



The many futures of Artificial Intelligence

Scenarios of what AI could look like in the EU by 2025

Introduction: the many futures of AI in Europe

The future of AI is difficult to predict

Artificial intelligence is the most transformative technology of the last few decades. The general-purpose nature of such a technology, much like electricity or the internet, makes it very difficult to grasp the full extent of its potential impact on our futures. This does not only relate to the development of the technology itself but also to the development of its political and social-economic environment. For instance, in the context of the current capture of an unprecedented amount of data, how much of that data will be free to use for algorithms? Will there be laws and regulation on the design and use of algorithms? Will the immense market power of large tech companies that control most of the AI knowledge in the world, be limited? What role will governments take in this entire process: drivers of limitless innovation or torchbearers of privacy and AI ethics? There are many questions and consequently many scenarios for the development of AI.

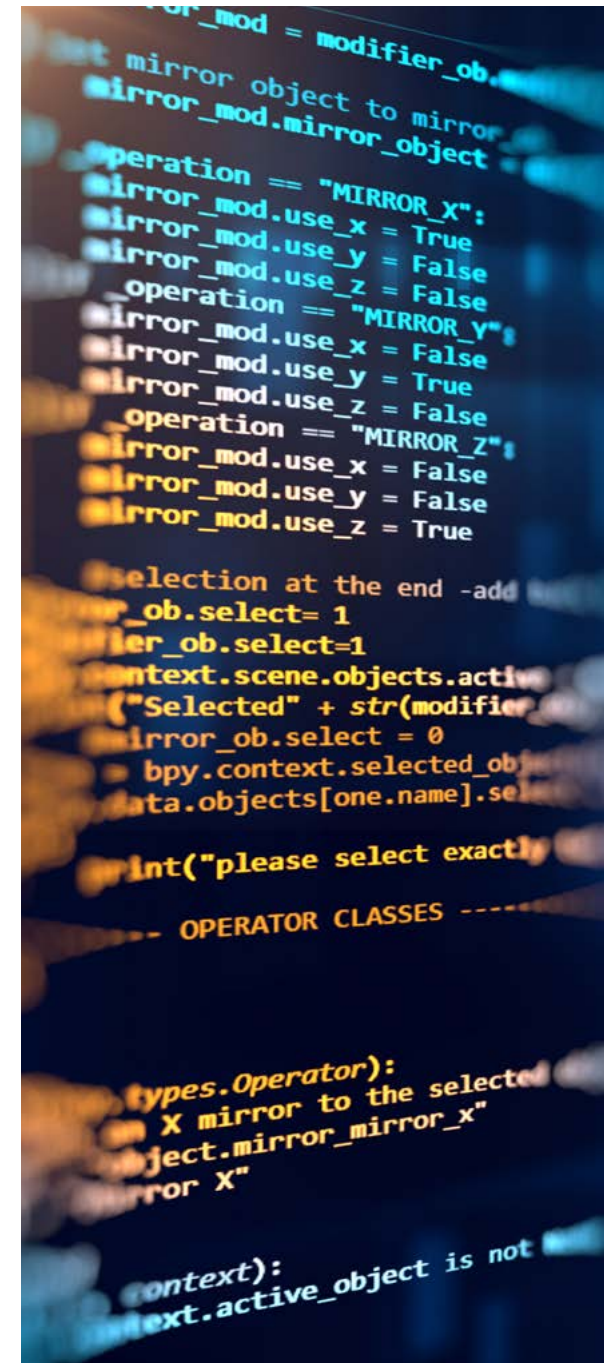
There is no perfect future for AI

This paper presents the future of AI through four scenarios. Any of the four scenarios could be the future of AI in Europe, depending on how

actively governments will drive the development of the technology and its adoption and the direction regulators will choose to take. Looking at these various scenarios, it is important to understand that there is no one perfect future of AI. However, thinking along the lines of scenarios will make clear that there are trade-offs to be made and that different regulatory policy regimes have different outcomes. This paper does not intend to answer, but merely poses the vital question – what is the preferred future for AI in Europe? And while we are on the topic, to think about what are the principles that are non-negotiable, regardless of which future we choose.

Choices to be made

While working on this paper the European Commission¹ has presented its white paper on a European future which contains two key elements. The Union clearly shows an ambition to boost the development of AI to be able to compete with the great market powers of the US and China. At the same time it wants to shape a technology that protects citizens from (unintended) consequences of technology in order to build trust in using AI applications.



¹ Shaping Europe's digital future: Commission presents strategies for data and Artificial Intelligence. Published February 19, 2020. Read more [here](#).

