European Commission

Digital Transformation Monitor

USA-China-EU plans for AI: where do we stand?

January 2018

© ShvetsovaDesign/Shutterstock.com

USA-China-EU plans for AI: where are we?

AI is internationally recognised as a main driver of future growth, competitiveness and job creation. It helps to increase productivity and efficiency and it lowers costs; it is also a major driver for innovation and promises to unlock new creative jobs and growth opportunities. AI is likely to be the competitive advantage of the 21st century: it is now the responsibility of policy makers and business leaders to seize the moment.

1

Promises of AI

AI is already changing our daily lives, improving human health, safety and effectiveness. It enables tremendous value gains coming from the enhancement of productivity, but also from an increase in consumer demand and from the dissemination of innovation.

AI: the new factor of production for the 21st century?

AI could contribute up to EUR 13.33 trillion to the global economy in 2030, more than the current output of China and India combined. Of this, EUR 5.6 trillion is likely to come from increased productivity and EUR 7.73 trillion from consumption-side effects.[1]

With the convergence of other transformative technologies such as the Internet of Things and Big Data Analytics, AI has the potential to overcome the physical limitations of capital and labour and to create a new basis for economic growth.

AI must thus be considered not only as a productivity enhancer but rather as a new factor of production. In a nutshell, AI is a new way to create growth. It could double annual economic growth rates according to Accenture and Frontier Economics.[2]

Significant social gains

Today, AI is already used to forecast crop yields from space, to automate a microscope to diagnose malaria, to make customer support multilingual and to help students to learn.

More than 60% of consumers and business decision makers believe that AI can help provide solutions in the most

important issues facing modern society ranging from clean energy to cancer and disease.[3]
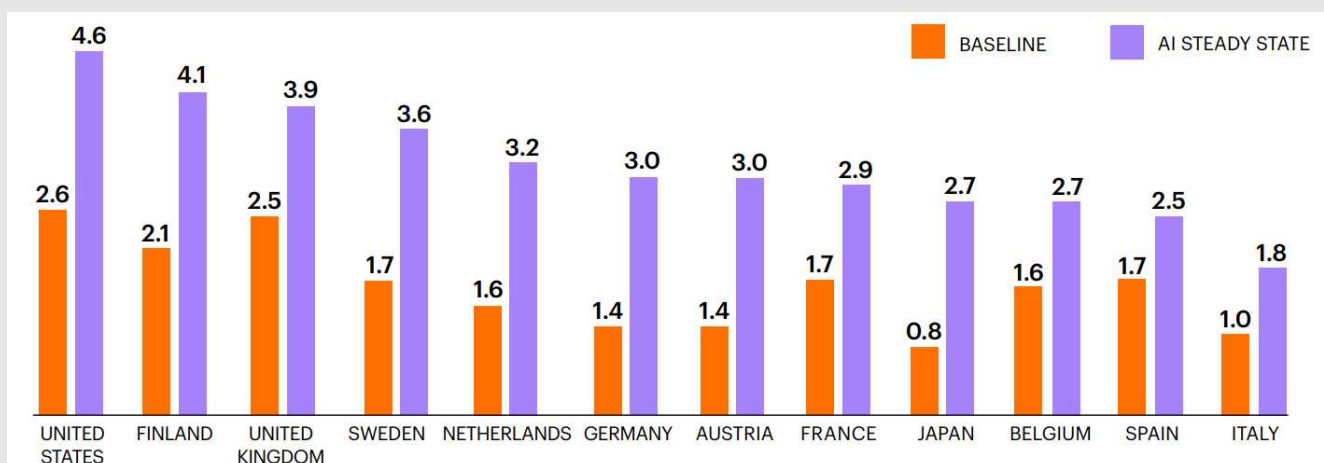
By tailoring drugs and treatments, it would deliver savings of EUR 1.7 to EUR 8.45 trillion in the healthcare sector.

