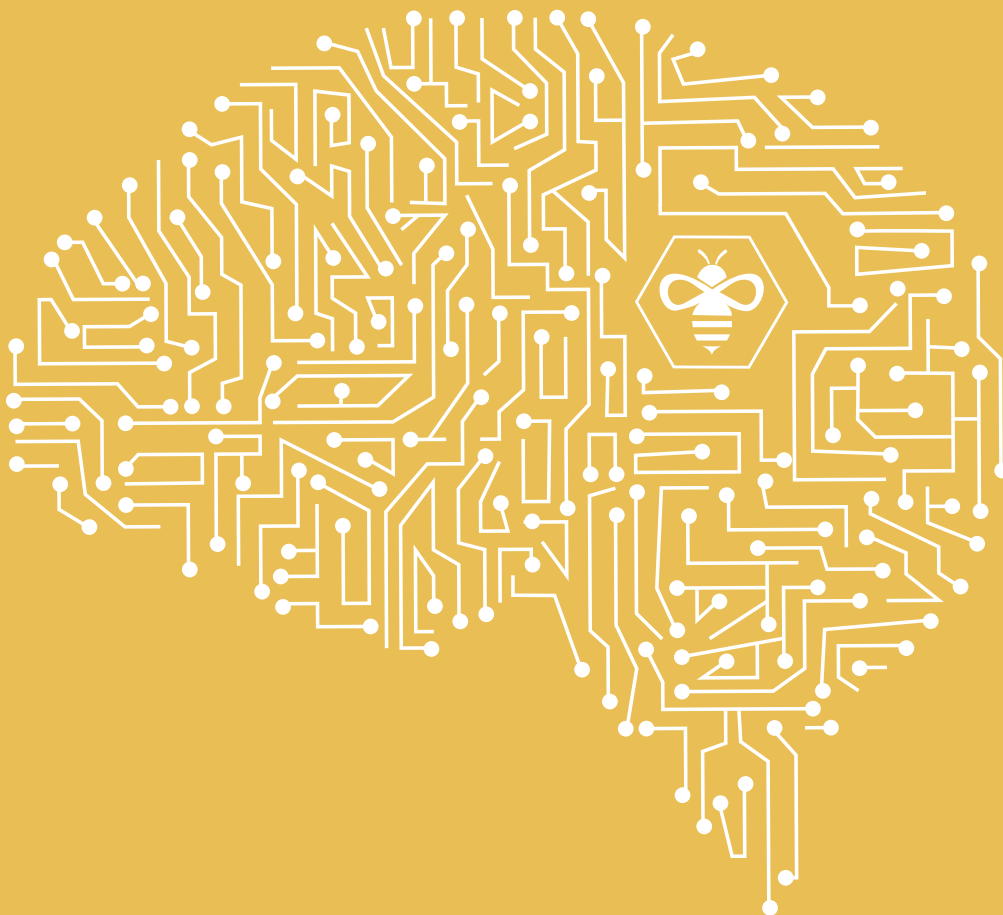




Artificial Intelligence & Financial Services

Cutting through the noise



Factsheet

In 2018, 83% of global investment in Artificial Intelligence across M&A and VC/PE was in the United States or China

Pitchbook

India produces 2.6 million science, technology, engineering and mathematics (STEM) graduates each year, more than the G-7 combined

Forbes

Increased Artificial Intelligence adoption is expected to lead to a 1.2% increase in Global GDP by 2025

McKinsey

Artificial Intelligence is expected to generate US\$1.2 trillion of additional value for the financial industry by 2035

PWC

Artificial Intelligence accounted for 10% of all VC investments in 2018

Forbes

Only 6% of global companies are actively implementing Artificial Intelligence strategies

BCG/MIT

The demand for data scientists increased by 650% since 2012

LinkedIn

Financial services account for 19% % of total IT spend on Artificial Intelligence

IDC

AI-focused IT spend represents 1.8% of total IT spend globally

Gartner

90% of the world's available data was produced over 2016-2018

Forbes

Preface

Artificial intelligence (“AI”) as an emerging technology has had a chequered history. We have observed periods of hype followed by several “AI chasms” over the past five decades. Today, we are beginning to observe AI powering many real-world applications from identity to natural language or automated assistants. More importantly, AI is being seamlessly embedded into services which we now consume on a daily basis. Perhaps the biggest area of change has been the significant interest from businesses around using AI to create efficiencies in their organisations which would result in growth of both productivity and innovation. At the same time, AI’s impact on work and the workforce is going to be seismic. The demand for certain skills will completely decline while completely new professions will be created requiring skills which have yet to be created. We are now at the cusp of a new era that will build on the network and Information Age.

AI has the power to impact multiple verticals in the same way that the internet was transformational to every aspect of our lives. Therefore, it really does fall into the definition of a “disruptor” to an industry. What makes it unique is that it is truly interdisciplinary, spanning computer science, mathematics, neuroscience, philosophy and more.

Over the last few years, the “renaissance” in AI has been fuelled by several trends emerging in parallel. These include: high-performance computing; cloud services; growing pools of unstructured data; and advances in fundamental research which are all supported by increased interest and investment. We believe that any significant technological change is prone to the traditional Gartner “Hype Cycle,” where the initial trigger of innovation leads to a peak of inflated expectations before unwinding into disillusionment and then, over a longer period of time, becoming increasingly embedded into the world around us and contributing to improved productivity. This cycle has been observed time and time again (3D Printing, Blockchain, Internet-of-Things).

This paper will argue that through a combination of factors, the age of Artificial Intelligence may have finally arrived, when the balance shifts decisively from promise and promotion to practical application. Importantly, we believe that the financial services sector will lead in the adoption of AI technologies, and that firms at the vanguard of change will create a more substantial moat between themselves, the “leaders” and others, the “laggards”.

Finally, we hope that this white paper will provide our readers with an initial framework to assess the opportunity and implications of Artificial Intelligence in the financial services industry. We hope that this proves to be a useful addition to our ongoing series of white papers which are intended to be a tool for practitioners. As always please feel free to provide any feedback!

***“By far
the greatest
danger of Artificial
Intelligence is that
people conclude too early
that they understand it.”***

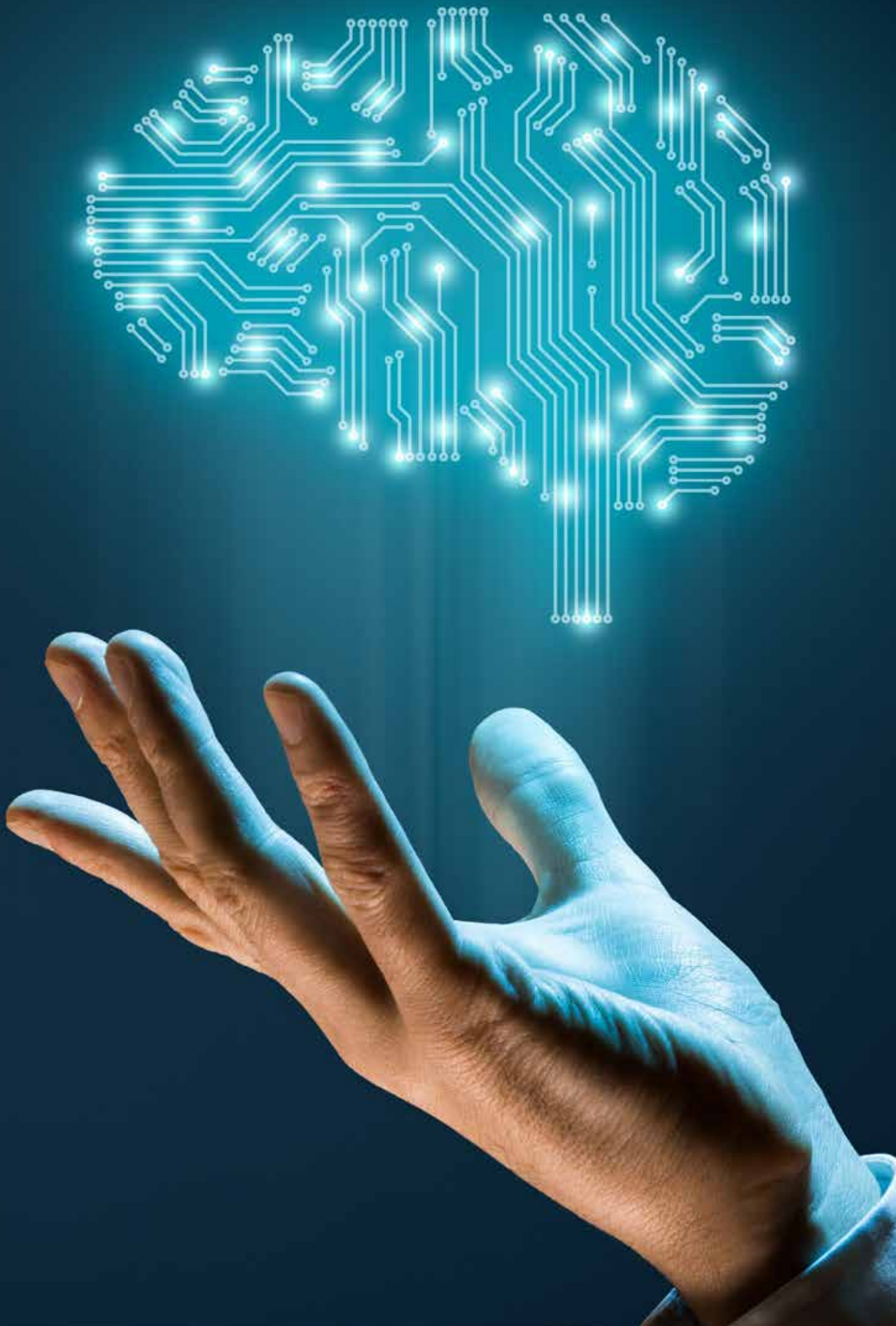
*Eliezer Yudkowsky,
Founder Machine
Learning Research
Institute*

Matteo Stefanel



Udayan Goyal





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1. Introduction

In this paper, Apis aims to parse the “hype” from the reality with regards to the explosion in investment and proposed applications of Artificial Intelligence across several industries over the last 24 - 36 months.

Artificial Intelligence (“AI”), perhaps more than any other recent technology, has been co-opted into hundreds of definitions and in many companies has reached the point where it is used as short-hand for “innovation.” That said, we believe some of this attention is warranted due to its multiple and significant applications. To understand this trend, we thought it important to unpack exactly what the building blocks of AI are. In [Section 2](#) we consider the various sub-segments that constitute modern AI. **The foundation of AI is the exponential emergence of large data-sets that are being generated across all modern industries today and are collectively referred to as “Big Data”.** This data is then utilised to identify correlations, make inferences or predict specific occurrences through various techniques - from traditional statistical techniques to more advanced Machine Learnings and Deep Learning models.

We subsequently consider the economic impact of AI across two axes: Firstly, its impact across several industries ([Section 3](#)). Secondly, its potential impact and adoption in Growth Markets ([Section 4](#)), with a particular focus on China and India (arguably the two strongest Growth Market AI powers) in relation to the United States. We highlight that the **financial services industry is likely to lead with regards to adoption of AI across its value chain due to the inherent advantages of having large data-sets, dematerialised products and an existing base of talent.** When turning to Growth Markets, we show that currently AI is a two-horse race between China and the US, and that realistically only India has a potential opportunity to build a strong AI competence within a 5-10 year horizon. The intersection of these two observations is **that Apis’ investment universe (financial services) will see significant scope to adopt AI technologies**, but that this will need to be led by individual companies and largely through co-opting best practice from other regions and sectors. As such, we believe, **there is significant opportunity for Apis to benefit from its sector focused mandate as AI broadens the gaps between the “leaders” and “laggards” within each market.**

In [Section 5](#) we aim to highlight real-world applications of AI in the financial services landscape, considering each of our focus sub-sectors: Payments; Credit & Savings; Insurance and Capital Markets. As well as marketing and customer service which cuts across all of these sub-segments. Finally, in [Section 6](#) we consider the current investment climate within AI and show how current AI funding is led by corporations (large technology players predominantly) and overwhelmingly focused on developed markets; this in-turn **supports Apis’ view that leading growth markets financial services firms will need to develop a strategy around: (i) purchasing / licensing developed market AI products; (ii) building a capability within their operations; or (iii) most likely, a combination of both.** As such, we wrap up with our proprietary AI due diligence check-list that supports investment professionals as they consider practical indicators for investment in AI.

We hope that this paper provides a helpful state of AI for readers and contributes towards demystifying this broad field and its applications. It is our conviction that as computational capabilities and data generation continue to grow exponentially, understanding the basics of AI, will become as important as knowing how to read and write.

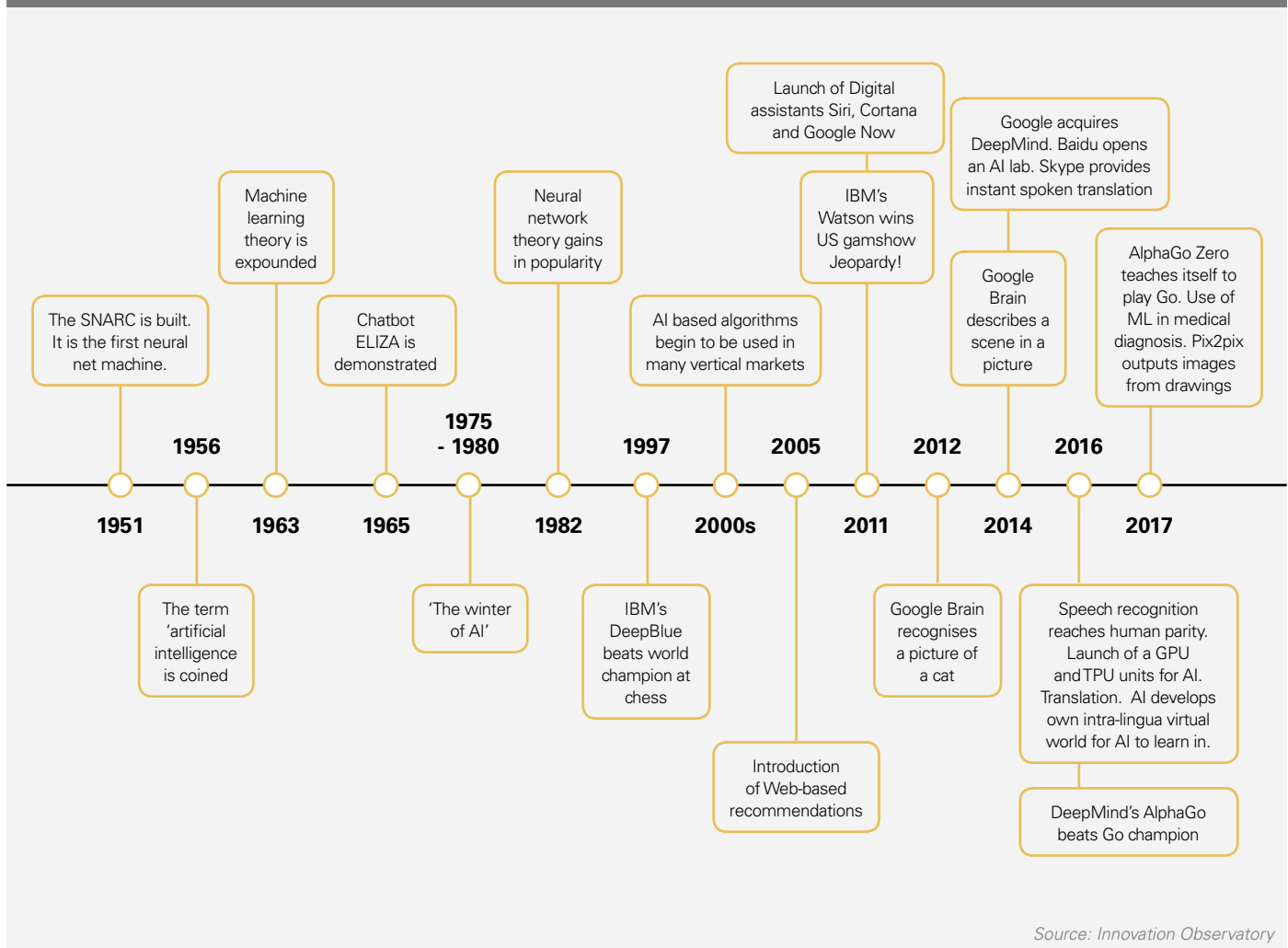


2. Artificial Intelligence Primer

To gain an understanding of Artificial Intelligence today, we first seek to understand the history and evolution of this group of technologies, and subsequently understand the key terms that are often used interchangeably to describe it. In doing so, we hope to lay the foundations to beginning to discern between the excitement around AI, and its realistic implications.