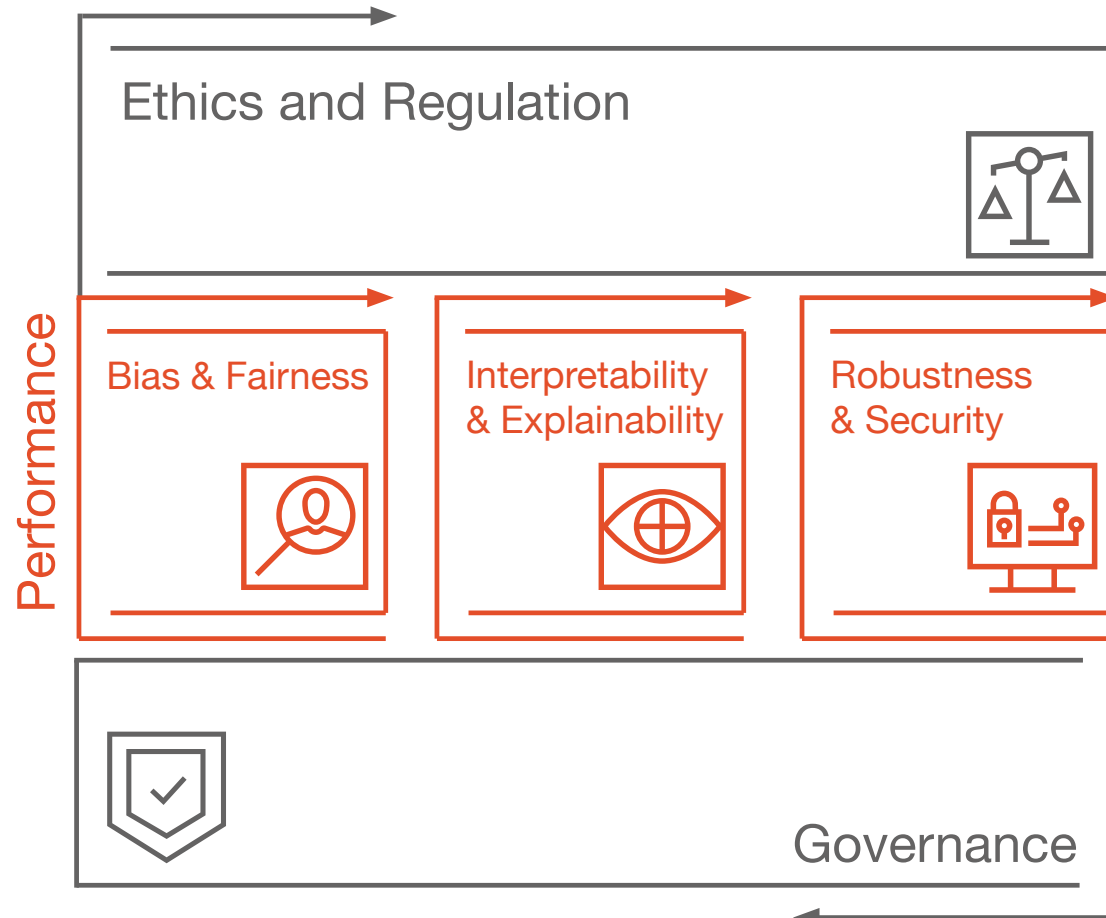
The European Union envisages a human-centered AI future. But even with this articulated starting point of a human-focused AI as the European unique selling point, there are still choices to be made. Our scenarios help to make these choices.

Responsible AI in all scenarios

With great potential comes great risk. Any company that has started incorporating AI in its operations has, at some point, come face to face with ethical, moral, legal or regulatory grey areas. Regardless of the future scenario, businesses will need to develop, implement, and use AI solutions that are both morally responsible and also legal and ethically defensible. At PwC, we believe Responsible AI will be at the centre of the AI development debate in Europe, in all four of the scenarios. Regulators and businesses will need to ensure that AI fulfils a number of criteria. First, that it's ethically sound and complies with regulations in all respects; second, that it's underpinned by a robust foundation of end-to-end governance; and third, that it's supported by strong performance pillars addressing bias and fairness, interpretability and explainability, and robustness and security.

In order to realize the full potential of AI, regulators as well as businesses must address the principles described above, while focusing on specific areas. Though the role of each stakeholder could be slightly different in each scenario, the key focus should be same for all - increasing investments in AI is important, but innovating responsibly is even more critical.

Responsible AI is critical regardless of future scenario



Why a scenario based approach

It is difficult to define (future) AI

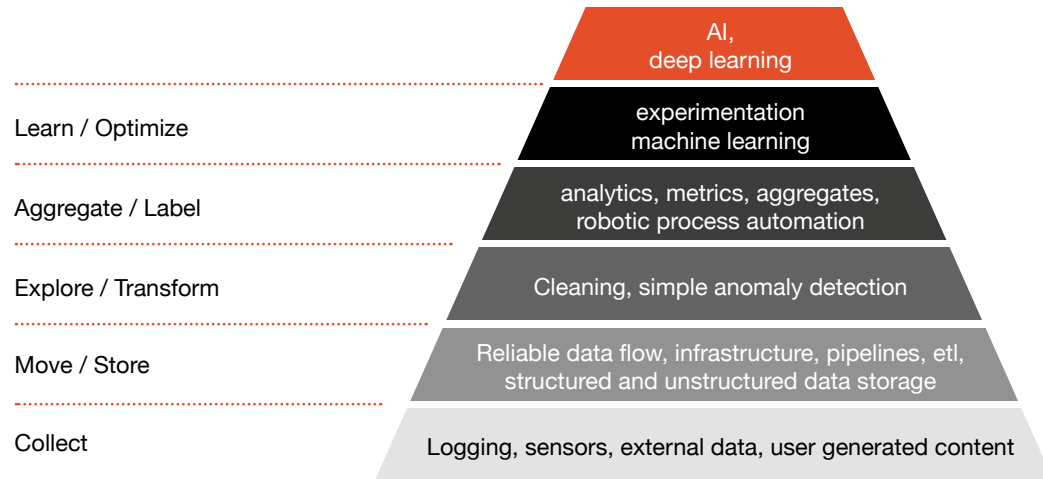
Artificial intelligence is the most transformative technology of the last few decades, considering its scope of impact. With an innovation as radical as AI, it becomes difficult to keep track of what constitutes AI, let alone what it will look like in the future. When the term was first coined in 1956, it referred to the entire field of 'thinking machines' that included cybernetics, automata theory and complex information processing. Today, the definitions of artificial intelligence are much more evolved, but not any more specific than before. AI can be considered the classic 'horizon term' - one whose meaning keeps evolving as we keep innovating. Amazon defines AI as the field of computer science dedicated to solving cognitive problems commonly associated with human intelligence, such as learning, problem solving, and pattern recognition. While this definition, as most, focusses on the algorithms that drive learning, problem solving and pattern recognition, there are other layers to the functioning of successful artificial intelligence. When we look at the future of AI, it is important to consider all layers that makes for a successful AI application, since all will collectively define what the future of AI looks like.