In the electricity and energy sectors, AI has the potential to cut 10% in national electricity usage by using deep learning to predict power demand and supply. Machine learning could also yield 12% fuel savings for manufacturers, customers and airlines by optimising flight routes.[4]

More than 70% of business leaders

believe that AI will be the business advantage of the future[3]

Figure 1: Real gross value added by AI[2]

2

Different economic gains across the globe

As shown in the figure above, even if all economies will benefit from AI, some regions will gain more than others, both in absolute and relative terms. China and North America are likely to see the biggest impacts.
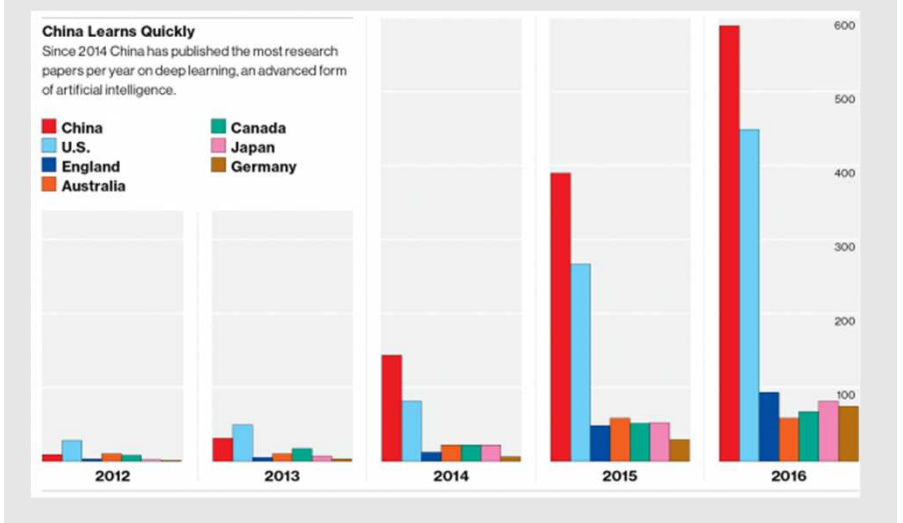
70% of the global economic impact

of AI will be concentrated in North America and China[1]

On the other hand, developing countries will experience a more modest increase due to expected rates of adoption of AI technologies which are much lower.

North America

North America is expected to see the fastest boost in the next few years. The region's AI potential is multiplied by other transformative technologies such as Big Data analytics and the Internet of Things, whose use is already widespread. And the gains will be accelerated by advanced US technological and

Figure 2: Chinese and US domination on AI research [5]

China Learns Quickly
Since 2014 China has published the most research papers per year on deep learning, an advanced form of artificial intelligence.

China | Canada
U.S. | Japan
England | Germany
Australia

consumer readiness for AI combined with existing assets such as advanced infrastructure, strong investment, a large pool of skills available and the rapid flows of information and data.