AI has a long history of being “the next big thing”

Figure 1: Evolution of AI



Artificial Intelligence (“AI”) is not a new concept, the first formal definition of AI was coined by computer scientist John McCarthy at the now famous 1955 Dartmouth Conference: “Every aspect of learning, or any other feature of intelligence, can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how machines use language, from abstractions and concepts, solve all kinds of problems now reserved for humans, and improve themselves”. This provided a pragmatic direction for subsequent AI research efforts and created huge excitement in computer science.

However, AI has a history of failing to deliver on its promises, the first AI “winter” occurred in 1973, with the UK Science Research Council commissioning the Lighthill Report. This report criticised the failure of AI to achieve its “grandiose objectives” and noted that “in no part of the field have the discoveries made so far produced the major impact that was then promised”. This was probably due to inadequate computational capabilities at the time, than to unrealistic expectations. In simple terms, it had been impossible to scale any AI solutions to real-world applications with the hardware available at the time.

2. Artificial Intelligence Primer

That said, academic research in the field continued, with the 1990s and 2000s being a period which coincided with significant advances in computing power and led to new leaps in the field of AI. Some of the most well-publicised examples of such breakthroughs include IBM's Deep Blue machine which prevailed against the world's best chess player (1991) and IBM's Watson's victory over record-holding contestants in the televised American quiz show "Jeopardy" (2011). **More recently, Google DeepMind's AlphaGo defeated Go's top-ranked player in four out of five matches (2017). This event was considered a landmark achievement within AI, as it was widely believed that computer victory in Go was at least a few decades away,** partly due to the enormous number of valid sequences of moves in Go compared to Chess.

The emerge of AI is due to several the technology being at the intersection of several key trends

The increased prevalence of AI in the past few years is supported by several key changes that should underpin a fundamental change in the long-term adoption of the technology. Specifically driven by the following areas:

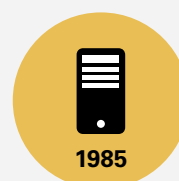
1. **High-Performance Computing**, with the adoption of new algorithms and new computing tools, has improved the learning ability and usability of AI. Advancements in AI research and increased sophistication of algorithms have also paved the way for new alternative computing architectures (such as Google's Tensor Processor Unit or "TPU") specially designed for AI-related computations. Shane Legg of Google's DeepMind notes: *"training an AI algorithm that would take one day on a Google TPU would have taken a quarter of a million years using a cutting-edge 1990s microprocessor"*;
2. **Big data and the increases in the number of devices and sensors connected to the Internet of Things ("IoT")** are generating enormous amounts of data. In addition, data generated by digitalised processes at economical prices is helping accumulate more data, which can be processed to generate high-value insights. Big data has ample room to grow, 90% of the world's data has been generated in the last two years, while data from the IoT (mobile phones, smart appliances etc.) will far outstrip data from the Internet of People;
3. **Cloud technology** which enables the aggregation and storage of ever more data in parallel to have democratised access to **high computing power**. Google and several other platforms offer such capabilities at affordable prices. This made data and computing power more accessible to an even wider set of users, which in turn boosts innovation and opportunities for AI.

Figure 2: Drivers of AI progress since 1990

Explosion in data and data access coupled with...

Year	Global Internet Traffic
1992	100 GB per day
1997	100 GB per hour
2002	100 GB per second
2007	2,000 GB per second
2016	26,600 GB per second
2021	105,800 GB per second

...dramatic increase in computing power...



Cray-2 Supercomputer

2 GB
244 MHz



Apple iPhone X Smartphone

512 GB
3,000 MHz

Source: Apis analysis

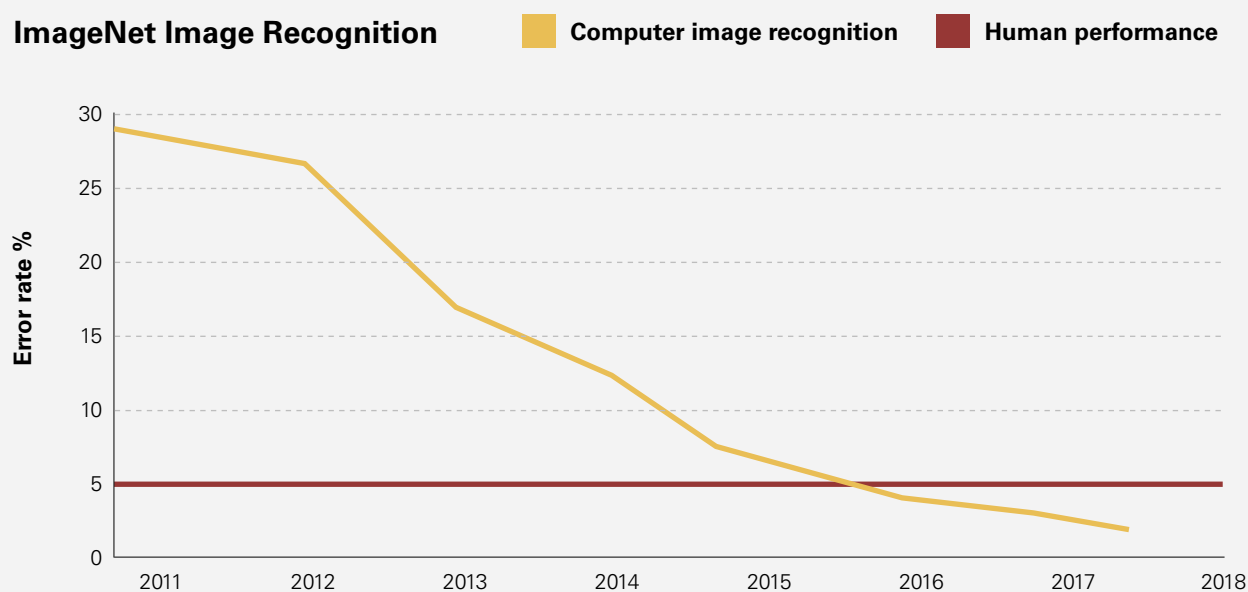


2. Artificial Intelligence Primer

These advances combined with progress in computer science have enabled the development of much more insightful result from these large data-sets; **this in turn has been supported by greater investment and increased interest, which is accelerating progress.** Indeed, and as seen in the figure below, by 2016, computer image recognition accuracy surpassed humans for the first time.

Figure 3: Artificial Intelligence Inflection Point

ImageNet Image Recognition



Source: MMC Ventures

Artificial Intelligence remains a largely misunderstood field

As much as AI has been a source of fascination across many fields ranging from computer science to philosophy for over 70 years, it is an area that remains widely misunderstood and which elicits impassioned debates. AI also raises some deep philosophical and ethical questions (e.g. *can a machine have a mind, mental states, and consciousness in the same way that a human being can? Will machines replace humans?*) that have been explored in several books and films. Popular literature on AI typically feature competing utopian and dystopian narratives. This has created both exuberance and fear. **The lack of a precise, universally accepted definition of AI is attributed to having helped the subject blossom at an ever-accelerating pace.**

Figure 4 Sample Popular Literature on AI



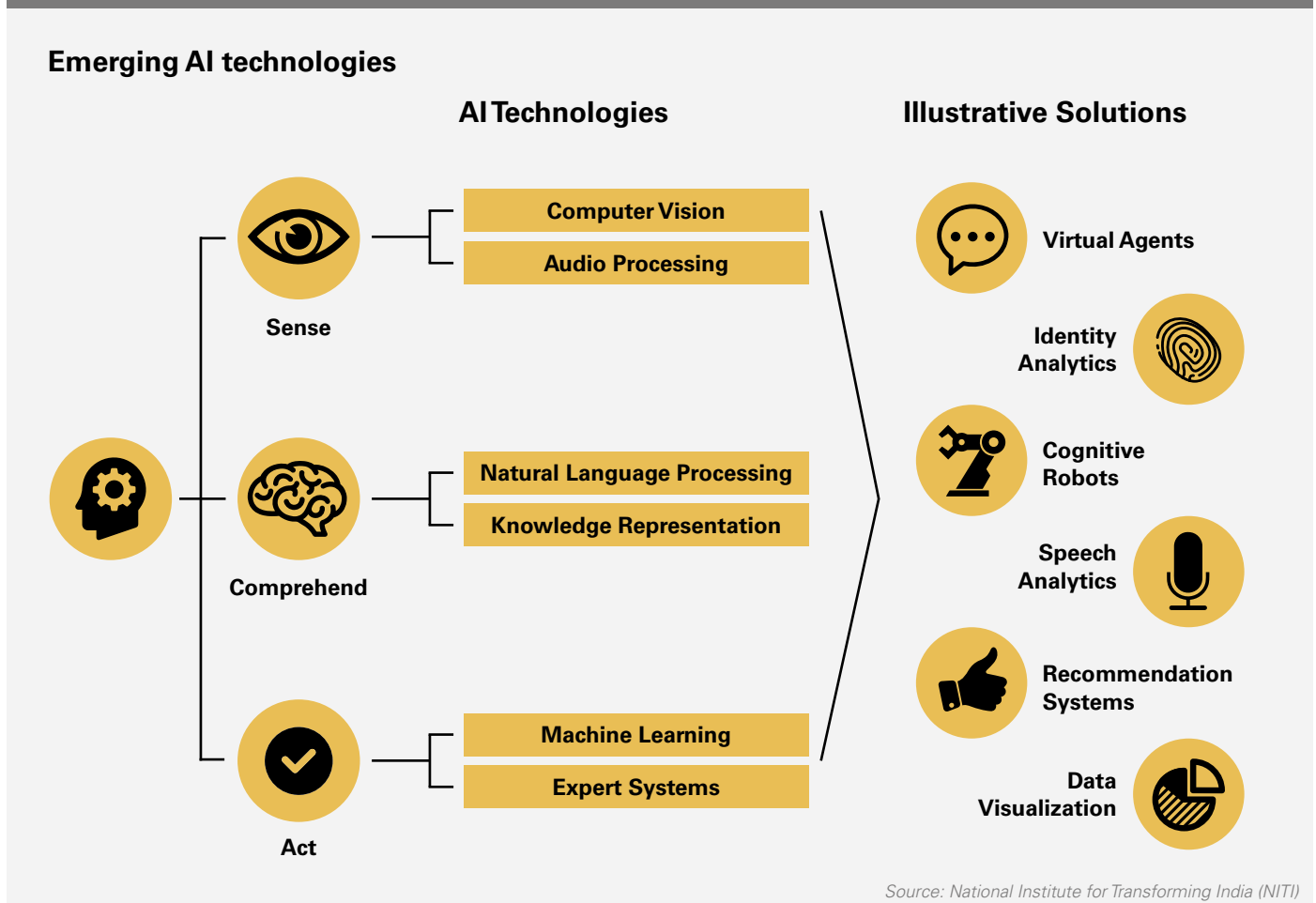
Source: The Royal Institution (UK)

2. Artificial Intelligence Primer

Nils J. Nilsson, author of “The Quest for Artificial Intelligence: A History of Ideas and Achievement” provides a helpful definition: “Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment.” More broadly, **when a computer completes tasks based on a set of stipulated rules that solve problems (algorithms), this “intelligent” behaviour is loosely referred to as AI. To complete this definition, AI is a group of technologies (computer vision, natural language, virtual assistants, robotic process automation, and advanced machine learning) that enables machines to emulate the human capabilities of sensing, comprehending and acting.**

For example, through computer audio and vision processing, AI systems (machines) can actively perceive the world around them by acquiring and processing sound, speech, images and videos. Then, through natural language processing and inference engines, these AI systems analyse and understand the information collected. They can then *take action* through technologies known as expert systems (a computer system that emulates the decision-making ability of human expert, translated mainly as if-then rulers for the algorithm). Therefore, every AI application begins with large amounts of training data (audio, video, text, speech, etc.).