The layers of successful Artificial Intelligence applications

The figure provided here links the concepts from the well-known DIKW (Data-Information-Knowledge-Wisdom) hierarchical structure in information science, to the corresponding concepts within the domain of Artificial Intelligence. The starting ground for any meaningful AI is proper data that can come from various sources such as sensors, for example in IIoT (Industrial Internet of Things) settings, acquired external data, user generated data or other sources. This data must be governed, structured, contextualized, curated, managed or otherwise controlled and refined. Without this control and refinement, the data will not be transformed to information and not be made into knowledge or wisdom.

Knowledge is created when the information in AI settings is embedded into a larger scale context and meaningful environment, which is represented here in the steps of experimentation, machine learning, AI, and deep learning.

The wisdom is reflected in the application of the results and outputs of the AI models and mechanisms. Using these metaphors can help to better understand the individual addressing and influencing points of the future AI scenarios.



The nature of AI and its political environment make predictions difficult

Predicting the development of the general-purpose technology AI is more difficult than forecasting the changes with specific applications, like some of the other emerging technologies like virtual reality or drones. The general nature of AI, and the fact that it has countless applications, gives rise to multiple uncertainties, and complicates our vision of the future. This does not only relate to the development of the technology itself but also to the development of its political and social-economic environment.

Scenarios based on two uncertainties

In this report, we consider two main uncertainties that are expected to have a significant influence on the future of AI and use them to build four scenarios that might result from them. Later in the report, we examine each of these scenarios in detail – answering questions like, how will AI develop, where will the focus of governments and regulators lie, what will the market structure look like and what will be the overall impact of AI use on the economy, industries and consumers. As the science fiction writer William Gibson famously said, ‘The future is already here – it’s just not

evenly distributed’, we discover that most of these scenarios already exist in some form, somewhere in the world. For each of our four future scenarios, we will also analyze where in the world we are already seeing that version of reality, to build a clearer vision of what AI could look like in 2025.



Uncertainty 1: Cautious regulations on AI or focus on innovation?

Data forms the basic building block for artificial intelligence development (see figure on page 4). It needs to be available, meaning that it is captured in sufficient detail. And it needs to be usable, that is, it needs to be allowed to be used for training AI applications. That brings data privacy regulations to the forefront of all uncertainties defining the future of AI, especially in the EU. GDPR regulations are considered the gold standard in protecting the privacy of individuals as well as protecting the interests of individuals when subjected to automated decision making or profiling. However, it is still fairly early for us to have a full understanding of how it will be interpreted and enforced – making it a key lever that will shape the future of AI in EU. The future is not entirely based on how visionary regulators are, but also how proactive they are with regulations.

- **Data and platforms**

Data ownership and use is central to all regulations regarding AI, and forms the base layer to successful AI applications (see figure on page 4). GDPR fundamentally prioritizes the protection of individuals in relation to the processing of their personal data, yet,

the direction that it will take in the future is dependent on far more than its initial purpose. The interpretation of GDPR provisions in specific scenarios is as critical as it is uncertain. For example, GDPR requires organizations to minimize the amount of data they collect and use it only for its original intended purpose. This is the overarching provision – however, we are yet to find out if there will be leeway and exceptions made for specific innovations in public interest. These restrictions of using data only for its originally intended purpose, significantly limits organizations' ability to innovate with data. It prevents them from collecting new data before they understand its potential value and from reusing existing data for new purposes.

Will regulators allow for more exceptions to laws and regulation to stimulate innovation or will they impose fines even when it limits companies' ability to innovate?



- **Algorithms**

Apart from privacy and data use, a number of other regulations could impact how AI develops and is used in the future. Notable among them is how algorithms will be regulated. Regulators are expected to first assess what AI Algorithms are based on, and what principles could be standardized or regulated. At the moment there are overarching guidelines on what standards AI algorithms are expected to adhere to. For example, Article 22 of the GDPR establishes that wherever companies use AI to make a significant decision about individuals, such as whether to offer a loan, the data subject has the right to have a human review that decision. While this in itself is not restrictive of AI development and adoption, and is definitely an important provision to have, it does necessitate the development of a redundant manual process for any individuals who opt out of the automated process, impacting the commercial feasibility of AI use. While there are also technologies being developed that will create such alternative and explanatory paths, going forward, it is expected that regulators will form specific guidelines on algorithms. However, it is uncertain if the new regulatory environment will be supportive of AI adoption.

Will regulators retain manual review requirements for AI decision making or will they eliminate such provisions, retaining manual review only in cases of dispute? How will regulators deal with biases in AI decision making, considering they might be inevitable? How proactive and visionary will they be?

- **Market structure**

Michael Berns, PwC Director for AI: “In the past years, few technology companies have dominated the AI development landscape. US Tech giants like Google, Amazon, Facebook and Apple (the so called GAFA companies) as well as Microsoft have all been acquiring AI firms in the last decade and many of them have been accused of aggressive market behaviour on occasions. There have been repeated calls from regulators to curb the power of the big tech – all GAFA firms had some antitrust probes with full investigation pending in the US and EU. Meanwhile Tencent, Alibaba and Baidu continue their tremendous growth in China while some other Chinese firms like Huawei, SenseTime, Megvii and others have been banned from exporting to US due to concerns regarding their role in surveillance with facial recognition and voice transcription.”

The role of regulators has evolved over the years. They now have a wider scope aimed at protecting public interests – from keeping an eye on strategies of companies and their systemic effects, to privacy protection, abuse of market power and even national security concerns over how data is used. The position of large tech companies have also changed over the years. Despite the historical aversion, some of the GAFA companies have begun to accept the idea of more regulation and have even indicated that they would invite more regulation and legislative solutions. These recent events will have big ramifications on how AI is developed – with lower market power, less data and resources to innovate, pace of AI development might be slow down, especially for applications that are very resource intensive. While it will prevent the creation of natural monopolies, consequently, the market might have to rely more heavily on start-ups for AI innovation.