China

China will likely uptake AI technology more slowly but could see a large impact on GDP by 2030.
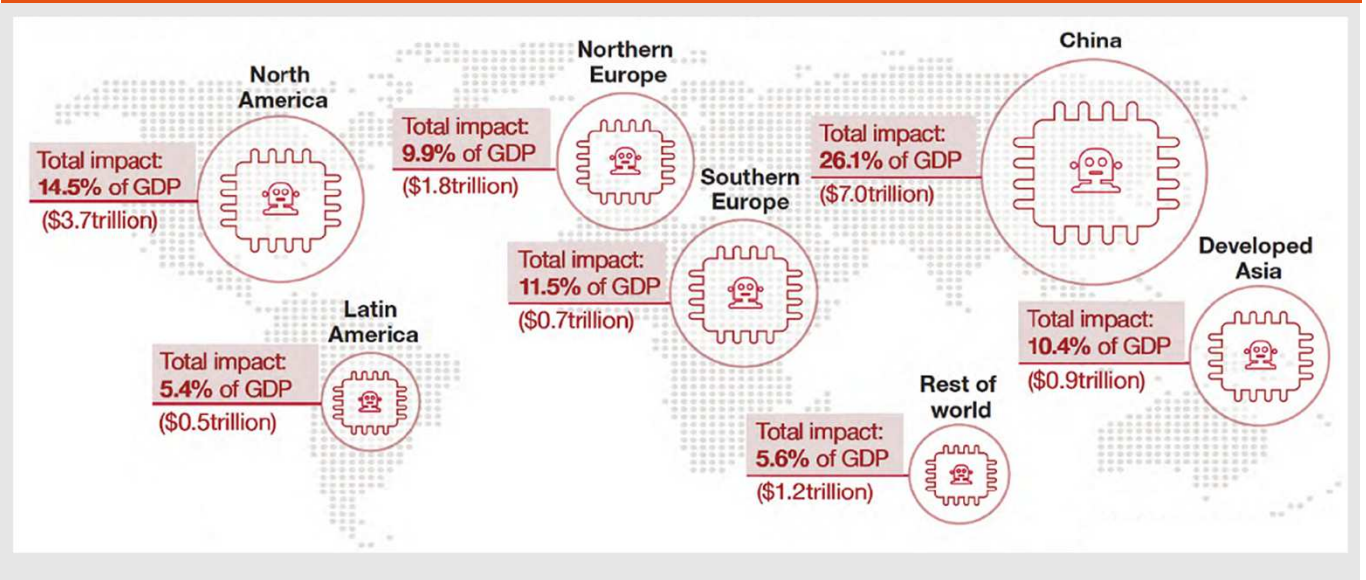
The large part manufacturing plays in Chinese GDP increases the potential gains from introducing more productive technologies and automating processes. Gathering technology and expertise necessary for developing AI technologies will require time which explains why the US will have an earlier GDP boost.

The Chinese economy is characterised by a higher rate of capital re-investment than that of Europe or the US. This increases AI's value potential. AI will also have a role pushing China into a more sophisticated and consumer-oriented economy.

China's long-term potential is well illustrated by the surge in AI patents filed in China: China now ranks second after the US. China even comes first in terms of numbers of published AI-research papers.

"Right now, AI is a two-horse race between China and the US"
Anthony Mullen, Gartner, Director of research[6]

Figure 3: Which regions gain the most from AI? [1]

North America
Total impact:
14.5% of GDP
($3.7trillion)

Northern Europe
Total impact:
9.9% of GDP
($1.8trillion)

China
Total impact:
26.1% of GDP
($7.0trillion)

Southern Europe
Total impact:
11.5% of GDP
($0.7trillion)

Latin America
Total impact:
5.4% of GDP
($0.5trillion)

Developed Asia
Total impact:
10.4% of GDP
($0.9trillion)

Rest of world
Total impact:
5.6% of GDP
($1.2trillion)

3

A global race for AI leadership

AI promises so many economic and social benefits that a lot of countries are now conducting research and investing heavily to accelerate its uptake. The idea behind is that early AI adopters will be the next global leader.

Non-adoption can be a critical risk for businesses and governments. The impact of AI on productivity is so competitively transformative that businesses that fail or fear to adopt could quickly lose a significant amount of their market share and have their business model become obsolete.

Hence the need for policy makers to stimulate AI adoption and educate the population to understand the opportunities offered by AI and provide them with necessary skills to partner with machines. Many countries have understood the critical role they can play and are developing their strategic plans for R&D and leadership in AI.

Global competitors

American R&D Strategic Plan

The US was the first country to have implemented a comprehensive AI research and development strategic plan in May 2016. The plan establishes a set of objectives for federally funded AI research both occurring within the government and outside such as in academia.

Given that the private sector is investing heavily in AI at an increasing pace, the government chose to focus its resources on the types of AI research that the private sector will be less likely to support, such as public health, urban systems, social welfare, criminal justice, environment sustainability and national security as well as fundamental research.

"AI will become "the main driving force for China's industrial upgrading and economic transformation"
State Council Notice on the Issuance of the Next Generation AI Development Plan

The American National AI R&D Strategic Plan

The US government sees AI as an urgent priority and developed in six months a comprehensive national plan for AI focusing on seven key priorities:

1. Make long-term investments in AI research;
2. Develop effective methods for human-AI collaboration;
3. Understand and address the ethical, legal, and societal implications of AI;
4. Ensure the safety and security of AI systems;
5. Develop shared public datasets and environments for AI training and testing;
6. Measure and evaluate AI technologies through standards and benchmarks;
7. Better understand the national AI R&D workforce needs.