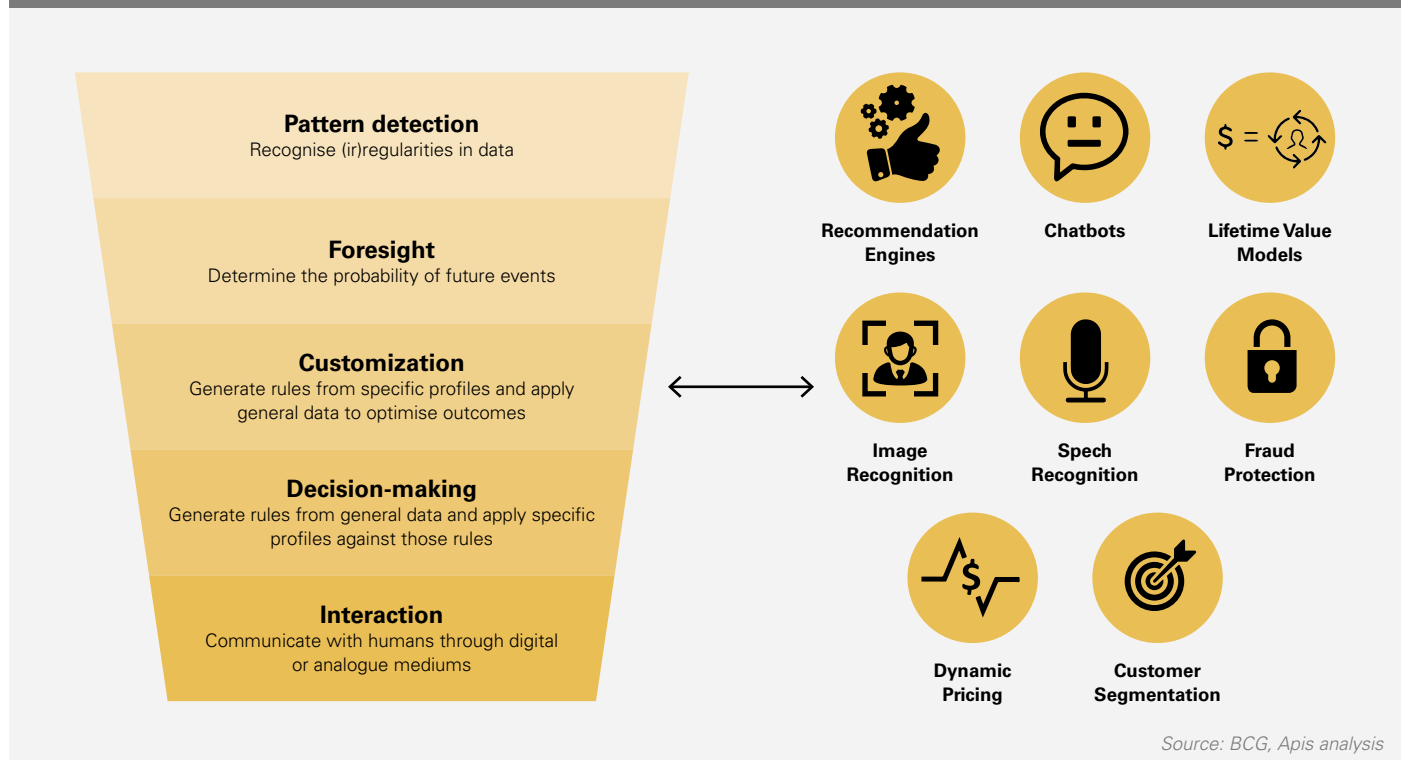
Figure 5: Artificial Intelligence Definition



2. Artificial Intelligence Primer

Whilst there is no agreed definition of AI, we lay out below the core technical components of the field. Many applications of AI-driven technology use a combination of the facets described below. Within AI, two major categories exist:

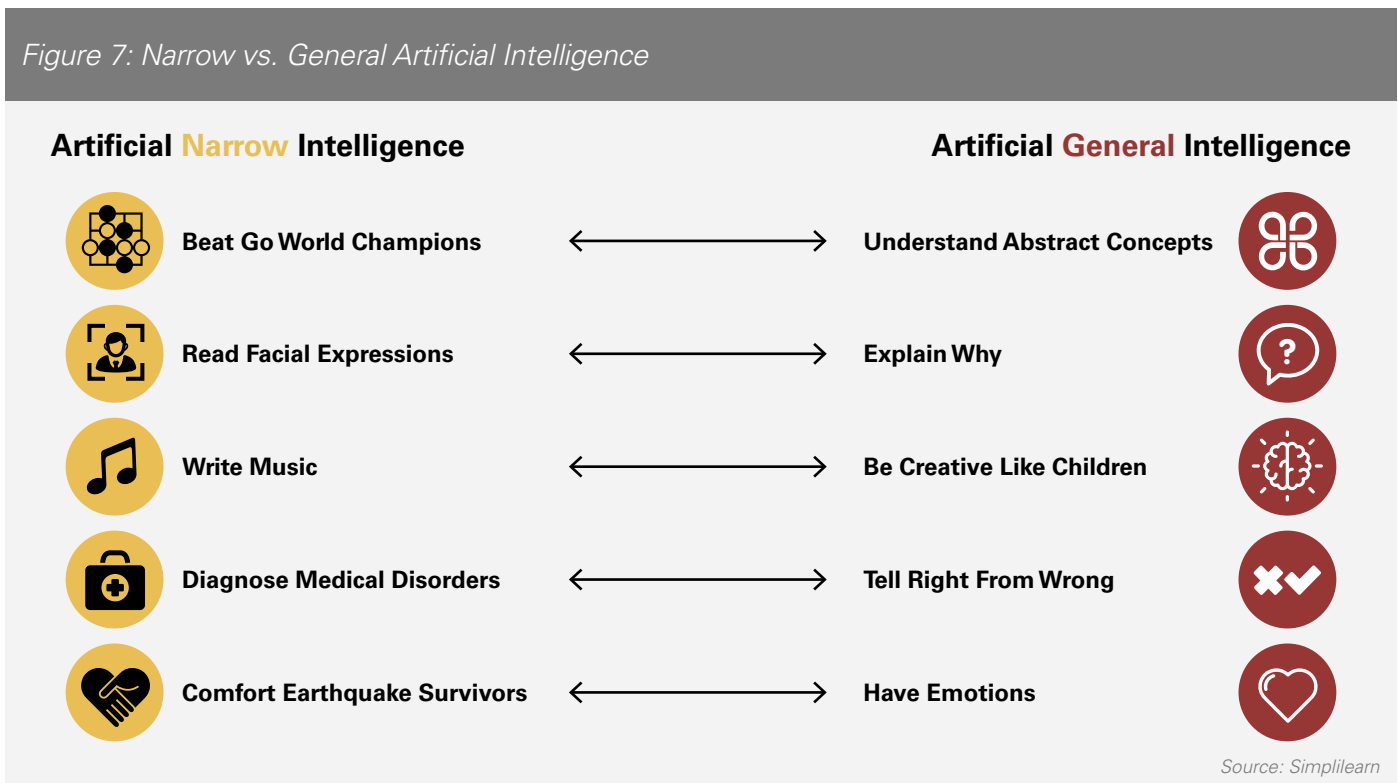
Figure 6: Artificial Intelligence Definition and Common Applications



- **Applied or Narrow AI, which is the most prevalent form today.** This is an application of AI to enable a machine to replicate or even surpass human ability for a single dedicated purpose. Common applications include facial recognition or elements of autonomous driving. The IBM and Google machines described earlier are examples of Narrow AI as they were limited to playing Chess, Jeopardy or Go.
- **General AI**, an AI which can be used to complete a wide range of tasks in a wide range of environments. This more advanced type of AI is predicated on solving complex real-world problems in a way that mimics humans. Unlike Narrow AI, this type of intelligence is not limited to a single application where humans still have to impose certain rules (e.g. label data) before the computer system can “learn.” Applications of General AI are mainly seen in movies. **It is this type of AI which led to the development of Machine Learning, though no one has yet claimed the first production or development of General AI.**

2. Artificial Intelligence Primer

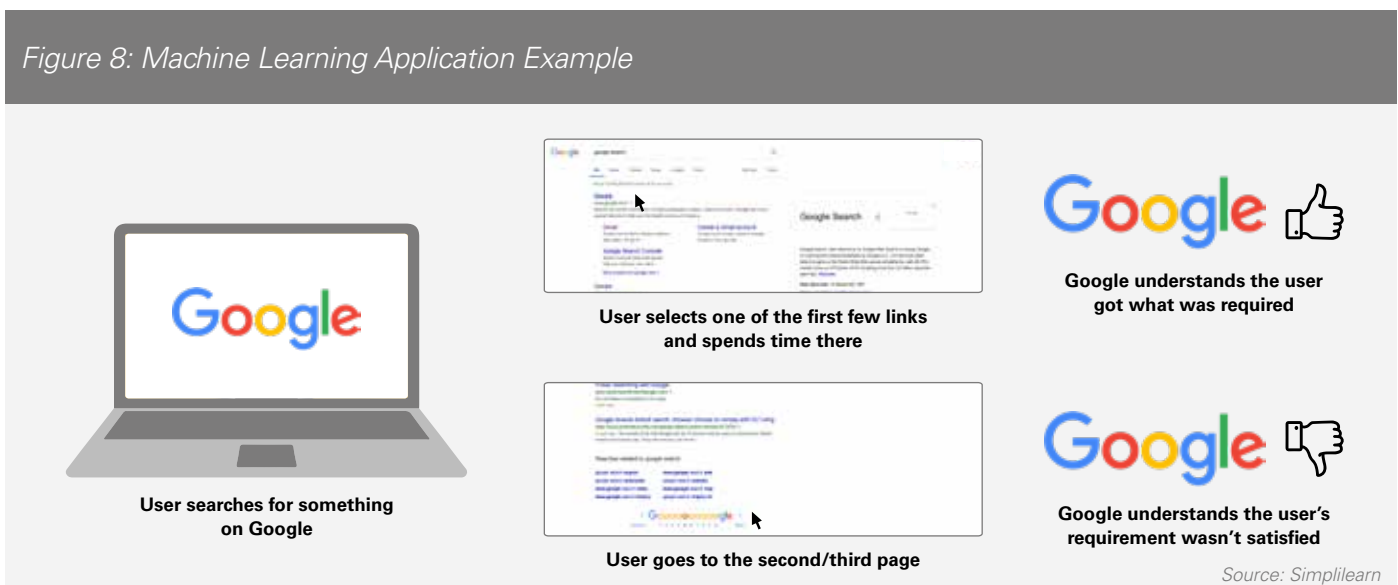
Figure 7: Narrow vs. General Artificial Intelligence



Artificial Intelligence vs. Machine Learning vs. Deep Learning

Machine Learning ("ML") is a subset of AI. ML entails feeding vast amounts of data into an algorithm until it *learns* from the information it processes and complete tasks on its own. ML enables programs to learn through training, instead of being programmed with rules. By processing training data, ML systems provide results that improve with experience. In other words, ML is a method of training algorithms such that they can learn how to make decisions independently. The defining characteristic of an ML algorithm is that the quality of its predictions improves with experience. A widespread application of ML is search engines whose results improve over time as the algorithm learns what the user's requirements and preferences are.

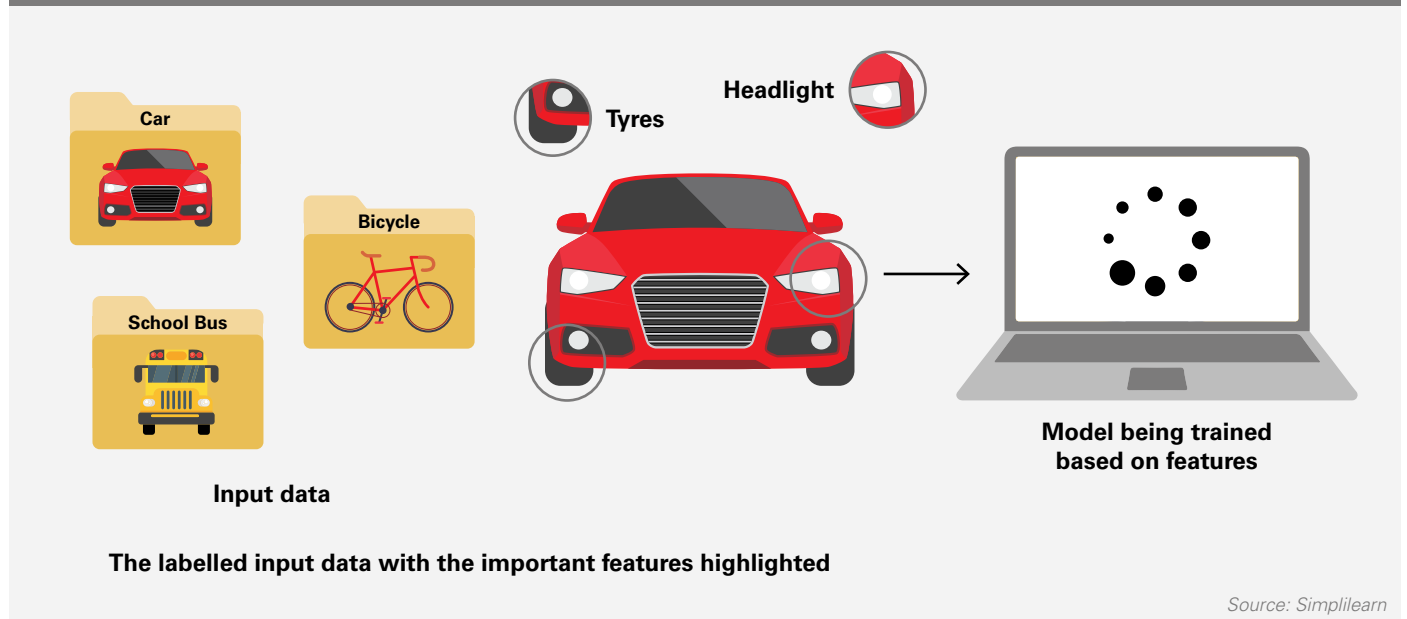
Figure 8: Machine Learning Application Example



2. Artificial Intelligence Primer

Typically, the more data is provided to an ML system (assuming it is relevant), the more effective its predictions (up to a point). By way of example, for a facial recognition software, this means feeding thousands of photos or videos of a car into the algorithm until it can reliably detect a car from an unlabelled sample, even if it has never seen that car before.

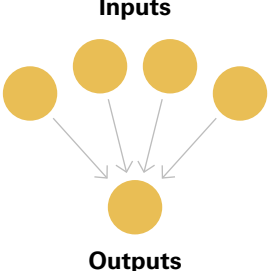
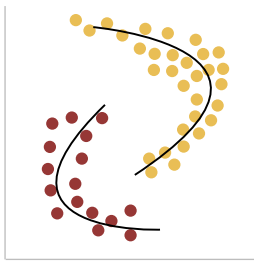
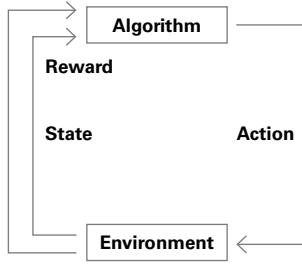
Figure 9: Machine Learning Algorithm



ML can be separated into three types of learning: supervised, unsupervised and reinforcement learning. In supervised learning, algorithms are developed based on labelled datasets, and are trained to derive input-output links, by providing the algorithm with the "correct" values. This means that humans must label and categorise the underlying training data, which can take up a huge amount of time, and limit datasets to those categorised by humans. Supervised learning is for example used in insurance underwriting or fraud detection. By contrast, in unsupervised learning, algorithms are not trained and are instead left to find regularities in the input data without any instructions as to what to look for. Customer segmentation is an example of unsupervised learning. In both cases, it is the ability of the algorithms to change their output based on experience that gives Machine Learning its power. A more recent type of learning is known as reinforcement learning, whereby the algorithm learns using sparse and time-delayed data labels (virtual rewards or punishments) and receives feedback which tells it whether it chose the correct action. This is essentially learning by trial and error. Examples of reinforcement learning include AlphaGo (and most games), and autonomous vehicles.