Could large tech companies expect more regulatory oversight on their market power, the extent of data they control and how they use it? Instead, will regulators push innovation from start-ups?

Uncertainty 2: Active government push or industry driven AI?

The position that governments take on any developing technology has a very strong effect on the ultimate impact the technology will have. While regulators will determine the broader boundaries within which businesses will develop and use AI, governments will have a wider role to play, with a wider selection of tools at their disposal to influence the future of AI. National governments as well as EU could determine focus areas for AI, which areas to incentivize, how to push research and innovation, influence user adoption and talent development. Their level of involvement could vary widely – from almost a completely free market structure where governments have little to no control, to an active involvement through national strategies, incentive plans and direct investments – governments can take any position. As far as AI is concerned, multiple governments are forming national AI strategies at the moment. These strategies usually contain long-term commitment on investments in AI. Often these plans are very new and it is hard to say what effect they will have, which makes us consider this as a key uncertainty. Governments can increase the amount of money spent on AI, could take an active role in defining where

investments are made, and can also work with or restrict the area of influence of large tech firms.

- **Investments**

To keep the improvements made in AI going, a constant flow of investments is important. Governments could take an active role in this – by either directly investing in AI or through incentivizing investments from private parties. The consensus seems to be that AI and the benefits of AI will increase exponentially over many years to come. With this comes the argument that governments should get involved as soon as possible to get the most benefits from the rise of AI. But of course, governments could also choose to take a distinctly passive approach and let a free market exist, driven by the industry, without any direct involvement apart from giving a wider strategic direction. If AI does become as valuable as is claimed, the investments coming from firms and other non-government investors (the free market), can be enough to keep AI growing at its maximum speed. Either way, this is a key uncertainty which will determine the future of AI development.

How large will government investments in AI be, as compared to private investments? Will governments define and lead the way in defining where investments should be prioritized, or will that remain the purview of tech companies?

- **Talent**

Under a free market situation, the development of talent in AI fields will be largely driven by market forces. This essentially means that there will be little to no push from the government to increase the availability of talent by investing in education and training. That will largely remain the purview of tech companies, that might lobby and work together to retrain their workforces. On the other end of spectrum, governments will not take such a passive stance to talent development. They will invest in educational and training institutes, be involved in creating new curriculums and working with the industry to develop the right skill sets and set up funds to sponsor research and development directly. Whichever way this plays out, investments in talent will have a long-term influence on how AI shapes up in any geography. Since we are only looking forward five years, it is still a very important decision to be made, that will



have a lasting influence on the advantage that countries develop for themselves in the race for AI leadership.

Will governments take an active role in developing talent for artificial intelligence? How much would they be willing to invest in early education and reskilling of existing workforce?

- **Adoption**

Free markets are characteristically free of government control. In the context of pushing AI adoption, government involvement can have far reaching consequences. Governments can be involved in a myriad of ways: they could only set some priorities where AI investments could focus, or they could go as far as to push adoption through direct subsidies, tax benefits or other financial incentives. This entire spectrum of possible involvement is vital to the future of AI. In the industry driven end of the spectrum, the areas where AI applications develop would be completely governed by market forces of demand and supply. Which areas score highest on societal benefits would

have no bearing on such decisions. While this is not necessarily bad, it could limit the overall benefits to the economy. At the same time, such an approach maximizes value to the shareholders of large tech companies, which in turn, ensures a steady flow of future investments to AI development.

Will governments push AI adoption in industries and sectors to ensure the benefits of AI to society? Will they define priorities and focus areas for adoption push, such as healthcare or let market forces decide which applications see the light of the day with consumers?

The scenarios: what will 2025 look like for the EU?

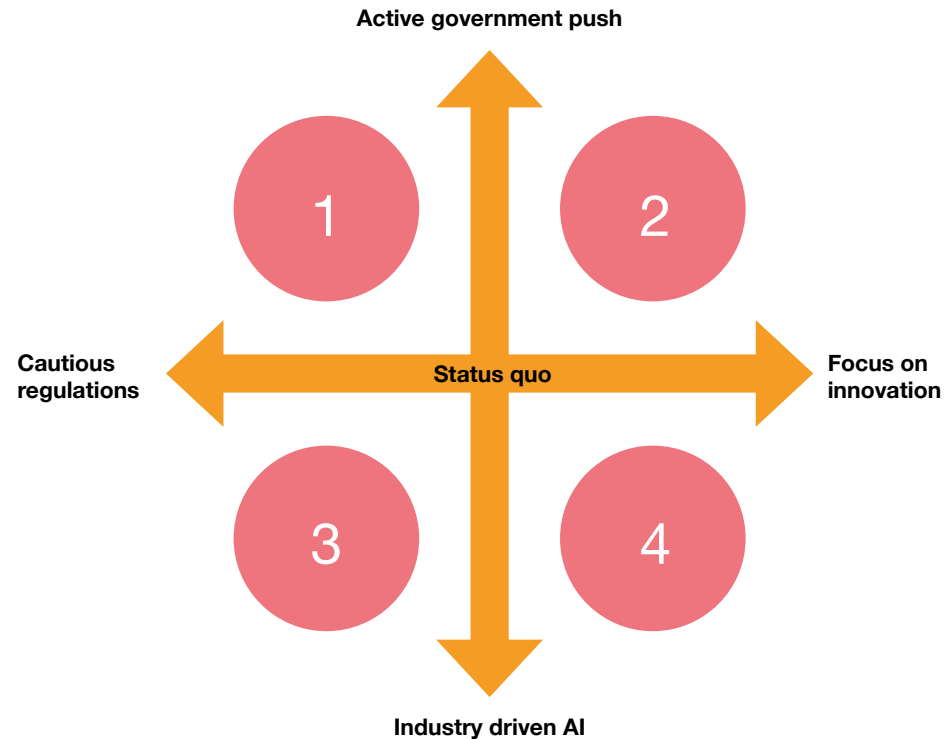
Four 'extreme' scenarios

The two uncertainties - regulatory environment and extent of government interventions - can give rise to four extreme scenarios which could play out in the EU in the short to medium term. Considering the future of AI is highly uncertain, we use what has happened in different parts of the world to connect the dots to the European future of AI. For each potential scenario, we look at countries that have found themselves in similar circumstances in the last five years. Analysing the way these countries have directed AI development and where they find themselves as a result, can give us critical inputs into the policy options for the EU on where it could be by 2025.