China's plan to be the AI world leader

In July 2017, China released its Next Generation AI Development Plan in order to become the world leader in the field by 2030. It articulates a "three-in-one" agenda in AI:

- Tackling key problems in R&D;
- Pursuing a range of products and applications of AI;
- Cultivating an AI industry.

It includes extensive government funding and investments along with a focus on attracting and developing leading talents in AI.

The plan calls for investments totalling billions of dollars in a number of domestic AI initiatives and creates a blueprint for collaboration between research entities, private industry and the Chinese military.

By 2020, China plans to have achieved major progress in next generation AI technologies, including big data, swarm intelligence, hybrid enhanced intelligence and autonomous intelligent systems.

Ultimately by 2030, China aims to become the world's premier AI innovation centre. By then, China's AI industry is targeted to exceed 1 trillion RMB (EUR 130 billion), with AI-related fields totalling RMB 10 trillion (EUR 1.6 trillion). [7]

An investment plan for South Korea to catch up with its competitors

In March 2016, South Korea announced that it would invest 1 trillion won (EUR million 760) in AI over the next 5 years.[8] It includes money for the founding of a high-profile, public-private research centre with participation from several Korean conglomerates including Samsung, LG Electronics and Hyundai Motor.

The country also announced the creation of a council to provide recommendations to overhaul R&D in AI.

Japan is now also joining the race

In March 2017, the Japanese AI panel defined the Industrialization roadmap for the development and commercialization of AI. It comprises three organization phases:

- Phase 1: Utilisation and application of data-driven AI developed in various domains (till 2020);
- Phase 2: Public use of AI and data developed across various domains (till 2025-2030);
- Phase 3: Ecosystem built by connecting multiplying domains.[9]

UAE Strategy for Artificial Intelligence

In October 2017, the UAE Government launched the UAE Strategy for Artificial Intelligence, a first in the region. The strategy aims among others to boost government performance at all levels, use an integrated smart digital system that can overcome challenges and provide quick efficient solutions, make the UAE the first in the field of AI investments in various sectors and create new vital market with high economic value.[10]

Europe is lagging behind

No strategic plan at EU level

Europe is currently lagging behind its competitors in the race for AI leadership in several fields:

- It does not have yet an AI strategic plan;

- The level of public and external investment is much lower than in the US or Asia;

- Adoption from companies and the general public remains low;

- There are no EU-wide liability rules on AI and robotics, creating uncertainty for adoption.

Even if the European Commission is funding projects related to AI and robotics, it lacks of a clear vision on how to support the uptake of AI. The only step is the report that the European Parliament's Legal Affairs Committee published on civil law rules on robotics, which raises important ethical questions. In addition, an invitation to put forward a European approach on AI by early 2018 was sent out to the Commission at the European Council Meeting on 19-20 October 2017.

To compensate the lack of initiatives at the European level, Member States such as France and the UK are developing their own AI strategic plan to compensate.

#FranceIA

On 20 January, France launched its AI strategy called #FranceIA. It defines the government's top priority, which is to identify and bring players together in order to foster the structuring of a fully rounded French industrial sector.
The focus is on the respect for privacy, the protection of personal data, transparency, accountability and contribution to collective wellbeing. The aim is to develop a French AI model based on the respect for privacy and ethics. Meetings have been organised between institutional players, researchers, companies and start-ups to set the guidelines for France to follow.

Finland aims to become a top country in AI

A steering group was appointed on May 2017 by Minister of Economic Affairs Mika Lintilä to examine how to make Finland one of the world's top countries to deploy AI. The steering group released in October 2017 eight key actions to make Finland a leader in AI adoption and research:

1. Enhancement of business competitiveness through the use of AI

2. Effective utilisation of data in all sectors

3. Ensure AI can be adopted more quickly and easily

A EUR 50 million partnership between Inria and Fujitsu

In 2017, Inria, the French National Institute for Research in Computer Science and Automation, signed a partnership with Fujitsu, the third provider of IT services in the world.