2. Artificial Intelligence Primer

Figure 10: Machine Learning Techniques – Supervised vs. Unsupervised vs. Reinforcement

	Supervised Learning	Unsupervised Learning	Reinforcement Learning
			
What is it?	An algorithm uses training data and feedback from humans to learn the relationship of given inputs to a given output (e.g. how the inputs “time of year” and “interest rates” predict housing prices)	An algorithm explores input data without being given an explicit output variable (e.g. explores customer demographic data to identify patterns)	An algorithm learns to perform a task simply by trying to maximise rewards it receives for its actions (e.g. maximises points it receives for increasing returns of an investment portfolio)
When to use it?	You know how to classify the input data and the type of behavior you want to predict, but you need the algorithm to calculate it for you on new data	You do not know how to classify the data, and you want the algorithm to find patterns and classify the data for you	You do not have a lot of training data; you cannot clearly define the ideal end state; or the only way to learn about the environment is to interact with it

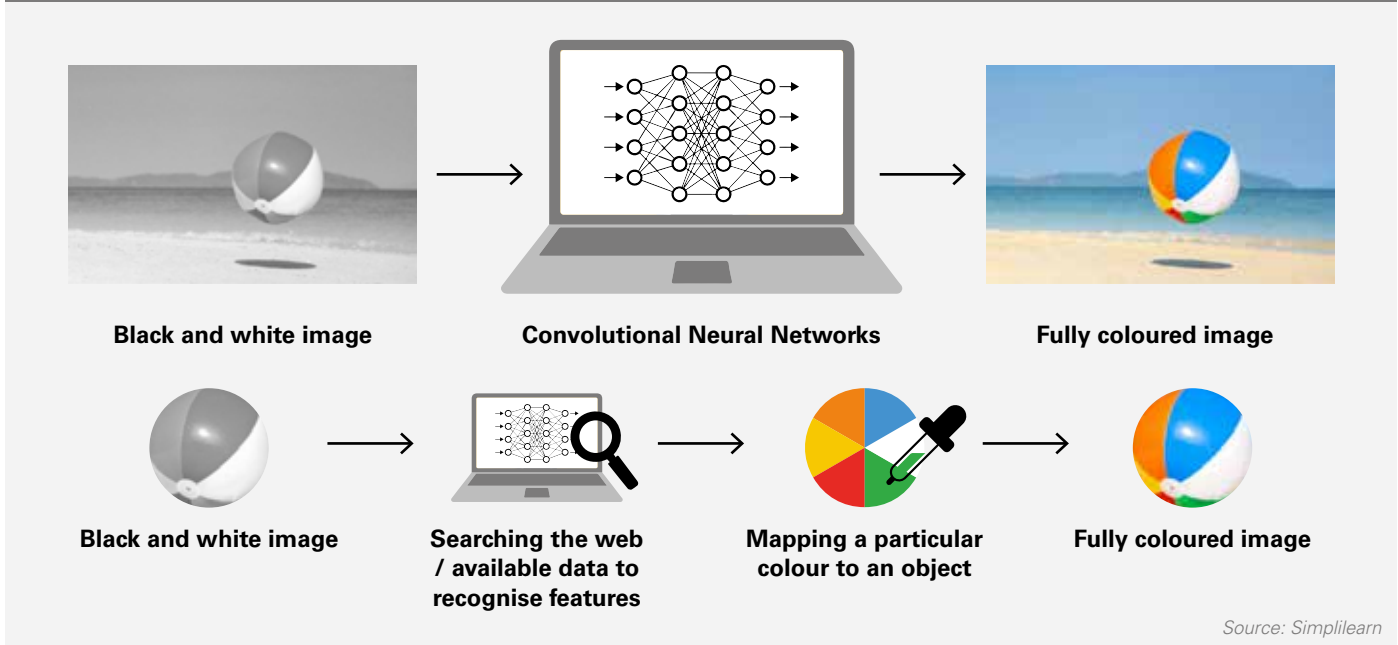
Source: National Institute for Transforming India (NITI)

Much of the recent excitement about AI has been the result of advances in Deep Learning (“DL”). DL is a subset of ML and is primarily powered by artificial neural networks, which loosely model the way neurons interact in the human brain. Neural networks have grown in popularity as they have a unique capacity to derive meaning and detect trends that are too complex to be observed by either humans or computers. Neural networks alone are expected to generate up to 40% of the total potential value that all analytics techniques could provide. Neural networks have many layers of simulated interconnected neurons, hence the term Deep Learning. Whereas earlier neural networks only had three to five layers and dozens of neurons, DL neural networks can have ten or more layers, with simulated neurons numbering in the millions. The networks can therefore ingest millions of data points and process them through multiple layers that learn increasingly complex features of the data at each layer. For example, once a neural network learns what an object looks like, it can recognise the object in a new image. However, neural networks neither explain nor understand what they are analyzing. This ‘black box’ effect makes it difficult to understand the reasons behind the decisions made as a result of DL, which leads to potential liabilities that will shall explore later in this paper.



2. Artificial Intelligence Primer

Figure 11: Deep Learning Application Examples



DL has unlocked significant capabilities (face and voice recognition, data analysis, handling KYC, chatbots, etc.) which are being applied to a wide variety of prediction and optimisation challenges.

Overall, there is no universally accepted definition of AI, and this can be seen further in how different businesses describe their AI strategy. Amazon, for example, 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."* Amazon further states: *"Without ML, Amazon.com couldn't grow its business, improve its customer experience and selection, and optimize its logistic speed and quality."* For Google, ML and DL are the priority with their tools being able to: *"create smarter, more useful technology and help as many people as possible."* Finally, IBM states that its three areas of AI focus are *"AI Engineering, building scalable AI models of tools; AI Tech where natural language processing, speech and image recognition are explored, and AI Science, to expand the frontiers of AI."*

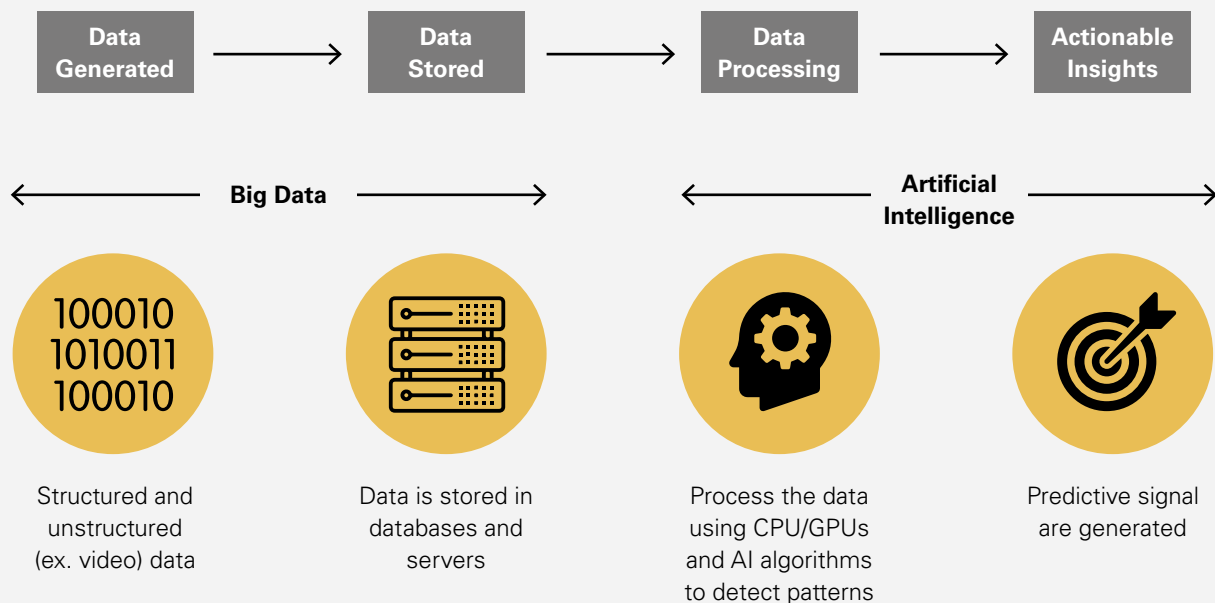
2. Artificial Intelligence Primer

What about Big Data..?

AI and Big Data are interlinked. Gartner defines Big Data as “high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision-making”. By 2025, “IoT” is expected to generate an additional 1 trillion gigabytes of data (a ten-fold increase from 2016) from 5 billion internet users (up from 2 billion currently) and 15 to 20 billion connected devices (mobile phones, smart appliances, etc.). The large datasets are increasingly difficult to analyse.

This is where AI comes in. Compared to traditional methods of analysing data, which linearly analyse data in the way they were originally programmed, AI programs learn from the data in order to respond intelligently to new and incremental data and adapt their outputs accordingly. A data scientist specialising in AI uses code and ML algorithms to create any type of AI, including prediction engines, image classifiers, etc. Data scientists therefore spend a large proportion of their time “data mining”; that is using code to clean, enrich, concatenate data such that it is ready to use with ML algorithms. AI can be seen as a key to unlocking the value of big data; and ML is one of the technical mechanisms that underpins and facilitates AI.

Figure 12: Compounding effect of big data and Artificial Intelligence



Source: House of Bots, Apis analysis

In summary, Artificial Intelligence is a group of technologies. Machine Learning is a subset of Artificial Intelligence and describes algorithms that can learn and make predictions from analysing Big Data. As the quantity of data available has grown exponentially, so have AI applications, particularly in data-rich sectors such as financial services. Compared to traditional analytics, Machine Learning can track non-linear relationships, unveil new determinants and unexpected dependencies amongst variables. **Deep Learning** is a subset of Machine Learning, inspired by the nervous system. It is characterised as “deep” due many layers, enabling far more complex processing. Most Artificial Intelligence applications combine both Machine and Deep Learning. **Rapid progress in AI is fuelling increasing investment, leading to more progress, creating a virtuous cycle of AI adoption.**



3. The Economics of Artificial Intelligence

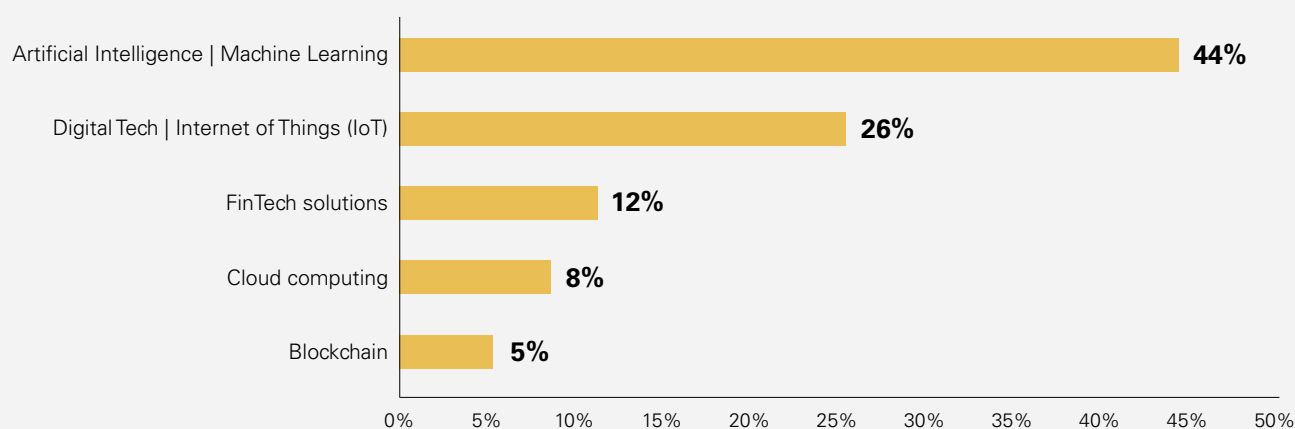
Artificial Intelligence's impact on business and economies

Having laid the groundwork to understand the basic concepts of Artificial Intelligence, including Machine Learning and Deep Learning, in this section we attempt to assess the potential impact of these technologies in a business, and by implication macroeconomic setting. The lack of a universally agreed definition of AI means that different approaches have widely different conclusions on the potential impact of AI on business.

Artificial Intelligence is set to impact nearly every industry

Whilst AI adoption is uneven and at a relatively early stage, the technology is increasingly categorised as a **General-Purpose Technology ("GPT")**, with a potential to yield a transformative impact on both industry and society. Other GPTs include the steam engine, electricity, and the internet. As recently as 2017, AI was described in the Harvard Business Review as "the most important general-purpose technology of our era. The impact of [AI] on business and the economy will be reflected not only in its direct contribution but also in its ability to enable and inspire complementary innovations." Progress in AI is expected to be exponential rather than linear. Progress over the past 12 months in many areas (vision, natural language processing, motion control) has far outpaced progress during the 12 months prior. This is compounded with rapidly rising investment levels, whilst data is being generated at breakneck speed, and the cost of computing and sensors is falling.

Figure 13: Technologies having the greatest impact on business in the next decade



Source: NewVantage Partners; survey respondent sample had a heavy financial services / insurance skew (~75%)

The applications of AI technologies cut across multiple industries and can be grouped in three key aspects: (i) automation, (ii) prediction (decision-making) and (iii) the creation / augmentation of business models.










(i) Automation: Higher levels of automation have been made possible as AI technology (e.g. machine vision, speech recognition, and natural language processing) matures and drives faster adoption. **Automation is expected to improve both processes and customer interaction.** Well documented use cases of automation include customer service chat robots ("chatbots") and automatic machine identification (the use of voice or facial recognition for authentication), which are now able to analyse conversations, understand the customer's intention, and which improve customer experience as the customer is no longer required to memorise usernames and passwords. **Almost every occupation is expected to be affected by automation, though only 5% of them could be fully automated, based on current technologies. The most likely scenario will be that most workers will work alongside rapidly evolving machines, which have the potential to change the nature of these occupations.**

3. The Economics of Artificial Intelligence

(ii) Decision-making/Predictions: Traditional analytics are limited to trend analysis, causality analysis, data mining and prediction, whilst AI offers more relevant predictions, suggestions and “personalised analysis” by finding patterns (causation and/or correlation). As such, AI is a better decision-making tool for risk management, credit scoring, marketing, and several other areas. **Recent developments in AI have mainly focused on lowering the cost of predictions, as well as making them faster, and more accurate.** This has far-reaching implications as predicting actions can enable increasing customer retention (by predicting churn) or prevent downtime (via predictive maintenance on machinery or infrastructure). **Prediction is also increasingly being used to solve problems that were not historically considered prediction problems.** Autonomous driving has been reframed as such. When used in driverless vehicles, AI predicts *what a good human driver would do* in every scenario, as opposed to following a set of if-then rules (e.g. *if a human walks in front of the vehicle (then stop)*) which has limitations as there are too many “ifs” (potential scenarios) that would need to be covered. With ML techniques, AI’s predictions improve with time as the algorithm learns every time it makes incorrect predictions. That said, AI or ML techniques still face certain challenges. Predictions rely on good quality data which can be difficult to obtain or create, while labelling it (to train the ML algorithm) is largely a manual task. Several other issues including limitations in the technology (e.g. overfitting, whereby a model corresponds too closely to random/noisy data) and the need to continually retrain or refresh models, remain.

(iii) Augmented and/or new Business Models: As AI technology progresses, new business models are being created and are changing the structure of several industries. One such example is Byte Dance (known as Jinri Toutiao in China, where it means today’s headlines), a media platform launched in 2012. The company creates media content using automated writing technology, which is then automatically distributed, in a highly personalised manner, to every user (who spend 70 minutes a day on the platform – double the global average time spent on Facebook). Byte Dance is the most well-funded AI company globally today with US\$ 3.1 billion raised to date.