Companies need to understand the consequences

While companies may not have an active role to play in which scenario it lands, they will need to understand the ramifications of each situation and how they can take a leadership position by adopting AI.

We also raise some of the questions that are relevant for companies for each scenario - what will AI look like in 2025? How fast will it develop? What will the start-up landscape look like, and what will be the role of large tech companies? What will be the overall impact on the economy, consumers and overall welfare in the countries?



Scenario 1: Preparation meets opportunity

Data privacy laws will be interpreted strictly

In this scenario, the EU will retain its conservative stance on AI regulations. Data privacy laws, including GDPR will continue to be interpreted strictly, keeping individual's privacy at the centre of all discussions, even at the cost of delaying innovation. More teeth will be added to the regulations, as companies that stray too far from guidelines will be fined heavily, increasing their AI related cost of compliance. Cautious regulations will apply not only to platforms that collect data and, on its use, but specific guidelines with respect to algorithms will also emerge. They will no longer be limited to just general guidelines that individual rights must be preserved and biases avoided but will focus in more detail on specifics of what kind of decisions can be taken by AI and manual reviews will be mandatory for many instances. This of course will not restrict innovation completely, as companies will continue to develop technical capabilities which can be leveraged to process data responsibly, leading to a more sustainable scenario with responsible AI at the forefront.

Combined with a government push

At the same time, cautious regulations will limit some of the growth potential of AI by increasing development and compliance costs for companies. In this scenario however, cautious regulations are combined with an active government role to push AI, which will have a distinctly positive impact. The government will continue to be active in providing the incentive necessary for AI growth.

Government intervention will not be limited to setting national AI policy agendas, but will also define which areas within AI require boost, through financial assistance and subsidies, and promote responsible AI as a part of its central agenda.

AI development in a sustainable way

Pushing AI development through a central agenda, while keeping its growth on a tight leash, will ensure that AI development happens in a sustainable manner, even if it is a bit slower than other regions.

Scenario 1: Preparation meets opportunity (Sustainable AI)

- Slower development of AI due to stricter regulations. Fewer applications are developed but the ones that are, are more likely to take off
- Government focus defines which applications are prioritised and incentivised
- Adoption in Europe picks up driven by government push and lower concerns of consumers
- Tech companies, including start-ups begin to focus and differentiate on the basis of data safety and privacy compliance standards

Active government push

Cautious regulations

Country focus: United Kingdom

The UK is among the leaders in artificial intelligence in Europe*. While, so far, it is bound by the same cautious regulations that bind the rest of the EU (consider GDPR), it has made a concerted effort to push innovation in AI and is considered to be well ahead of the rest of the EU countries in its ability to develop and capture the potential of AI. However, over time Brexit will likely undermine some of that leadership due to a number of reasons including reduced research funding and a smaller talent pool.

Active government push in the UK

Since the last few years, the UK government has consistently been pushing AI development, putting it at the upper end of this uncertainty axis. First and foremost, the UK government identified AI and data as one of four areas in which the UK can lead the world in technology in its Industrial Strategy, first published in 2017. The £1bn AI sector deal, launched in 2018, also added many other AI push measures, such as:

- Investing in R&D, skills and innovation in regulatory policy making and practices.
- Supporting sectors to boost their productivity through artificial intelligence and data

analytics technologies.

- Initiating a Centre for Data Ethics and Innovation, and strengthening the UK's cybersecurity capability.
- Helping people develop the skills needed for the jobs of the future through investment in STEM skills and computer science teachers, as well as retraining and researching the impact of automation across sectors.

Cautious regulations in the UK

The UK has so far adhered to the same cautious AI regulations that apply to the EU, specifically with respect to data protection. In fact, it has also introduced supplemental legislation in line with the European ethical principles and requirements. In the UK, section 14 of the Data Protection Act 2018 has further legislated the GDPR Article 22 limitations on the use of automated processing and profiling which causes legal effects concerning individuals, or which significantly affects them. That means that if a data controller in the UK decides to carry out automated processing or profiling on special categories of data, then, it must implement the additional measures, including:

- Notifying the individual in writing that a decision has been taken based solely on automated processing.

- Putting in place an internal policy to deal with individuals' requests to reconsider the decision or involve human intervention on the automated processing-based decision. The regulation also sets timelines for requests by the data subjects, and the responses by the data controllers, who must respond in writing.

* Oxford Insights Index

Scenario 2: Eyes on the prize

A very active government role

In this scenario, the EU as well as its member states will take a very active stance on the development and adoption of AI. This includes formulating European, national and regional AI policies, setting up implementation agencies with specific responsibilities for pushing AI in the region, developing necessary skills by working together with universities, supporting research and actively investing in AI development - directly and indirectly through subsidies and tax breaks and investing in privacy enhancing technologies to ensure competitive advantage.