Fujitsu plans to invest EUR 50 million into AI and deep-learning R&D in France .[12] The project includes a Centre of Excellence at the École polytechnique, joint research with Inria and building an ecosystem of commercial partnerships.

4. Ensure top-level expertise and attract top experts

5. Make bold decisions and investments

6. Build the world's best public services

7. Establish new models for collaboration

8. Make Finland a frontrunner in the age of AI

The UK's new Digital Strategy

In 2017, the UK revised its Digital Strategy to boost its AI sector and capitalise on its existing competitive advantage. Accenture has estimated that AI could add EUR 730 billion to the UK economy by 2035. [11]

The UK's Digital Strategy proposal includes:

- A major AI review to identify the critical elements for the technology to thrive and grow in the UK.

- A funding boost of EUR 17.3 million to support the development of new robotics and AI technologies in universities across the UK. [11]

The strategy puts strong emphasis on tackling digital inclusion in the coming years thanks to upskilling and reskilling. It also pledges free "basic digital skills training" for adults.

Public-private initiatives in Germany

Germany does not currently have a national strategy regarding AI. However, numerous successful initiatives have been developed at the state-level. Cyber Valley for example is a tech hub funded by the state of Baden-Württemberg and the industry which creates new collaborations between academics and businesses in the field of AI. Members include Amazon, Facebook, BMW Group or the University of Tübingen.

In June 2017, Germany developed also a strategy on how to further advance automated and connected driving in the country. The strategy aims at exploiting the opportunities for growth and prosperity inherent in Mobility 4.0.

Towards 2 dominant players

The US and China have both developed a comprehensive roadmap for AI leadership, concentrate the higher level of external and internal investment for AI and are the most active countries in the field of research. They are therefore likely to concentrate most of the economic impact derived from AI.

In 2016, the US absorbed around 66% of external investment (VC, PE and M&A activity) while China was a distant second at 17%.[4] The US benefits from a dynamic innovative ecosystem with the San Francisco Bay and Silicon Valley attracting around 40% of global external investment.[4]