Figure 14: AI impact aspects and sample use cases

 Automation	Manufacturing  <ul style="list-style-type: none">• Predictive maintenance or condition monitoring• Warranty reserve estimation• Propensity to buy• Demand forecasting• Process optimisation• Telematics	Retail  <ul style="list-style-type: none">• Predictive inventory planning• Recommendation engines• Upsell and cross-channel marketing• Market segmentation and targeting• Customer ROI and lifetime value	Healthcare and Life Sciences  <ul style="list-style-type: none">• Alerts and diagnostics from real-time patient data• Disease identification and risk stratification• Patient triage optimisation• Proactive health management• Healthcare provider sentiment analysis
 Intelligent analysis and decision making	Travel and Hospitality  <ul style="list-style-type: none">• Aircraft scheduling• Dynamic pricing• Social media - consumer feedback and interaction analysis• Customer complain resolution• Traffic patterns and congestion management	Financial Services  <ul style="list-style-type: none">• Risk analytics and regulation• Customer segmentation• Cross-selling and up-selling• Sales and marketing campaign management• Credit worthiness evaluation	Energy, Feedstock and Utilities  <ul style="list-style-type: none">• Power usage analytics• Seismic data processing• Carbon emission and trading• Customer-specific pricing• Smart grid management• Energy demand supply optimisation
 New business models and industries			

Source: BCG, Apis analysis

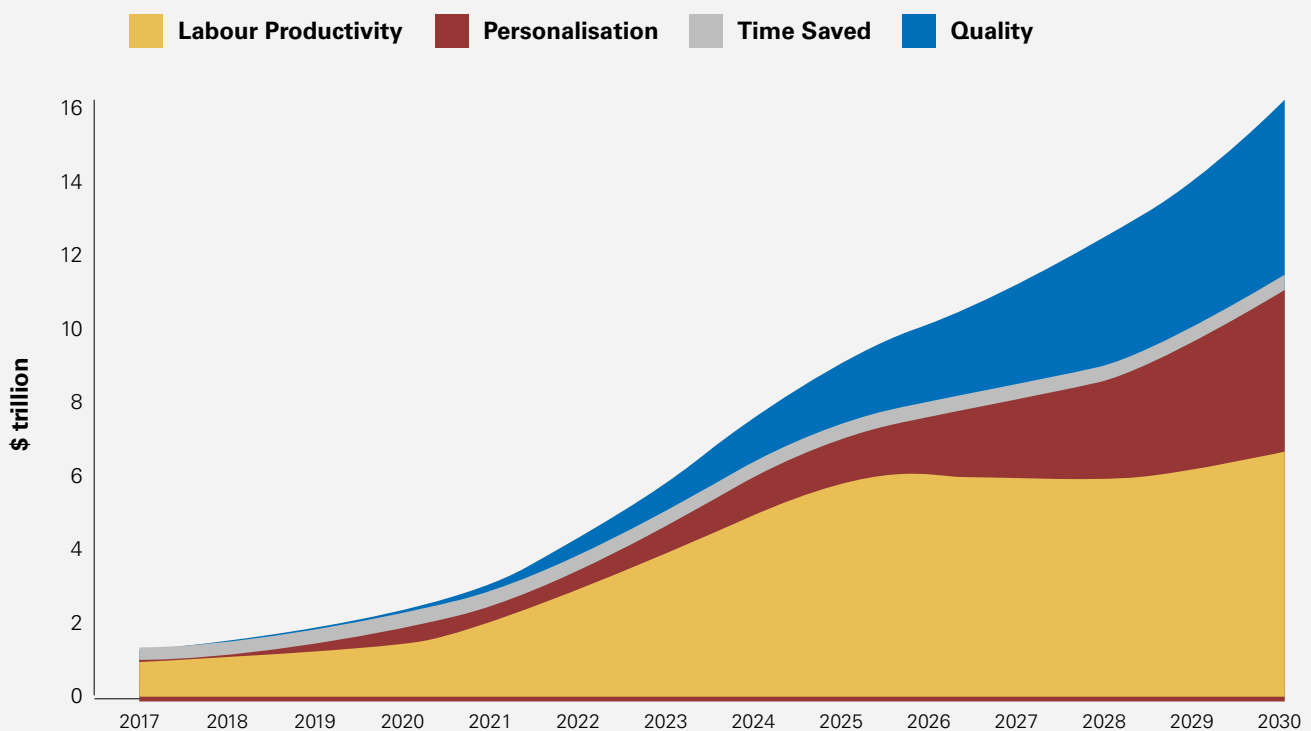
Source: BCG, Apis analysis



3. The Economics of Artificial Intelligence

Overall, AI is expected to be a significant disruptive force (with much broader implications than other technologies), that is expected to impact every industry vertical, from transport to financial services, which will give rise to new business models and render some legacy models obsolete. **By analysing 300 use cases, PWC estimated AI's potential contribution to the global economy to reach US\$15.7 trillion by 2030 (for context this is equivalent to 6x India's 2017 GDP), representing a 14% increase in global GDP.** The majority (US\$ 9.1 trillion) of this additional value is expected to come from increased consumption, as higher quality and more personalised products and services are created leveraging Big Data insights, including from the IoT sources (using AI). This is expected to lead to a virtuous cycle whereby insights create better products which in turn leads to increased consumption. Data-driven innovation can already be seen in the way entertainment content (for example, Netflix, Amazon and Spotify) is distributed and consumed. Financial services is amongst the sectors which stand to generate the most value from increased customisation, which we will explore in the following section. The remainder (US\$6.5 trillion) is expected to come from automating routine tasks and/or augmenting employees' capabilities, allowing them to concentrate their efforts on value-added work instead.

Figure 15: Estimated impact of AI across global economy



Source: PwC

3. The Economics of Artificial Intelligence

Using a different approach, McKinsey analysed over 400 AI use cases across 19 industries and nine business functions and concluded that **AI can create between US\$3.5 trillion and US\$5.8 trillion in value across 19 industries. This value represents between 1 and 9% of the 2016 revenue of each of the 19 industries**, indicating wide variations amongst different industries. This value will be captured in a wide range of ways, including revenue growth, cost savings, or more valuable products.

Figure16: Estimated impact of AI across industries

	Aggregate dollar impact (\$ trillion)	Impact as % industry revenues
Retail	0.4 - 0.8	3.2 - 5.7
Transport and logistics	0.4 - 0.5	4.9 - 6.4
Travel	0.3 - 0.5	7.2 - 11.6
Consumer packaged goods	0.2 - 0.5	2.5 - 4.9
Public and social sector	0.3 - 0.4	1.1 - 1.4
Automotive and assembly	0.3 - 0.4	2.6 - 4.0
Health-care systems and services	0.2 - 0.3	2.9 - 3.7
Banking	0.2 - 0.3	2.5 - 5.2
Advanced electronics / semiconductors	0.2 - 0.3	3.3 - 5.3
Basic materials	0.2 - 0.3	1.6 - 3.1
High tech	0.2 - 0.3	5.7 - 10.2
Oil and gas	0.2 - 0.2	1.8 - 1.9
Insurance	0.1 - 0.3	3.2 - 7.1
Agriculture	0.1 - 0.2	2.4 - 3.7
Chemicals	0.1 - 0.2	1.0 - 2.3
Media and entertainment	0.1 - 0.2	2.9 - 6.9
Telecommunication	0.1 - 0.2	2.9 - 6.3
Pharmaceuticals and medical products	0.1 - 0.1	4.2 - 6.1
Aerospace and defense	<0.1T	1.8 - 3.2

Note: Artificial intelligence here includes neural networks only. Numbers may not sum due to rounding.

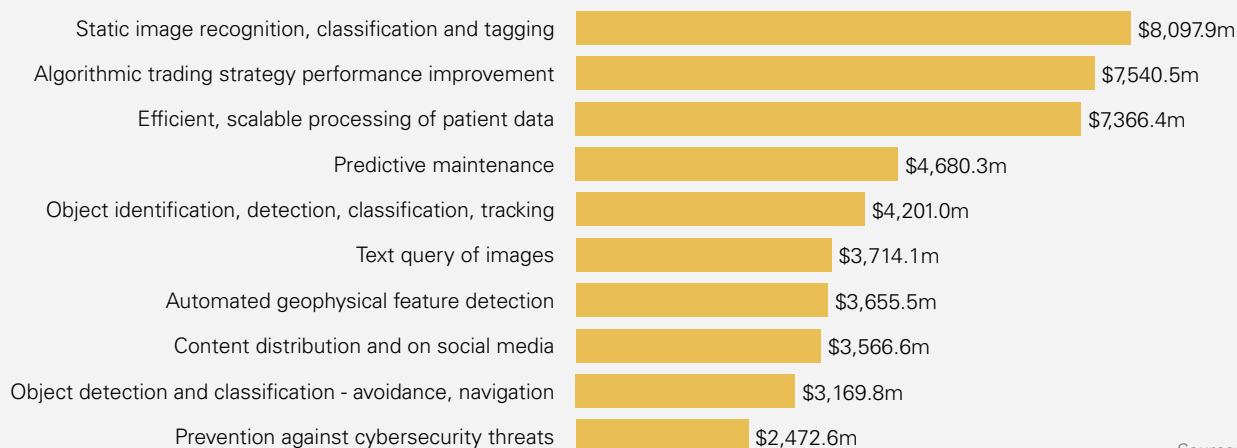
Source: McKinsey Global Institute



3. The Economics of Artificial Intelligence

Focusing on the top 10 AI use cases, another approach forecasts that revenues generated from the direct and indirect application of AI will grow from US\$643.7 million in 2016 to US\$36.8 billion in 2025 (a 56-fold increase). Out of these top 10 uses cases, 60% are related to Big Data and 40% are related to image or object recognition, which is an interesting indication of the potential nature of the AI market.

Figure 17: Global AI revenues from top 10 uses cases (2016 -2025)

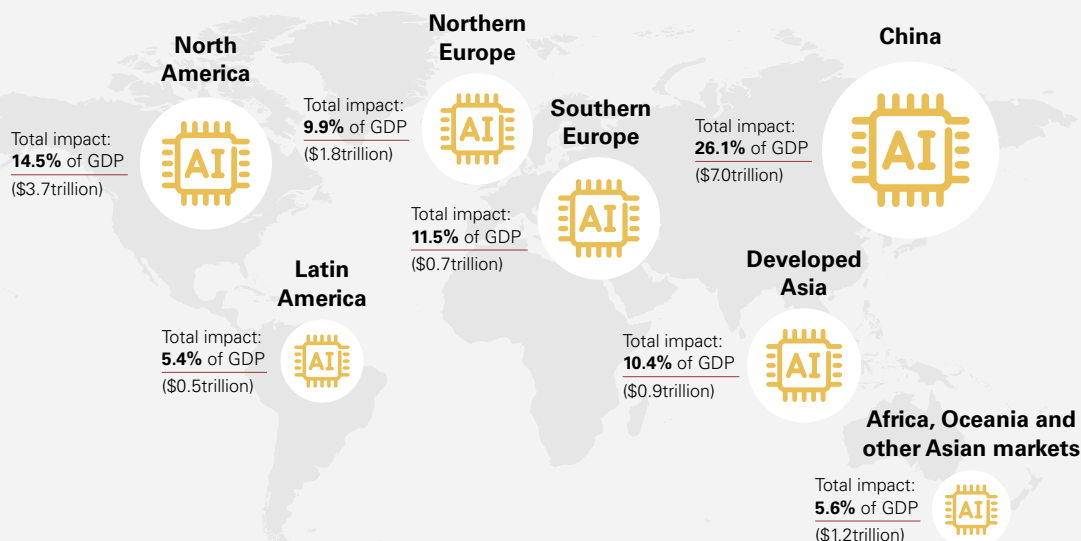


Source: Statista

Estimating the potential impact of AI on various industries is by its very nature highly subjective, however two key observations are critical from the various estimates: 1) the impact of AI will span across almost all industries; 2) It will underpin a significant positive increase in the revenue pools of these industries.

Based on current estimates, China and the United States stand to reap the lion's share of gains (in absolute terms) from AI deployment, though all economies are expected to benefit. At first, Growth Markets are expected to gain modestly due to much lower current levels of AI adoption, though we will show how a combination of favourable demographics, government support and lack of legacy infrastructure in these markets can foster particularly rapid AI development in a later section.

Figure 18: Global AI GDP by region (2030)



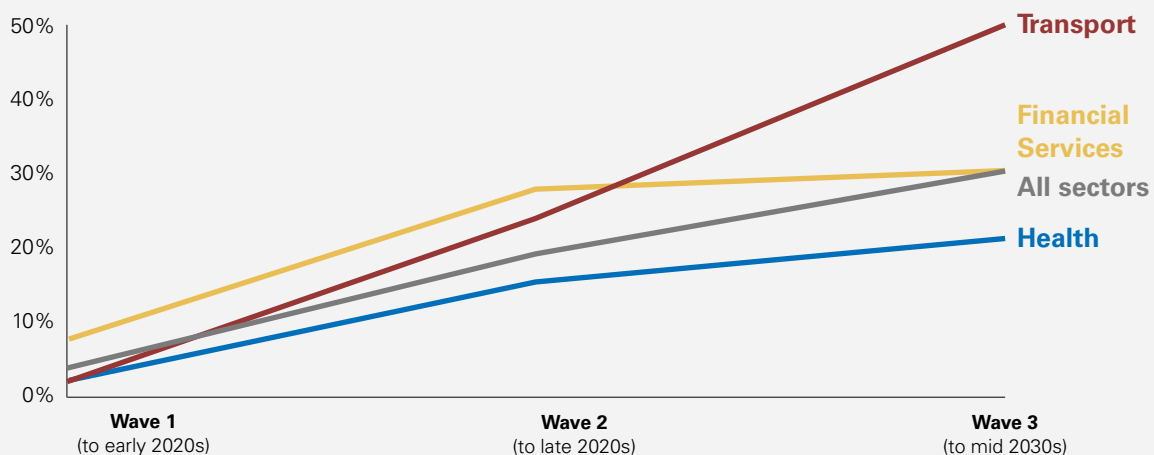
Source: PwC

3. The Economics of Artificial Intelligence

Notwithstanding an initial restructuring phase of the job market, Artificial Intelligence is set to have a positive impact overall

AI technologies have the potential to transform the nature of work. This is largely due to automation, which includes machines carrying out tasks that are currently completed by humans, complementing the work humans do and performing tasks that surpass human capabilities. According to McKinsey, Automation is expected to displace 15% of the global workforce (400 million workers) by 2030. This will be offset by an increase of up to 33% in demand for labour (890 million jobs) by 2030, with the largest gains coming from Growth Markets including India. Some forecasts also include an additional 10% increase in labour demand for jobs that do not exist yet, based on the impact of previous technological innovations. Some of these will include Machine Learning Engineers, Deep Learning Scientists, and Fraud Analysts. **Demand for advanced technological skills, as well as for social, emotional and higher cognitive skills (creativity, critical thinking, complex information processing) in particular, is expected to grow fast, whilst demand for physical and manual skills is expected to decline.** This shift is expected to occur gradually and varies amongst industries. In the short-term, financial services, where several tasks can be automated and where algorithms can lead to faster and more efficient analysis, will be the most impacted sector. Longer-term, transport, given the development of autonomous vehicles, will be the sector with the largest impact. Automation is also expected to particularly affect workers with lower education levels.

Figure 19: Global AI GDP by region (2030)



Source: PwC estimates based on OECD PIAAC data (median values for 29 countries)

Viewing AI from this conventional automation paradigm of eliminating jobs can however be simplistic and ignore the significant benefits of AI boosting human capabilities. For example, recent research to test the accuracy of an AI-based technique to identify cancer cells showed that the AI scored 92%, below the human pathologist average of 96%, but that when human experts worked alongside the AI, they achieved 99.5% accuracy. Based on several surveys, employees are also generally upbeat about the prospects of AI and see the technology as a key means to improve efficiencies and to drive better outcomes, in almost every industry. Rather than be replaced, roles are expected to be augmented with AI.