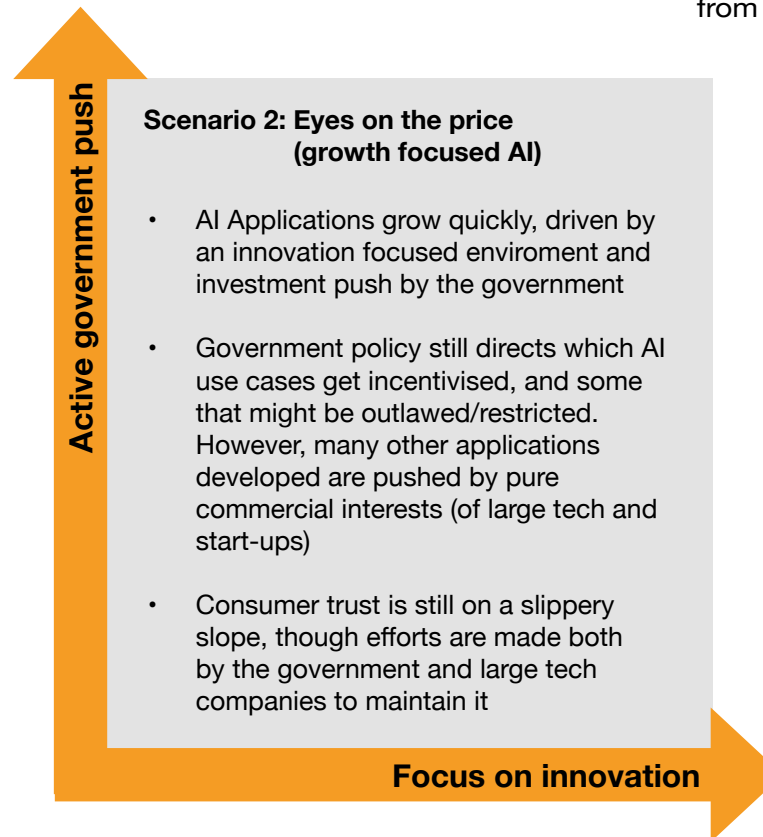
Combined with a flexible approach on regulation

Besides an active government role in stimulating AI, this scenario also assumes a flexible approach of regulators on AI - relaxing regulations where necessary to allow innovators to experiment and channel investments in the right direction. Such a regulatory environment encourages companies to innovate when in doubt, which is not an uncommon situation when regulations lack specifics. Liberal regulations could put a strain on consumer trust, as data privacy will continue to be a concern, alongside a host of others, like discriminatory algorithms.

This is expected to be tackled by renewed efforts from the government and major technology companies to work together to retain consumer trust through maintaining and developing best practices with data use.

An uninterrupted growth path

Overall, the result is expected to be a scenario where AI can have a uninterrupted growth path, as it benefits not just from an regulatory environment that supports experimentation and innovation, but also financial and policy support from the government.



Country focus: China

The classic example of such a scenario is the AI landscape in China. The Chinese government puts its high ambitions into practice by giving AI an active push, while keeping a relaxed regulatory environment.

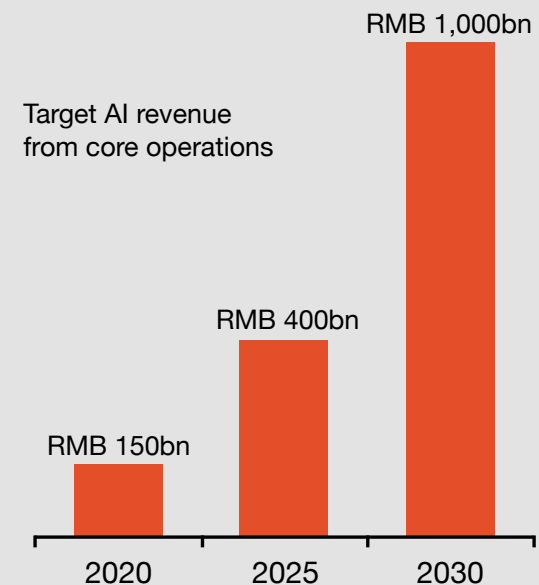
Active government push in China

The State Council of China published its Next Generation AI development Plan in 2017, highlighting the country's strategy of building a domestic AI industry worth nearly US\$150 billion over the next few years and to become the leading AI power by 2030. China has :

- Outlined the steps to be taken for specific AI applications like military readiness and city planning and also how to introduce AI courses to schools to ensure talent availability in the future.
- Set up a new office called the AI Plan Promotion Office, which is responsible for the implementation and coordination of the emergent AI-related projects, primarily driven by government-led subsidies.
- Established an AI Strategy Advisory Committee to conduct research on strategic issues related to AI and to make recommendations.
- Established an AI Industry Development Alliance, which is co-sponsored by more than 200 enterprises and agencies nationwide and focuses on building a public service platform for the development of China's AI industry with which to integrate resources and accelerate growth.

Focus on innovation in China

China is pegged as a potential leader in AI in the future, not only because of its liberal view of AI regulations, but also allowing access to large troves of data to create viable AI algorithms. China has focused on following the concept of open-source sharing and promote collaboration between industry, academia, research, and production units. China is expected to be flexible with its own rules it applied on AI. Generally these are interpreted as guidelines which could be bent if any actions are considered necessary for the greater good.



Scenario 3: Fail faster, succeed sooner

Regulation focused on innovation

In this scenario, the EU and national regulators will take a visionary view on AI innovation. The focus of regulations will be to encourage innovations, while regulators work out specifics related to the AI applications being developed. Focusing on AI innovation could include more exemptions on data use that allow companies to innovate at a fast rate. Considering the data and privacy regulations are inherently weak in this scenario, consumer trust in AI will suffer. However, a liberal regulatory environment does not necessarily have to mean weak consumer protection. Driven by consumer demand for data protection and consequent reputational risks, companies, especially large tech companies could push the boundaries on self-regulation as a differentiator and a means to minimize risks to their market power.