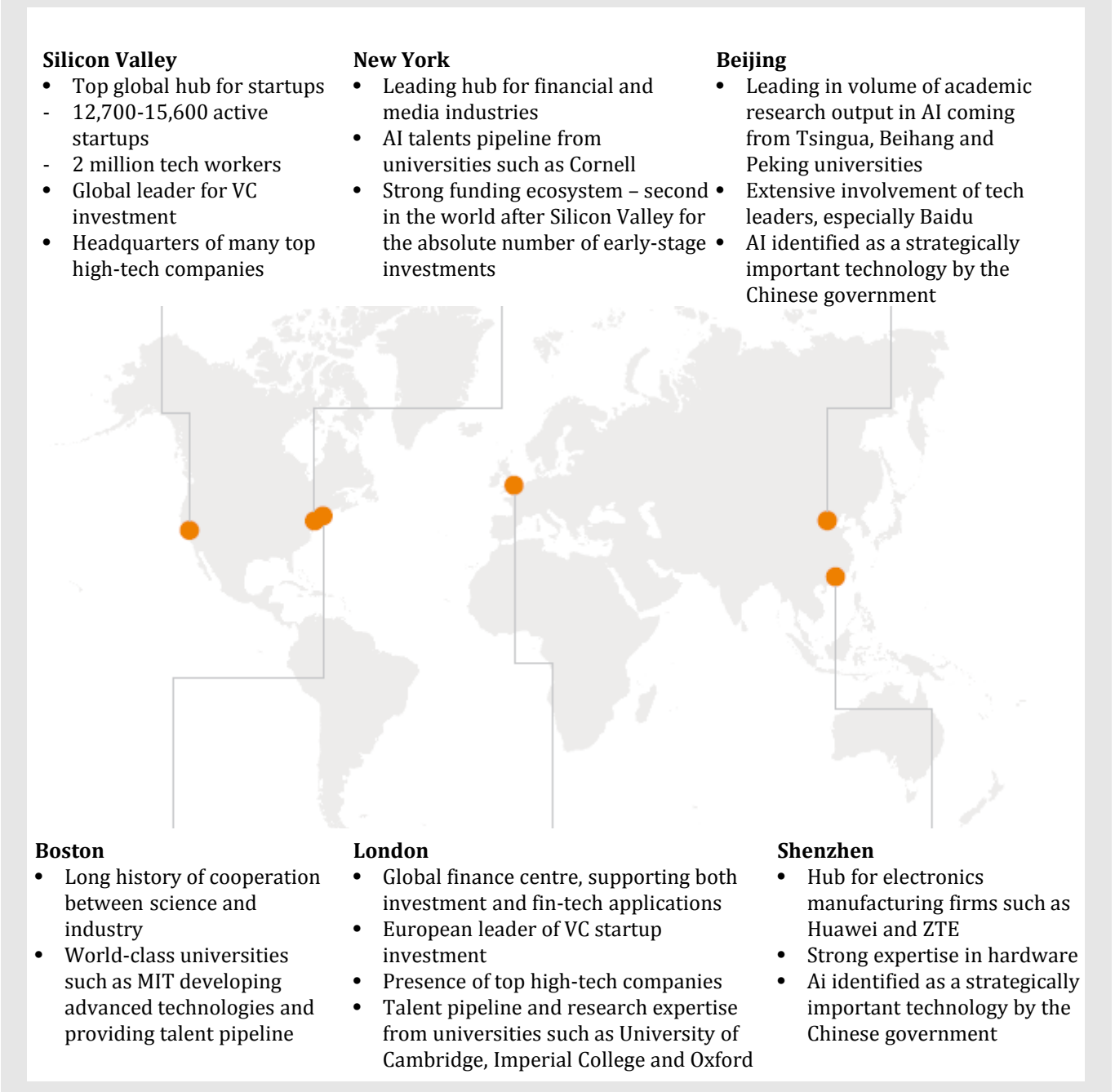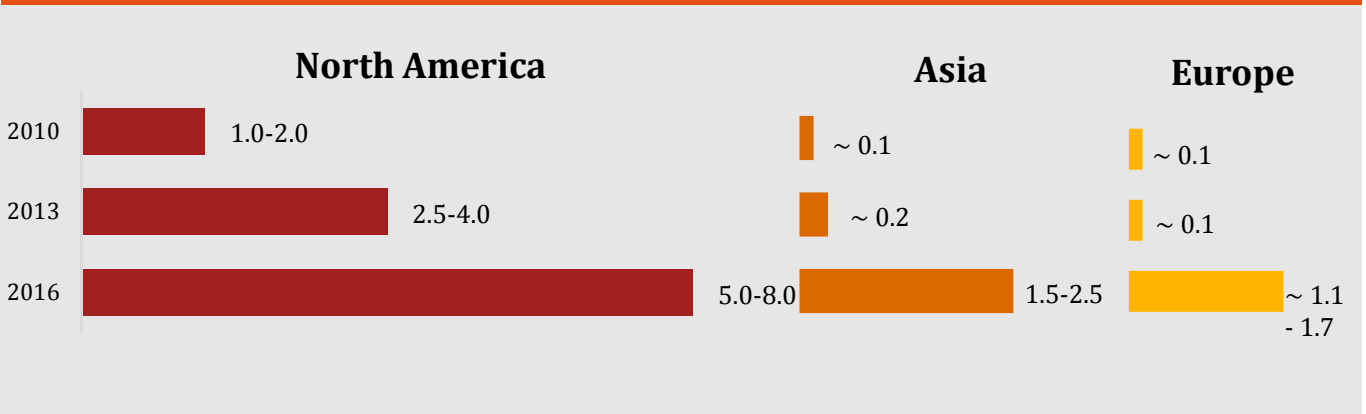### Figure 4: AI Investment, 2016 [13]