3. The Economics of Artificial Intelligence

Figure 20: Examples of evolving roles in Banking

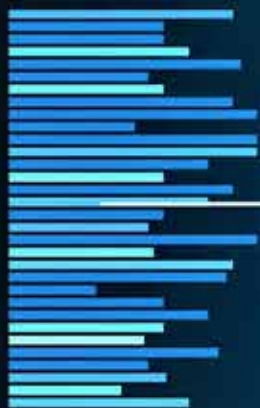
Today	Tomorrow
A contact center agent answers customer calls and messages, handling both minor and major issues.	Virtual agents and automation take care of simple queries and issues, allowing the human workforce to manage relationship portfolios and deal with exceptions and major issues involving complexity and sensitivity.
A communication specialist reads comments about the bank on social media and responds to those likely to have the greatest impact.	Supported by comprehensive scanning of social media, the specialist develops a strategy for optimising the bank's profile and trains intelligent machines to respond to comments, rapidly at scale.
A credit supervisor reviews loans and granted, to ensure loan criteria have been met and risk minimised.	AI reduced the duplication of effort by flagging marginal credit decisions and highlighting problematic issues. The supervisor can then focus and spend more time weighing the merits of these applications.
A risk and operations professional manually updates and checks various types of compliance reporting and controls for a business or functional area.	AI platforms, using machine learning and predictive analytics, simplify and drive efficiency in data gathering, raise the quality of controls, augment the risk and ops professional, and free up time for her to focus on analysis, and end-to-end view of the organisation's risk profile and early identification and rectification of issues.
A financial advisor spends a significant amount of time onboarding a potential customer, taking personal details and interrogating his financial situation. Then she goes away to do the research and hopefully secure the relationship.	The prospective customer goes online and uses AI to onboard himself. He completes the other administrative requirements and provides relevant research which he has sourced. This allows the financial advisor to focus on the true value of her offering: building the relationship and providing quality advice.

Source: Accenture

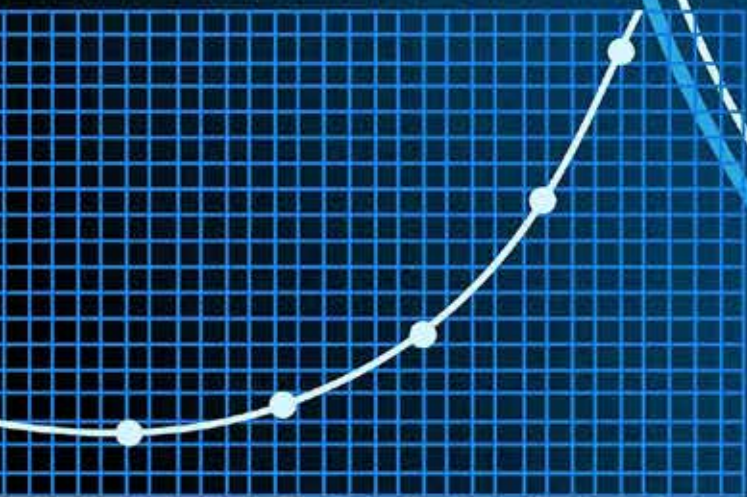
Finally, an innovative approach to quantifying the economic impact of AI relies on evaluating which goods and services AI is reducing the cost of. This method was proposed by three Economics professors at the University of Toronto (where the leaders in AI at Facebook, Google and Uber were trained) and suggests that as the price of predictions drop, the value of substitutes to prediction (i.e. humans) will go down, whilst the value of complements (i.e. data, and humans) will go up. Humans are key complements to AI as they drive judgement (interpreting the prediction results) and action (deciding and implementing new sets of actions based on the AI prediction results).

Just as there is no single definition of Artificial Intelligence, there is no single view of its potential economic impact.

Estimates range from hundreds of billions to trillions of dollars of additional value to the global economy. Most sources however converge in preliminarily concluding that Artificial Intelligence is gradually unleashing a transformation of industries with significant disruption to the job market. By way of summary, Artificial Intelligence is set to impact business via automation, an improved ability to make predictions based on increased data and more complex algorithms, and in ways that have yet to be contemplated. **Within industries, those are the most digitally-native, such as technology and financial services, will lead the way in adoption and by implication in economic gains.** Whether this disruption will be positive or negative will depend on how companies, governments and individuals address this shift. With early indications pointing to an overall positive impact as jobs are mostly augmented (automation concerns tasks, not jobs).



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4. Artificial Intelligence in Growth Markets

Artificial Intelligence Ecosystems in Growth Markets

Most studies about the impact of AI on economies have focused on developed markets, often neglecting the important role AI can play in accelerating the development of Growth Markets. This section focuses on the potential of AI in Growth Markets, highlighting the similarities with financial services development. We have also included the United States as a benchmark given its central role in the development of AI.

Reverse innovation with Artificial Intelligence

Growth Markets that have grown rapidly on the back of cheap labour costs are now seeing the returns on labour reducing because of escalating wage costs. As GDP growth in Growth Markets becomes more capital intensive, productivity will have to rise to maintain growth and AI could play a key part in this. Moreover, Growth Markets have younger populations, who typically have a higher propensity to learn and use new technologies.

Focusing on the financial services sector, AI is already solving some of the key challenges facing the financial sector in Growth Markets. By way of example, digital wallets have become an invaluable source of insights into the consumption and saving habits of individuals in these markets. This alternative source of data has enabled the provision of credit when more traditional sources (bank statements, credit history) were not available. In some cases, Growth Markets are adopting technology quicker and more fervently than many developed market countries, by necessity.

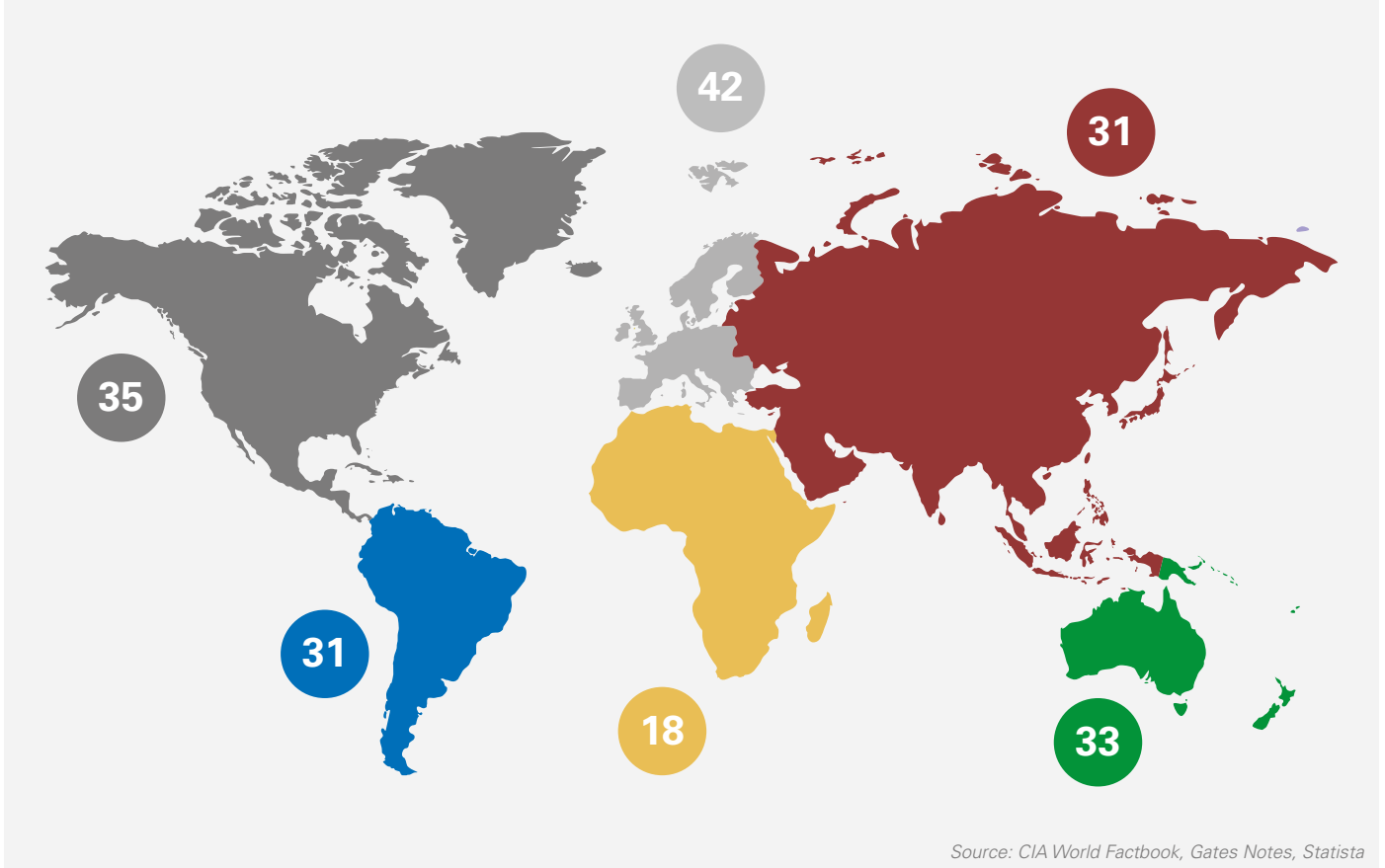
Several factors are responsible for this:

- **Digital infrastructure build-out and increasing technology adoption:** Growth Markets are rapidly building out digital infrastructure. They have also experienced a telecommunications boom, initially based on a huge increase in mobile phone penetration and more recently on rapidly expanding internet penetration. Building on this digital infrastructure, Growth Markets' younger populations are driving increasing technology adoption and usage. These trends position Growth Markets to leapfrog traditional financial services with a new wave of alternative financial institutions offering technology-enabled and low-cost, products and services. We believe that this trend will be reinforced by a rapid rate of adoption of smartphones and data connectivity. By way of example, Ericsson predicts that smartphone penetration will more than double to 6.1 billion people by 2020, with the greatest uptake being in Growth Markets. In addition, 3G mobile phones subscriptions in Sub-Saharan Africa are increasing at a rate of 15% p.a. between 2016 – 2022, with the result that the vast majority of subscribers will have faster internet speeds by 2020. The data generated through these connected devices is a powerful base to build AI applications.
- **Government collaboration and support:** While the private sector is leading the AI push, some governments have also been investing heavily in the necessary infrastructure required to power their digital economies. As an example, in India, a government initiative created the largest biometric identification platform in the world (Aadhaar) with over 1 billion registered citizens. Meanwhile, in China, the government has significantly increased its investment in technology. The country is also leading the way in the deployment of 5G mobile networks and is in the process of creating the world's largest 5G mobile network.
- **Favourable demographics and talent:** The demographics, comprised of relatively young people, in most Growth Markets make rapid adoption of technology more likely. Combined with education, another essential pillar that is necessary for AI development, Growth Markets appear primed for AI development. For example, India has seen a huge increase in university graduates in recent years, a significant number of which study science, technology, engineering and mathematics (STEM).



4. Artificial Intelligence in Growth Markets

Figure 21: Median Age by Region (2017)



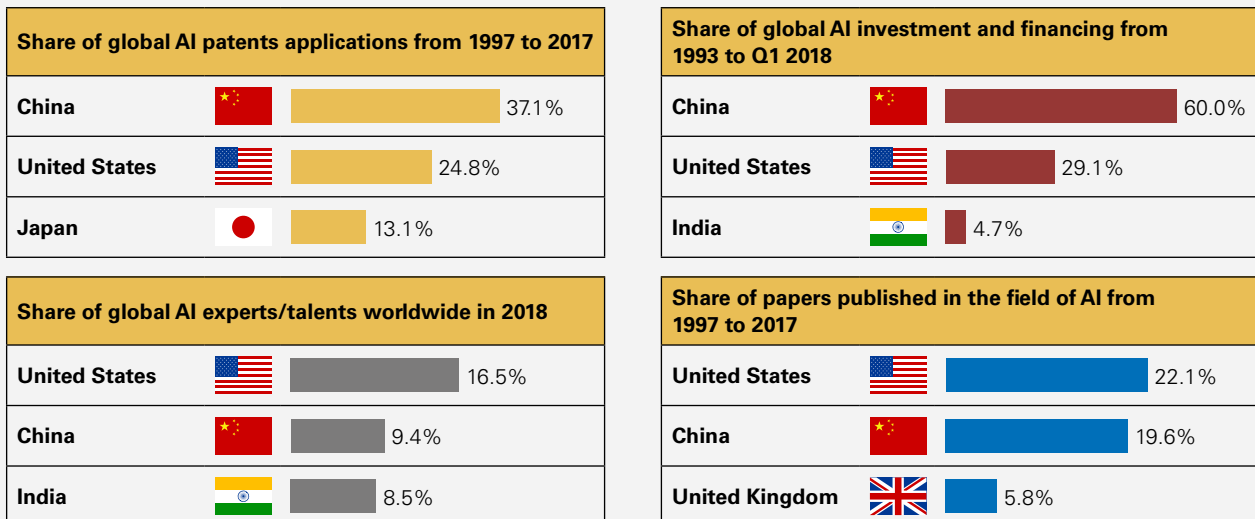
While AI will likely significantly increase productivity in Growth Markets, it may also present social and economic challenges including:

- **Labour intensive and jobs involving programmable tasks will likely be substituted by AI solutions.** Some estimates suggest that as much as 50% of work tasks in China could be done by a combination of AI and robotics. The resulting mix of growing demand for highly skilled technology professionals and the likely oversupply of less relevant labour may worsen the level of inequality. While large populations and the vast data pools that come with them are a positive feature of Growth Markets, there is a risk that this data becomes too centralised and controlled by either a handful of companies or in some cases, just the government.
- Some **Growth Markets still need to make significant investments in the infrastructure necessary for an AI ecosystem to thrive** such as in mobile network connectivity and efficient capital markets to encourage investment. The legal implications of AI pose a challenge given the rapid pace of its development. It will be difficult for legislators, and society at large, to keep pace with the issues raised by AI's development. Policymakers will need to create new frameworks to legislate for the issues raised by AI.

4. Artificial Intelligence in Growth Markets

The international Artificial Intelligence race is on: China and the US have built a significant head start...but Growth Markets have a role to play

Figure 22: AI Race: A tale of two giants



Source: Gartner, China Academy of Information and Communications

AI promises significant economic and social benefits. As such, several countries are aggressively investing in AI research whilst simultaneously fostering a conducive business ecosystem. **Today, two countries dominate across all aspects of AI, be it research, investment or adoption - China and the United States. According to CB Insights, in 2017, the two countries combined accounted for 86% of total AI funding (US\$15.2 billion).** This gap is widening, for the first quarter of 2019, China and the United States' share of total AI funding rose to 91%. India, arguably an emerging economic "superpower", is expected to make moderate gains initially, but the country's government-led AI strategy, supporting infrastructure and highly educated graduate population (in sciences in particular), will make it well positioned to reap significant benefits from AI. Other markets are at a much earlier stage but will begin to absorb and use AI technologies being trialled in these larger markets. This is consistent with Apis' investment strategy across Growth Markets where similar themes may manifest themselves in a number of our target countries.