AI development is driven by the market

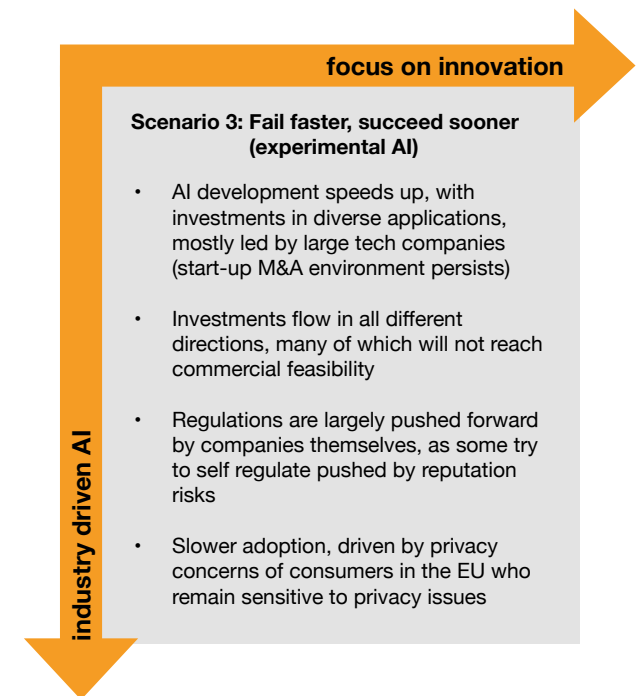
On the other axis, governments encourage an industry driven market for AI. This implies that while governments do not restrict AI growth by introducing specific regulations, they also do not actively encourage its development or adoption. The stance of most governments in

this scenario would be of ensuring minimum intervention. Start-ups as well as large technology companies will pick up the mantle and drive AI development. This essentially means that the applications with the most return on investments for the shareholders are the ones that will be prioritized. Considering AI is still in early stages of development, this scenario would mean that a lot of investments may flow to applications that have not yet established commercial or even technical feasibility, as companies experiment in diverse areas. Eventually the market will determine which applications have the most potential, while the development of others stops, regardless of their social benefits.

A vibrant innovation environment

While it might be inconceivable to many that companies will self-regulate, in a free market scenario, companies will have to think long and hard on their differentiation strategies and developing consumer trust will remain a major factor. Overall, this scenario is expected to be a little volatile to begin with (in terms of where investments flow and returns realized), but it will be characterized by a vibrant start-up and

innovation environment. Provided that governments have or come up with supportive regulations (in the area of for example intellectual property and patent laws) and necessary talent is available, companies driving the development of AI, have the (potential) opportunity to establish leadership positions across applications and industries.



Country focus: USA

The US has long been the pioneer in AI technologies with many of the large tech companies investing in AI based in the US. It also has a vibrant AI start-up ecosystem which has maintained its lead worldwide in AI innovation. A recent study by Center for Data Innovation found that the US showed clear leadership talent, research, development and hardware*.

Industry driven AI market in the USA

The USA historically took an industry driven approach to AI development, notably taking its first steps towards a national AI strategy only in 2019. Yet, its approach until now has been to draft the overarching principles to AI, but not prescribe details or focus areas for the industry.

- The US approach to AI is based on five pillars which are aimed at maintaining the US' lead in AI innovation and facilitate development by removing barriers for the market to develop AI further
- The five pillars include - (1) promote sustained AI R&D investment, (2) unleash Federal AI resources, (3) remove barriers to AI innovation, (4) empower the American worker with AI-focused education and training opportunities, and (5) promote an international environment that is supportive of American AI innovation and its responsible use.

Innovation focused regulations in the USA

While regulations are an entirely different matter, the USA also takes a categorically hands-off approach to regulations as well. Early in 2020, the White House revealed ten principles that federal agencies should consider when devising rules for the use of AI in the private sector and stressed the importance of limiting regulatory overreach**.

- The government recommended that federal agencies conduct risk assessment and cost-benefit analyses prior to any regulatory action on AI, with a focus on establishing flexible frameworks rather than one-size-fits-all regulation.
- The US also made it clear that it wants to avoid any 'heavy handed innovation-killing models', ensuring that the technology develops at a high pace. By keeping the innovation going and allowing power to free market forces, it aims to shape the technology's evolution in the right direction, consistent with its common values as a country.

* Other areas being adoption and data, where China was in the lead, "Who is winning the AI race: China, the EU or the US", August 2019

** Read more about the 10 principles [here](#).

Scenario 4: The balancing act

A cautious regulatory view

In this scenario, regulators in the EU will continue to apply its cautious regulatory view on AI – from data use and privacy to algorithms and their impact. As the learnings from AI development and use increase, regulators will continually revise the standards, keeping consumers at the centre of their strategy.

While leaving AI development to the market

While this is not very different from the path from the current path the EU has chosen, there will still be a significant shift in how governments handle AI policy. In this scenario governments will encourage an industry driven AI market and not actively push AI development. This could mean little to no directed investments from the government in AI.

Companies deal with high compliance costs

The impact of these two axis positions will be interesting. Regulatory restrictions on data and algorithms will almost directly impact the development and large-scale feasibility of new applications – compelling tech companies, start-ups and incumbents alike, to carefully vet the areas where they invest in. Again, this is not

necessarily an impediment. Carefully vetting areas of investment will this be important because of the lack of incentives from the government and potentially expensive R&D phases, but also because strict regulations would mean high compliance costs. Any new AI application areas will first have to be evaluated to ensure there are no potential data use issues. Any application on the path to be commercialized will first have to be tested for possible biases, to ensure there are no compliance issues with not just current, but also potential future regulations.

