategyⁱⁱ are: productivity, health, medical care (telemedicine in particular), welfare and mobility. Its new roadmap for industrialisation has been organised into three phases:

Phase 1: Utilisation and application of data-driven AI developed in various domains

Phase 2: Public use of AI and data developed across various domains

Phase 3: Ecosystem built by connecting multiplying domains

Use AI to Build on Success in Robotics and "Monozukuri" to increase productivity

The country is aiming to replicate their proven strength and reputation in developing high-end technology with success in business. Japan considers AI critical to this vision, seeing it as a driver of parallel developments and investment in robotics and IoT. The Japanese Ministry of Economy, Trade and Industry (METI), for instance, is subsidising the development of new robots with built-in AI. The national strategy proposes that AI be integrated with the country's unique manufacturing style, "monozukuri" (craftsmanship) to further increase productivity. Japan hopes to integrate other traditional strengths such as arts and culture with AI to feed into industrial competitive strength.

Develop Semiconductors Dedicated to AI, Networks and Biological Intelligence

Japan is developing semiconductors specialised for AI applications, such as learning and inference, where the goal is improving processing speed more than accuracy. The strategy also stresses on the importance of reducing power consumption; miniaturisation of high-performance computers and development of new architecture such as neuromorphic and quantum architecture. Japan, further, sets out to understand and create intelligence from brain functions such as brain-machine interface (BMI), neurofeedback and rehabilitation assistive technology.

DATA ECOSYSTEM

Strengthen Data Maintenance in Priority Areas

Three priority areas - productivity, healthcare and mobility - have been recognised where government research centres will coordinate with respective ministries to use data for good. Japan seeks to enhance “data maintenance” in these priority areas through securing the latest AI data test beds and creating a mechanism for smooth sharing of anonymised data. This data sharing model will be built through multistakeholder collaboration - mock environments, simulators and demonstration environments will be developed with the support of the industry.

SKILLING FOR THE AI AGE

Prioritise Skills to Build an AI Workforce

Japan has identified three distinct skills that need to be fostered in the country’s AI personnel -general-purpose abilities relating to AI (problem solving), capacity to apply knowledge in programming techniques (realisation) and the ability to apply skills to social issues (utilisation). Besides long-term initiatives at universities, the country is keen to tap into skills that practitioners already possess for knowledge-sharing.

ETHICS AND REGULATION

Principles for Development of AI Networking

Japan has introduced a principle of “AI Networking” where developers should be mindful of insecurity arising from the interconnectivity and interoperability of AI systems. Broadly, the Strategic Council views these risks in two contexts: risks associated with functions and second, risks related to individual rights and legal systems. The strategy is focussed on designing systems to test AI applications and relying on regulatory sandboxes to mitigate such risks and promote individual autonomy.

The AI strategy advocates for a soft law to govern AI in the form of non-binding guidelines or best practices among stakeholders so that their risks can be controlled.

R & D

Role of Research Centres as Multistakeholder Platforms

Japan's approach to R&D is spearheaded by three national research centres tasked with studying areas from natural language processing, infrastructure technology to robots for industrial uses.ⁱⁱⁱ These research institutions, as per the strategy, will also double up as platforms for industry-academia-government collaboration to realise the goals identified in Japan's AI Industrialisation agenda.

Future of AI Policy

AI will Highlight New Geopolitical Fault Lines

The rise of AI is inescapable and countries are adapting to either retain their dominance in existing industries or make new inroads. The early adoption of AI by incumbent great powers indicates the centralisation of these technologies in already advanced nations. This can create an interdependence that can significantly upset the existing global trading order.

AI will be crucial in securing political and security considerations in the coming decades. The introduction of lethal autonomous weapon systems and the use of AI in military will significantly enhance existing defensive capacities for nations. These systems can help bridge critical gaps that nations have in their defence infrastructure - for instance South Korea has reportedly deployed sentry guns along its de-militarised zone to augment its infantry. The deployment of LAWS in areas like contested borders can also significantly affect the strategic balance.

In the long run, AI can perhaps act as an equaliser transforming and sustaining entire economic sectors. In the short to medium term, however, its adoption is likely to change the balance of power and there will be an urgent need to manage geopolitical stability with the equitable redistribution of benefits.

Carving out AI Futures for Emerging Economies

States are currently focused on locating AI within their existing domestic imperatives - minimising the social disruption that the technology will necessarily herald. Some of the most crucial national concerns will be recruiting and retaining AI talent, loss of jobs in the short term and skilling a new workforce in anticipation of changes in the labour market.

The challenge is especially acute for emerging economies driven by export-led development who stand to lose their labour cost competitiveness that is pivotal to their growth. Even while there is a little agreement on the pace of automation, nature of jobs most susceptible and the potential gains in productivity that the next wave of automation will herald, the need to reevaluate development strategies for emerging economies is certain. These states will need to find ways to leverage AI while addressing its economic and political fallouts on the job market.

They will need to develop and hone home-grown AI talent by devising skilling initiatives that are accessible, attractive and relevant to their domestic needs. Countries must prioritise skilling for jobs that AI is less likely to displace - especially those that require emotional capacity such as healthcare and management.

A Normative Leadership Void

After more than fifty years of speculation about the transformative potential of AI, countries around the world are beginning to reap dividends. In China alone, AI has birthed 14 unicorns - companies valued at over US\$ 1 billion.¹ Capacities in AI are being considered a strong indicator of economic growth, and the overall technical capacity of a state. There is, however, a void in normative leadership - who is scripting the governing principles behind AI?

With each passing year, deep learning technologies become more and more accessible to nations around the world. In five years it is likely that the competing nations will have comparable technical capacities. The battle then will not be technical, it will be over creating the dominant governing principles.

This is not a debate that will only concern the early adopters of AI. In fact, given the relative absence of ethical and principles based consideration in the national strategies of the two incumbent giants, it is likely that this normative leadership will emerge elsewhere. In this debate, elements of the EU's national strategy (a values-based AI) or India's national strategy (inclusion in development and beneficiaries of AI) are likely to take centre stage.

Coding Ethics

Even as tech-solutionism is finding few takers, states are geared towards deploying AI for good. They must do so while careful to embed transparency and accountability in design. However, the drivers of AI innovation are private sector companies and not nation states. As governments ramp up public-private cooperation in AI, they cannot abdicate responsibility and must create the foundation for the governance of the technology. What governance or oversight models can be set up to promote accountability, fairness and safety of AI?

If oversight and regulation is left to companies, it can be piecemeal and not sustainable in the long run. Since AI is inherently dual-use, it increases the possibility of the technology being put to harm through uses such as information warfare or surveillance. Further, states see a competitive advantage in setting technical standards on interoperability, privacy and security and gaining a first mover's advantage in strengthening their intellectual property in AI. China and Japan's strategies, for instance, specifically call for the countries to increase their efforts at standard setting organisations and industry associations globally.

Most AI strategies also envision a data sharing ecosystem where private actors will be encouraged to share anonymised data with the government and other industry stakeholders to build services that can benefit the public and be more customised to the user. Given this trend, the need to not only script ethics but comprehensive regulations on data sharing and anonymisation become even more crucial. For states to truly harness the technology and become AI powers, building technical capacity must go hand in hand with building safeguards through institutional frameworks.

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ORF, 20, Rouse Avenue Institutional Area,
New Delhi - 110 002, INDIA

E-mail: contactus@orfonline.org
Website: www.orfonline.org