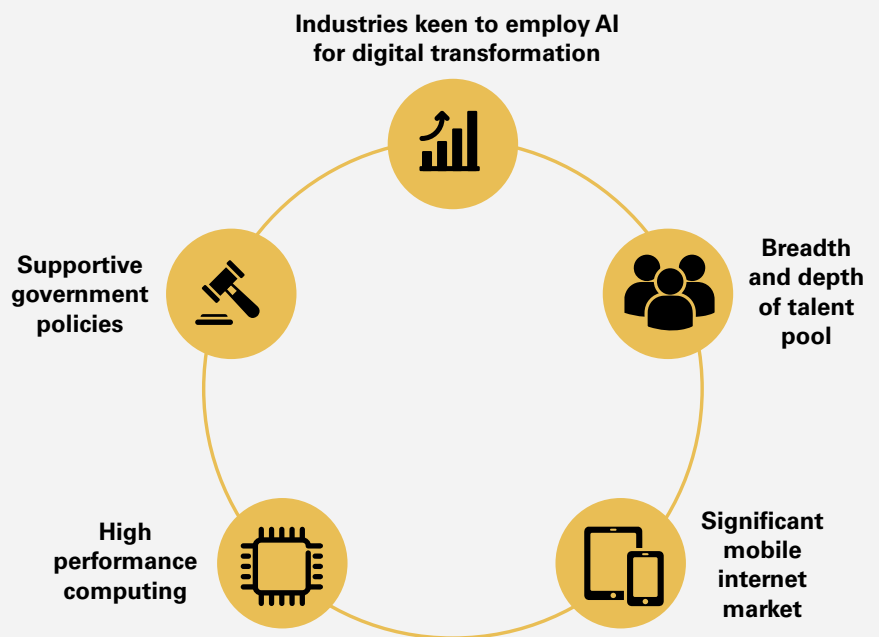
4. Artificial Intelligence in Growth Markets

The framework: Four primary enablers of AI adoption at the country level

We have identified four primary enablers of AI adoption, through which we will compare the current progress and AI potential of China and India, using the United States as a benchmark.

Figure 23: AI Adoption Enablers at the country level

Enabler	Description
 Data	The breadth, depth, diversity, access and quality of data
 Talent	The depth of the talent pool in AI including scientists, researchers and engineers
 Business Ecosystem	The business ecosystem for AI, including access to funding
 Government Policy	The top-down national government strategy for AI



Source: Apis analysis

4. Artificial Intelligence in Growth Markets

1 China Case Study



Leadership in AI is considered a top priority in China. The government has announced several ambitious plans and believes that being at the forefront of AI technology is critical to the global economic and military power of the country. The opening paragraphs of the Artificial Intelligence Development Plan ("AIDP") exemplify this view: *"AI has become a new focus of international competition. AI is a strategic technology that will lead in the future; the world's major developed countries are taking the development of AI as a major strategy to enhance national competitiveness and protect national security."* China's policy is also closely linked to the United States' progress in AI, and it is common for Chinese government organisations to translate every United States government and academic reports on AI into Mandarin, particularly to follow policies. Overall, China is devoting significant resources to cultivating AI expertise. The Chinese government believes it has largely closed the gap with the United States in AI R&D and commercialisation. By contrast, the Chinese government believes the country is still playing catch up in terms of talent, technical standards, as well as software platforms.



Data

"If data is the new oil, then China is the new Saudi Arabia." Kai-Fu Lee (Venture capital investor/AI expert)

China trails the United States in every enabler except for access to data. Given relatively lax privacy rules, Chinese technology firms can collect vast troves of data. In addition, with a smartphone penetration rate of over 50%, more internet users than in Europe and the United States combined, and a rich digital ecosystem (that now extends beyond Baidu, Alibaba and Tencent), China is producing huge sets of data that are particularly well suited (digitised, structured and labelled) to AI applications. **By 2030, China is expected to account for 30% of all data globally.**

In October 2016, some of China's largest tech companies agreed to share data with government authorities to improve consumer trust online. This was part of a broader project to create a national "social credit system." The project is still in pilot phase in many cities but has already contributed to putting the debate over data privacy at the forefront, pitting those who advocate for greater data protection against those who push for greater data democratisation to benefit AI.

Finally, whilst data quality, diversity, and especially quantity all remain key sources of competitive advantage for many AI applications, training large data sets is very computationally intensive. Computing power is an area where the United States still maintains its lead, albeit narrowly.



Talent

China can draw from a deep pool of talent, including the largest pools of STEM graduates out of any country in the world. Since 2014, the country surpassed the United States in terms of volume of AI research; this was specifically highlighted in the Obama White House's strategic plan for AI research. This is despite a pool of AI researchers estimated at 39,000 vs. the United States' 78,000 researchers. China is also gradually catching up in terms of innovation. In 2017, the Association for the Advancement of Artificial Intelligence's annual conference, known as the leading AI research conference, showed that China was responsible for 20% of new findings, second only to the United States who accounted for 48%. That said, China still lags the United States in terms of AI expertise, with only 25% of its engineers having over 10 years of work experience, against over 50% in the United States. To remedy some of these shortfalls, China is increasingly promoting cross-border collaboration in research and technology and supporting local companies in their international expansion.



Government Policy

The March 2016 victory by Google DeepMind's AlphaGo over Lee Sedol, widely considered to be the greatest Go player in history, was a turning point in China's AI strategy. Kai-Fu Lee, who was also President of Google China commented *"While barely noticed by most Americans, the AlphaGo game drew more than 280 million Chinese viewers. Overnight, China plunged into an artificial intelligence fever."* In July 2017, the State Council issued the "New Generation AI Development Plan," cementing existing investments in AI and explicitly indicating China's prioritisation of AI development. The plan includes specific targets: US\$150.8 billion in additional revenues for the core AI industry, and US\$ 1.5 trillion in additional revenues for AI-related industries, by 2030. Whilst the plan serves as an important milestone in China's AI development, it is still only one piece of China's overall AI strategy. A year prior, China released the "13th Five-Year Plan for Developing National Strategic and Emerging Industries" (2016-2020) which had identified AI development as 6th among 69 major tasks for the central



4. Artificial Intelligence in Growth Markets

1 China Case Study (continued)



government to pursue. Prior to that, the “Internet Plus” initiative, was also interlinked with AI development. **Overall, China’s plan can be summarised in three phases: (1) catching up to the most advanced AI powers, (2) becoming one of the world leaders in AI, and (3) achieving primacy in AI innovation.**

China’s expansion strategy has however started to receive increasing scrutiny and pushback from the United States. In 2017, the United States government banned Intel and other chip-makers from selling high-powered Xeon chips to China, whilst the Committee on Foreign Investment in the United States (CFIUS) has subjected China’s investments in U.S. chip-makers to harsher scrutiny and sometimes outright blocks.

As one of the leading countries in AI, China is expected to play a significant role in paving the way in AI regulation. By 2025, China is expected to establish AI laws and regulations, ethical norms, and the foundations of an AI security plan, which might become a global standard. This may already be underway. China is currently chairing the AI subcommittee of the International Organization for Standardization / International Electrotechnical Commission (ISO/IEC) Joint Technical Committee, one of the largest and most significant technical committees in international standardisation. The position is currently filled by a senior director at Huawei.



Business Ecosystem

China’s AI strategy is underpinned by a robust ecosystem comprised of a thriving hardware industry, in the form of computer chips and supercomputing facilities, an active M&A market (both domestically and internationally), and access to deep pools of capital. **As of June 2016, China became home to the most supercomputing facilities in the world, with a total of 167 (vs. 164 in the United States).** Sunway TaihuLight, China’s leading processor, became the world’s fastest processor over the same period. In terms of funding, China became the second largest AI market globally in 2017. However, the United States remains a much more active investor. Out of the 79 total acquisitions of AI companies globally between 2012 and 2017, 66 were done by American companies, while only 3 by Chinese companies (Baidu, in all cases). Nevertheless, Baidu, Alibabi and Tencent (collectively, “BAT”) have established themselves as global leaders in technology and AI in particular. By 2018, the BAT were responsible for 46% of all AI-related acquisitions (vs. 44% by United States-based companies).

4. Artificial Intelligence in Growth Markets

2 United States Case Study



Over the last several decades, the United States, has led the world in technology innovation. The United States' Silicon Valley remains the centre for innovative technology companies in the country and globally. San Francisco alone is home to 2,000 technology companies, making it the densest technology industry city in the world. This proximity to suppliers, customers, and cutting-edge research gives each a competitive advantage. Importantly, most of these companies are also leaders in their industries. These include software, social media, fibre optics, robotics, and medical instruments among others, all of which significant AI applications.



Data

Private companies and government institutions have access to a plethora of high-quality data sources. These include credit bureau data, government agency data and the enormous amount of data collected by private consumer-facing companies. However, according to a recent survey, datasets are often improperly formatted, lacking metadata, incomplete and / or incorrect. As a result, data scientists typically spend 80% of their time cleaning and preparing data. **In 2016, IBM estimated that the cost to the United States economy of "bad" data was US\$3.1 trillion.** Further, according to PWC, corporations are finding that poor quality customer and business data compiled over the years may be keeping them from leveraging AI and other analytics tools to cut costs, boost revenue and stay competitive. 76% of corporations interviewed by PWC said their firms were aiming to extract value from the data they already have but only 15% said they currently have the "right kind" of data needed to achieve that goal.

Finally, while General Data Protection Regulation (GDPR) compliance is now part of EU law, this type of regulation is a nascent concept the United States. The California Consumer Privacy Act, a law similar to GDPR, will only go live in 2020. While restrictions on the use individual data address some of the ethical concerns around AI, if they become widespread they may an impact on the ability of US companies to build effective AI algorithms.



Talent

According to the Global Technology Index, the United States has the 3rd highest concentration of engineers in the world with 85 per 1,000 people, after China and India. Further, it is projected that over 500,000 Information, Communications and Technology jobs will be created within the next decade, and by 2024 almost three-quarters of STEM job growth will be in computer-related occupations. The United States currently produces c. 570,000 STEM graduates annually placing in 3rd place behind China and India. Furthermore, the United States is the world leader in high quality AI research making it an ideal location for AI companies to launch or establish research hubs.



Government Policy

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 within the government and outside (academia, private sector).

On March 19, 2019, the US federal government launched AI.gov to make it easier to access governmental AI initiatives. The US government sees AI as an urgent priority and developed 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.

Prior to the American AI Initiative, the White House had already made American leadership in AI a top priority. In a July 2018, the Executive Office of the President identified leadership in AI along with quantum information sciences and strategic computing as the second highest



4. Artificial Intelligence in Growth Markets

2 United States Case Study (continued)



research and development priority after the security. Further to this, the Department of Defence announced it will invest up to US\$2 billion over the next five years towards the advancement of AI. Moreover, existing government spending on AI research and development totalled over \$2 billion in 2017 alone. This includes unclassified programs and excludes Pentagon and intelligence budgets.



Business Ecosystem

The United States has a mature, well-financed and thriving digital ecosystem, largely concentrated in the Silicon Valley and New York / Boston metropolitan area. Over 16 governmental agencies support AI companies financially and politically (including the Defence Advanced Research Projects Agency, CIA and NSA). The United States also has leading universities, as well very strong corporate research facilities at companies like Google, Microsoft and Facebook. In recent decades, the United States has provided the template for how countries can develop a thriving technology sector. This includes strong government support, applied research by universities and corporations, entrepreneurship, private funding, and a thriving M&A/VC/PE market. In **terms of funding for AI, 2018 saw US\$9.3 billion invested into AI-related companies in the United States. This was an increase of over 700% from US\$1.1 billion in 2013.** Meanwhile, the number of AI funding deals in 2018 was 466 versus 207 in 2013.

4. Artificial Intelligence in Growth Markets

3 India Case Study



A recent survey ranked India as the 13th most advanced country in the world with regards to the development of AI technologies. The Indian ICT sector has led the economic rejuvenation of India from an agriculture-based economy to a knowledge-based economy and transformed how India is perceived globally. The technology sector now plays a significant role in the Indian economy and accounted for 7.7% of India's GDP in 2016. Due to the growing need for governments to have an AI policy, in 2018, the Policy Commission of India, also known as the National Institution for Transforming India, launched an AI-focused research programme.



India has a highly developed public digital infrastructure in the form of the India Stack, a critical factor driving India's digital evolution and its shift toward a digital economy. The India Stack is a set of Application Program Interfaces (APIs) that enable instant communication between central information databases and consumer facing applications. In 2009, India launched an identification project, Aadhaar, to issue unique 12-digit identity numbers based on demographic and biometric information to all citizens. **A decade after its inception, Aadhaar has become a nationwide acceptable digital identification for over 1.2 billion people in India.** The Aadhaar number is a 12-digit random number issued by the Unique Identification Authority of India. Any individual, irrespective of age and gender, who is a resident of India, may voluntarily enrol to obtain Aadhaar number. This provides a huge database generated by the daily count of total registrations, enrolment applications accepted and rejected by state and district. It also contains other details such as Aadhaar generated by age, gender, etc.

The India Stack has four technology layers, each with its own function:

- Presenceless layer:** Enables individuals to verify their identity to anyone with their consent Aadhaar (19.7 billion authentications)
- Paperless layer:** Stores digital documentation that is easily retrieved Electronic Know Your Customer (KYC) data, eSign, Digital Locker (5.5 billion eKYC)
- Cashless layer:** Enables digital payments and other financial transactions Unified Payments Interface (UPI), Aadhaar Enabled Payments System (AEPS) (19 million UPI transactions per month)
- Consent layer:** Enables data to move freely and securely

The India Stack and its API infrastructure now serve as a rich source of public and private data. These data sources have the ability to enable the development of AI applications as the digital data footprints of individuals and companies continue to grow. For example, increasing digital financial transactions will likely lead to the faster development of AI driven credit underwriting models.

With the increasing adoption of digital devices and platforms in people's personal lives, individuals and SMEs are becoming more comfortable with digital transactions and increasingly willing to share their data. **In India, the cost of mobile data has fallen by 95% in the last three years, making it the cheapest globally. These low costs have driven an eight-fold increase in data consumption across the country.** Mobile data cost reductions have also led to a doubling of smartphone penetration in the last three years, to roughly 300 million users. Digital payment transactions have already climbed two to five times above expected levels, leapfrogging India roughly 2.5 years ahead in the digital payment curve.

Despite the progress in digitisation, a key hurdle in the development of AI in India is the availability of well-labelled local datasets. While India collects vast amounts of data across the country, most of it is unusable for AI applications due to lack of richness and quality.

At present, a few Indian government organisations make datasets publicly available, but they are limited in number and scope. Some of these datasets include:

- Reserve Bank of India (RBI) Database:** The RBI database is a website launched by Reserve Bank of India and has data on the macroeconomic indicators of the Indian economy. It contains a wide range of pertinent data for researchers and analysts. It has datasets across money and banking, financial markets, national income, saving and employment, and others. The objective of the database is to facilitate contemporary styles of data analysis that can provide important real-time numbers about economic activity, prices and more.
- Ministry of Statistics and Programme Implementation Database:** This dataset is provided by the ministry concerned with the coverage and quality aspects of government statistics released. The datasets are collected by conducting large-scale sample surveys across India.