And decide on the right applications

The key difference between this scenario and scenario 1 – ‘sustainable AI’, is that the responsibility of choosing the right applications and executing the development and commercialization will rest exclusively on the AI companies, with little to no policy guidance from the government. How well they are able to achieve this lofty goal, will determine which companies emerge leaders in this scenario.

cautions regulations

Scenario 4: The balancing act (cautious AI)

- Slower development of AI, with restrictions on data use and control over algorithms
- Large tech companies under increasing pressures - to comply with privacy and algorithm guidelines, and also internally to realise returns on investments
- Concerns about the market power they hold continue, and calls to control data gathering practices also grow
- Adoption picks up, but much later than anticipated as customer trust gradually builds up

industry driven AI

Country focus: The Netherlands

The Netherlands has a long tradition of innovation and has recently been making strides in this area. Many Dutch companies are early adopters of AI and are increasingly moving towards more advanced applications. The government defined its national plan for AI called Strategisch Actieplan voor Artificiële Intelligentie (SAPAI) in 2019. The action plan defines the intent of the Dutch government to accelerate the development of AI in the country and to ensure its place on the international AI stage. While there exists a defined national plan to its credit, the Netherlands also maintains a free market approach to AI innovation.

Industry driven approach to AI in the Netherlands

The Dutch national plan for AI focuses on boosting innovation in the country by ensuring the elements that are needed to further stimulate AI is available. While the focus remains innovation, the plan also makes note of safeguarding public interests as a priority. Some key highlights from the plan include:

- The policy places specific emphasis on public private partnership. It recognizes that it is the companies - from start-ups to large businesses - that make a difference with their innovation competitiveness.
- The policy also states that the added value that companies bring – not just because they might respond to social challenges, but also because they respond quickly to demand from the market – is what will drive innovation for the Netherlands, in effect maintaining the free market approach.

Cautious regulations in the Netherlands

The Netherlands is also subject to the AI related regulations set up by the EU, with respect to data privacy, the ethics of responsible AI and larger principles governing AI algorithms. The AI policy restates the commitment to the ethics of AI and data protection.

Recently, the Dutch Data Protection Authority (DPA) published its supervision and enforcement priorities for 2020-2023*, stating that in the coming years it will place extra emphasis in its supervisory work on three focus areas: data trade, digital government and artificial intelligence and algorithms. The DPA has also taken the position that purely commercial interests and maximization of profits cannot be considered a legitimate interest in processing personal data, signaling its stand on strict regulations for data use in the future as well. While the guidance specifically on AI is comparatively less, it does intend to have a monitoring system for AI systems and algorithms using personal data.

* Read more [here](#) (in Dutch)

Differing perspectives on innovation and regulation



When we talk of cautious regulations, its relevance is wider than AI. Well formulated regulations are meant to protect all public goods, from individual privacy and fair distributions to national security and competitiveness of the economy. The impact of this welfare economic principle is significant – it can take us from a situation that perpetuates inequality to one that promotes social trust. Keeping that in mind, being cautious on regulations is inherent to policy design in modern societies. The principle doesn't mean there is an easy fix, because there will be a trade-off between strict rules on privacy protection and the speed innovation, since rapid experimentation is just not compliant with such a scenario. You can focus on both innovation and regulations, but one will definitely need to come first and form the basis for the other.

There is no good or bad way, the choice is largely a matter of societal taste. Do you believe long term prosperity is served best by first building broad trust in AI and then stimulate innovation, or first try to win the AI race and then work on the trust. From an economist's perspective, scenario 1 might be preferable since it promotes social welfare. I would say, reaching the AI future is a marathon, not a sprint, and you cannot sprint a marathon.



Jan Willem Velthuisen
Chief economist
PwC The Netherlands



Europe is lagging behind in terms of AI innovation ambition. In many countries, we are seeing great business models based on data, which are working on making artificial intelligence even more intelligent. We stood for technology and innovation for many years. Now it is important not to lose touch and to use our innovative strength, our adaptability, and our empathy to stay in the race. This requires a data culture that serves as a guideline. Here, our value generation as well as our interactions with huge data sets and complex situations should become the new norm. How is data already being used sensibly today? AI is used in medicine to make more precise diagnoses, it helps in the fight against poaching, and creates an awareness of our environment.

AI aims to solve the world's biggest problems, and we can help by nurturing great talent, advancing technology, and relying on our innovative power.



Marcus Hartmann
Chief Data Officer
PwC Germany



According to PwC's Global AI Study from 2018 the estimated long-term impact of AI on GDP in Europe is around 10%, while China and US will benefit from 26% and 15% respectively. Based on these numbers China clearly has the most advantageous setup when it comes to AI leveraging Scenario 2. The question is – would that be the right model for Europe to adopt? The answer could be – it depends on the circumstances. If say the healthcare systems are further stretched and cannot provide timely response, would the population accept lower data privacy standards?

There is also the question of taking the lead on a technology. In order to keep up technologically with the rest of the world and in particular China and US an environment with active government push and more innovation focus (Scenario 2) would be required. The government push / funding could specifically support research, grants or tax advantages for smaller firms in order to close the gap to the likes of GAFAs, Chinese equivalents and AI unicorns. Unlike in the nineties when Europe slept through the beginning of the internet and the chance to create world players it still has a chance to create world leading AI companies if it changes its course.

* [PwC's Global AI Study – Sizing the prize](#)



Michael Berns
AI & FinTech Leader
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In the current environment, companies are reluctant to experiment with smart algorithms. GDPR is strict, but also unclear, because its provisions are formulated in general terms. That causes a fear of violating regulations which could lead to heavy fines and a damaged reputation.

It would be a good idea for the government (or the European Union) to allow companies room for experimenting, of course within certain boundaries. That would enable companies to experiment, innovate, learn fast and fail fast - something like the scenario 3. That does not have to mean very lenient regulations. By setting clear limits in advance and give companies access to a critical review of supervisory authorities during the process, instead of afterwards, regulations can actually stimulate AI development. This approach ensures that the government/ European Union can convert best practices from the bottom up into regulations without stifling the innovative power of organizations. Simply waiting for further elaboration on GDPR and other regulations or case laws will take too long in this dynamic game.



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