Figure 5: The AI landscape [4]

Silicon Valley
- Top global hub for startups
- 12,700-15,600 active startups
- 2 million tech workers
- Global leader for VC investment
- Headquarters of many top high-tech companies

New York
- Leading hub for financial and media industries
- AI talents pipeline from universities such as Cornell
- Strong funding ecosystem – second in the world after Silicon Valley for the absolute number of early-stage investments

Beijing
- Leading in volume of academic research output in AI coming from Tsingua, Beihang and Peking universities
- Extensive involvement of tech leaders, especially Baidu
- AI identified as a strategically important technology by the Chinese government

Boston
- Long history of cooperation between science and industry
- World-class universities such as MIT developing advanced technologies and providing talent pipeline

London
- Global finance centre, supporting both investment and fin-tech applications
- European leader of VC startup investment
- Presence of top high-tech companies
- Talent pipeline and research expertise from universities such as University of Cambridge, Imperial College and Oxford

Shenzhen
- Hub for electronics manufacturing firms such as Huawei and ZTE
- Strong expertise in hardware
- Ai identified as a strategically important technology by the Chinese government

Figure 6: External investment in USD billion[4]

	North America	Asia	Europe
2010	1.0-2.0	~ 0.1	~ 0.1
2013	2.5-4.0	~ 0.2	~ 0.1
2016	5.0-8.0	1.5-2.5	~ 1.1 - 1.7

4

Recommendations for the EU

The cost of non-action is high. If nothing more is done to boost investment and adoption, the EU is at risk of lagging behind the US and China in terms of competitiveness and innovation.

The need for a European Plan for Strategic Investment in AI

The current level of investment is not sufficient to enable a broad adoption of AI by European businesses. As a consequence, well established European enterprises and even whole business models could become obsolete or end up being outsourced.

To compete with its competitors who have all developed a prefinanced strategic plan for AI, it is also key for Europe to consult entrepreneurs and industry leaders in order to focus on their needs.

Increasing incentives for start-ups and big firms to invest in Europe.

Due to the wide availability of venture capital and talents in foreign AI hubs, many European entrepreneurs and investors are starting their business outside Europe.

To address this issue, decision makers could create financial incentives – e.g. tax breaks – to attract foreign talents and investors. Grants to universities, laboratories and research initiatives would also boost R&D in AI.
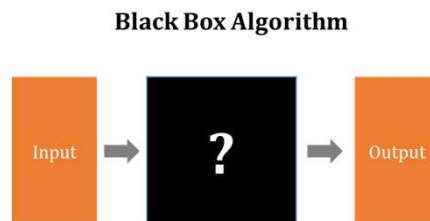
Guidance regarding trust and ethical issues raised by AI

Trust in AI and uncertainty on ethical issues are restraining users as well as entrepreneurs from further using outcomes of AI. Is it reliable? Is it transparent? Does it generate biased results or responsibility in the event of accidents? These are all key questions that are still unanswered. For example, what should choose a self-driving car between saving its passengers or pedestrians?

It would be valuable for the European Commission to provide regulation that would help clarify the moral, legal liability and data-ownership issues raised by AI. However, the legislative framework should be smooth enough to allow experimentation.

Address the current algorithm black box

Some machine learning algorithms are so complex that they cannot explain their results even to their programmers. Therefore, they operate today like black boxes which can be viewed in terms of their inputs and outputs without any knowledge of their internal workings.

Black Box Algorithm

As deep learning is now being used to guide all sorts of key decisions in medicine, finance, recruitment, there is a need to make those decisions understandable and accountable. Otherwise, AI could lead to major unspotted errors or discriminatory behaviour .

Achieving data quality

Given that machine learning is fuelled by data, AI can make completely biased decisions depending on the data it is given. Machine learning requires a strong commitment to data quality and neutrality to drive it. Europe could have a leading role in this area by defining standards for the quality of data used to power machine learning.

Educate all European citizens to harness AI

EU citizens lack the digital culture and skills necessary to adapt to the upheaval created by AI.

First, companies are struggling to find digital specialists, especially data scientists, which hinders the development of AI technology. Therefore, an upskilling plan for the workforce in the EU computational thinking will be necessary to fill the skills gap.

40% of companies trying to recruit ICT specialists reported difficulties in filling vacancies[14]

Besides, education on AI should not only concern the workforce but also children. Educating children on subjects linked to AI technology (e.g., benefits, cybersecurity or citizenship education in a digitalised society) and on computational thinking will change mentalities and shed light on the opportunities offered by the technology rather than on its threats.

The aim: catching the AI train

AI will change the world and the origin of growth in tomorrow's economy: it is an unavoidable shift for Europe. Adopting a comprehensive roadmap will help EU companies to tap into the full potential of AI, civil society to have full confidence in technologies and Europe to compete with the US and China in terms of digital leadership.

References

[1.] PwC, 2017, "Sizing the prize, what's the real value of AI for your business and how can you capitalize?", Available at: www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

[2.] Mark Purdy and Paul Daugherty for Accenture, 2017, "Why Artificial Intelligence is the Future of Growth", Available at: www.accenture.com/us-en/_acnmedia/PDF-33/Accenture-Why-AI-is-the-Future-of-Growth.pdf

[3.] PwC, 2017, "Accelerating innovation: How to build trust and confidence in AI", Responsible artificial intelligence study 2017, Available at www.pwc.co.uk/audit-assurance/assets/pdf/responsible-artificial-intelligence.pdf

[4.] McKinsey Global Institute, 2017, "Artificial Intelligence: the Next Digital Frontier?", Available at www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/how-artificial-intelligence-can-deliver-real-value-to-companies

[5.] MIT Technology Review, 2017, "Who is winning the AI Race?", Available at www.technologyreview.com/s/608112/who-is-winning-the-ai-race/

[6.] James Vincent for The Verge, 2017, "China and the US are battling to become the world's first AI superpower", Available at www.theverge.com/2017/8/3/16007736/china-us-ai-artificial-intelligence

[7.] Elsa Kania for The Diplomat, 2017, "China's Artificial Intelligence Revolution", Available at https://thediplomat.com/2017/07/chinas-artificial-intelligence-revolution/

[8.] Mark Zastrow for nature, 2016, "South Korea trumpets $860-million AI fund after AlphaGo 'shock'", Available at www.nature.com/news/south-korea-trumpets-860-million-ai-fund-after-alphago-shock-1.19595

[9,] Strategic Council for AI Technology, 2017, "Artificial Intelligence Technology Strategy"

[10,] Press release of the UAE government, available at: https://government.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/uae-strategy-for-artificial-intelligence

[11,] Press Release of the UK Department for Digital, Culture, Media & Sport, 2017, "£17 million boost for the UK's booming artificial intelligence sector", Available at www.gov.uk/government/news/17-million-boost-for-the-uks-booming-artificial-intelligence-sector

[12.] Fujitsu Website, 2017, "Fujitsu to invest over 500 Million Euros to support Digital Transformation in France", Available at www.fujitsu.com/global/about/resources/news/press-releases/2017/0309-02.html

[13.] McKinsey Global Institute, 2017, "10 imperatives for Europe in the age of AI and automation", Available at www.mckinsey.com/global-themes/europe/ten-imperatives-for-europe-in-the-age-of-ai-and-automation

[14,] Eurostat, 2016, "ICT specialists - statistics on hard-to-fill vacancies in enterprises", Available at http://ec.europa.eu/eurostat/statistics-explained/index.php/ICT_specialists_-_statistics_on_hard-to-fill_vacancies_in_enterprises

About the Digital Transformation Monitor

The Digital Transformation Monitor aims to foster the knowledge base on the state of play and evolution of digital transformation in Europe. The site provides a monitoring mechanism to examine key trends in digital transformation. It offers a unique insight into statistics and initiatives to support digital transformation, as well as reports on key industrial and technological opportunities, challenges and policy initiatives related to digital transformation.

Web page: https://ec.europa.eu/growth/tools-databases/dem/