4. Artificial Intelligence in Growth Markets

3 India Case Study (continued)



- c. **Aadhaar Metadata:** This provides a huge database generated by the daily count of total registrations, enrolment applications accepted and rejected by state and district. It also contains other details such as Aadhaar generated by age, gender, etc.
- d. **Import Exports Datasets:** The Indian Customs Electronic Commerce / Electronic Data Interchange Gateway is a portal with e-filing services for trade and cargo carriers. It has information such as documents, messages, and other processes by the Indian Customs EDI System.
- e. **Open Government Data (OGD) Platform India:** Set up by the National Informatics Centre in compliance with the Open Data Policy of India, OGD platform gives access to government-owned shareable data along with its information about its usage in an open and machine-readable format through a wide area of network across the country. A part of the Digital India initiative, it has been developed by using Open Source Stack. It publishes datasets, documents, tools and applications collected by government for public use and community participation of the products with visualisation, APIs, alerts etc.



Talent

India produces 2.6 million STEM graduates annually, second only to China and 4 times the number of STEM graduates produced in the United States. As such, India is creating the necessary pool of talent to drive innovation in technology. Despite this considerable edge, India lags significantly in producing world-class research and innovation in most technology fields, more so in AI. Moreover, a significant majority of this talent pool is focused on routine IT development and rather than research and innovation. Exacerbating the problem further is the fact that a majority of the small population focused on research almost always prefers to pursue advance degrees (Masters or PhD degrees) to subsequently apply their expertise abroad.

As a result, while India may appear to be relatively well positioned to take advantage of the AI disruption, due to poor availability of qualified faculty and researchers, this advantage could erode without policy interventions aimed at promoting access to such skills.

As per the Global AI Talent Report 2018, India has 2% of PhD educated researchers worldwide and is ranked 10th globally. The report also looked at leading AI conferences globally for presenters who could be considered influential experts in their respective field of AI. On this metric, India was ranked 13th globally, with just c. 40 top-ranked presenters.



Government Policy

In 2018, the National Institution for Transforming India (NITI) established the National Program on AI, with a mandate to create policies for the research and development in new and emerging technologies. NITI's approach is based on undertaking exploratory proof-of-concept AI projects in partnership with private sector companies, crafting a national strategy for building a vibrant AI ecosystem in India and collaborating with various experts and stakeholders.

For example, in 2018 NITI announced an agreement with Microsoft India to partner on national AI projects. As part of the agreement, Microsoft India will support NITI in using AI for new initiatives and solutions across several core areas to advance agriculture, healthcare, natural language computing:

- a. **Precision Agriculture:** Microsoft is developing proof of concept pilots to AI based real-time advisory based on satellite imagery, weather data, etc. to increase farm yields where the farm production yields in areas with low productivity. This service has the potential to increase crop yields, pest detection and pest incident predictions across locations identified by NITI. The project will involve applying data science, remote sensing and image processing apps to crop maps, yield data and weather data collected over five years. The pest risk detection model will provide information five days in advance of expected attacks.
- b. **Healthcare screening models:** Microsoft is developing AI applications to improve diabetic retinopathy screening models and facilitate early risk detection, risk assessment and timely medical intervention. The number of pathologists and radiologists in India is low relative to the overall population, especially in rural areas, and the equipment currently used can be augmented through image recognition AI. These AI applications will be deployed as proof of concepts across health centres identified by NITI. Microsoft will also support NITI in preparing a blueprint for AI-led diabetic retinopathy screening programs, which the Central and State Governments can incorporate into other relevant health screening & programs.

4. Artificial Intelligence in Growth Markets

3 India Case Study Continued



- c. **Indian languages project:** The aim of this is to lower the language barriers that restrict access to services. NITI and Microsoft have initiated a long-term project to build a complete natural language processing platform for Indian languages. The end objective is to develop of several applications, like conversational chatbots and assistants, conversing in 22 Indian languages.
- d. **Increasing available AI talent:** Microsoft and NITI will leverage content from the Microsoft India AI Professional Certificate program for developers, academic institutions and students across the country to help skill/reskill them in the areas of AI and data sciences. Furthermore, Microsoft will promote STEM education in the areas of AI and data sciences for young women in institutes identified by NITI. This will include a fellowship for select women candidates pursuing post-graduate courses in data sciences and AI, as well as a foundation level AI and data sciences course for young women graduates.



Business Ecosystem

According to a survey by Intel and the International Data Corporation, 22% of companies in India use AI techniques for any business process. According to a report on AI by NITI, this rate adoption of is concerning, given the country's position as one of the leaders in the global information technology industry which would have been expected to give India a structural advantage in developing an AI sector. However, the information technology sector in India has remained contented with delivering traditional information technology solutions and has lagged in adapting to new AI technologies compared to its counterparts in China and the United States.

Indian AI companies are constrained by the fact that most small and mid-sized businesses cannot afford to adopt AI applications. In addition, according to a 2019 report by Salesforce, India's AI ecosystem is held back by the lack of existing skilled professionals who can develop innovative AI solutions. Key findings of the study included:

- 76% of companies in India feel the shortage of skilled professionals is slowing down AI adoption.
- Indian consumers are largely aware of AI technologies and their benefits, thanks in part to entertainment-driven products and services.

In terms of venture capital funding, AI startups with operations in India raised c. US\$520m funding in 2018. This figure includes investments at varying stages of development, from pre-seed to well-funded companies. India and California based Automation Anywhere raised the largest amount with US\$300m from SoftBank's Vision Fund. When compared to 2017, the amount raised in 2018 represented a c. 370% increase from US\$113m.

Despite India having an information technology industry with over US\$160bn in annual revenues, it has yet to develop pioneering AI capabilities proportionate to its potential.

The challenges inhibiting AI adoption in India are as follows:

- a. **Lack of adequate talent to build and deploy AI systems at scale.** An estimate claims that only 4% of AI professionals in India have worked on emerging technologies such as Deep Learning and neural networks. There is also a significant gap of PhD research scholars in the field.
- b. **Difficulty in accessing to specific data required to build customised platforms and solutions.** It is difficult for new entrants to deliver services that can compete with data rich incumbents such as Facebook or Google. This phenomenon results in the creation of a virtuous cycle which reinforces the domination of the few big companies, creating a huge entry barrier for startups.
- c. **Low awareness of AI for resolving business problems in most public enterprises and government agencies,** especially given the scarcity of AI professionals.

China and the United States have established a significant headstart in terms of AI adoption, however, the race to AI does not seem set to play out as a zero-sum game. Collaboration is already prevalent across countries. China is a major market for US hardware, data can be inseminated seamlessly across borders, and researchers from around the world co-author AI papers. **Growth Markets also have the potential to become hubs for adoption** due to demographics (young, increasingly technology-oriented populations that now have access to low-cost mobile devices and some of the best mobile network coverage in the world), government collaboration and support in creating the necessary infrastructure required to power their digital economies.



5. Artificial Intelligence in Financial Services

Drivers and impact of Artificial Intelligence on financial services

In this section we explore the impact AI is having on the financial services sector, focusing on specific use cases across our focus sub-sectors of Payments, Credit & Savings, Insurance and Capital Markets, as well as Marketing and Customer Service, which cut across all sub-sectors. Financial services companies' performance is driven by risk analytics, cost optimization, customisation and personalised customer interactions. The result is that the sector will be at the forefront of AI adoption. As the use of AI continues to expand, it is transforming financial institutions' ability to drive business performance and improve access to financial services for underserved segments. AI is also lowering the barriers to entry that have historically protected large incumbents.

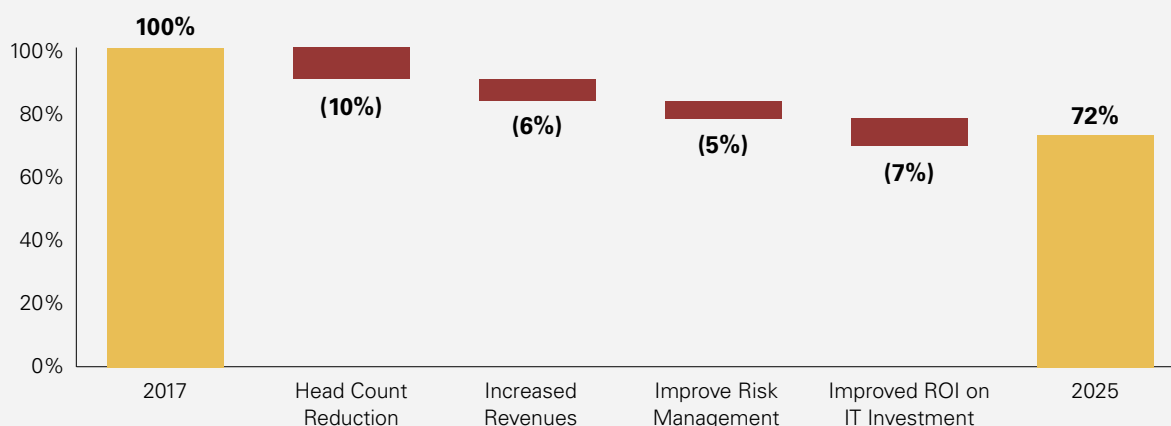
Financial services are at the forefront of Artificial Intelligence adoption

AI can increase productivity, not just by automating tasks, but also by inventing superior ways of performing them. Some illustrative use cases include:

- **MasterCard Labs uses Kasisto**, a financial services AI platform, to support more “natural” interactions within a messaging app. Specifically, the company is developing MasterCard KAI (text-based AI) for messaging platforms such as Facebook Messenger.
- **Amelia by IPSoft** is a cognitive agent that can cover a wide variety of service desk roles and transform the customer experience using natural language in applications. For example, it can help customers open new bank accounts.
- For **Credit Suisse**, **Narrative Science's Quill** has helped to summarise information by scaling investment research with natural language generation (NLG). This AI technology has enabled people to augment human intelligence with consistent and comprehensive research summaries.
- **Blend Labs** is accommodating complex rules and regulations changes in its mortgage loans process with intelligent and automatic compliance features.
- **Swiss Reinsurance Co.** is working with **IBM's Watson** to develop a range of underwriting solutions and achieve more accurate risk pricing. Cognitive computing helps them leverage unstructured information around risk to make better informed decisions.

In 2019, financial services companies are **expected to spend c. US\$5.6 billion on AI applications** and it is estimated that there will be a **28% improvement in financial institutions' cost-to-income ratios by 2025** as they automate routine processes currently performed by people and augment analytical functions such as risk management.

Figure 24: Impact on Financial Institutions Profitability: Impact on Cost-to-Income Ratio



Source: Opimas Analysis

5. Artificial Intelligence in Financial Services

Furthermore, AI represents a disruptive technology with the potential to reduce the barriers to entry that protect larger incumbents by facilitating the creation of lean, technology-driven business models that reduce the need for large workforces.

Using retail banking as an example, the table below illustrates the potential benefits of AI adoption in financial services:

Figure 25: Impact of AI on Finance Services: Retail Banking Example

	AI Use Cases	Market Examples	Typical Value Benefits
Customer Engagement	• Target & personalise customer offers better	• DBS, Chase, RBS, BBVA, DB, Capital One	• 2 – 3x better response rate • 20 – 30%+ revenue uplift
	• Chatbots / Digital agents for customer service & query support	• DBS, USAA, HSBC, BoA, CMB, Capital One	• Handle 1m+ queries daily • Improve resolution time by 80%
	• Secure Digital Identity with facial voice & behavioural biometrics for smarter onboarding and servicing	• Barclays, Wells Fargo, HSBC, USAA, WestPac, Capital One	• Reduce fraud by 70 - 80% and verification costs by 50 – 70%
	• Automated spend and Investment advisory	• USAA, Capital One, BoA, Betterment, Wealthfront	• Reduce costs by 80%+ • Increase clients / advisor by 2X+
Operations	• RPA for automating ledger reconciliations, automating tech support, IT automation etc.	• Wells Fargo, Chase, ICICI, Danske Bank, JP Morgan, BoA,, DBS	• Lower operating costs by 40%+ • Reduction in reconciliation time by 60- 90%
Risk & Compliance	• Detect fraud better, particularly for payments in real time	• Visa, Mastercard, Stripe, JP Morgan, Nordea Bank	• Reduce false positives in fraud by 60 – 80%
	• Enhance Cybersecurity with machine learning	• Capital One, Barclays	• Reduce time for detection by 30%+

Source: CGAP, Citi Digital Strategy, Citi Research

In line with the previously summarised overall impact of AI on business, its impact on financial services in particular is premised on the following aspects:

- Intelligent automation:** Automation technologies driven by Deep Learning that are adaptive and self-learning. For example, UK insurance startup Tractable leverages Deep Learning to create applications that perform visual tasks with more speed, accuracy, and scale than ever before. One of Tractable's products, AI Review, allows car mechanics to upload pictures directly onto an insurer's claims management system. AI Review then compares and reviews the pictures and provides a cost estimate for the repair job. The insurer then receives an assessment from AI Review flagging any potential leakage i.e. any difference between the quote received from the repairer and what the job should cost.
- Enhanced judgement:** Leveraging AI capabilities to augment human intelligence on core human-driven processes. The combination of humans and AI is set to significantly improve decision-making thanks to improved analytics. This can include AI-powered credit scoring and several other applications, some of which will emerge as the technology improves.
- Enhanced interaction:** Delivering superior experience to customers and users based on hyper-personalisation and curation of real-time information. This in turn drives growth in customer acquisition, retention and overall satisfaction. For example, IBM's Watson Assistant is an AI-based chatbot that can be used to build conversational interfaces into any application, device, or channel. Watson Assistant's natural language processing algorithms power its ability to interact with human languages. The application knows when to search for an answer from a company's knowledge database, when to ask for clarity, and when to direct you to a human.



5. Artificial Intelligence in Financial Services

We will explore the impact AI is having on specific sub-verticals of the financial sector and provide cases studies showing how financial services companies are applying AI solutions. The sectors we'll explore are:

1. *Payments (in the context of fraud detection)*
2. *Credit & Savings*
3. *Insurance*
4. *Capital Markets*
5. *Marketing & Customer Service*

Artificial Intelligence use cases in financial services are widespread



Payments (focused on fraud detection)

Machine Learning algorithms process large datasets better than humans. They can recognise a greater number of patterns on a customer's journey when compared to those captured by rules-based systems. Fraud can be identified in transactions by applying Machine Learning techniques to raw transaction data. The factors underpinning the importance of Machine Learning in fraud detection include:

- **Speed:** In rule-based systems, people create rules to determine which types of orders to accept or reject. As the volume and speed of transactions increases, it has become essential to have quicker solutions for fraud detection. Machine Learning techniques enable financial services companies to achieve the confidence levels needed to accept or decline a transaction by continuously analysing and processing new data.
- **Scale:** Machine Learning algorithms become more effective as the volume of data increases. This contrasts with rule-based models in which the cost of running and maintaining systems increases with scale as the number of customers increases. Machine Learning improves with more data because the algorithms can identify the differences and similarities between multiple data points. After being trained in identifying fraudulent transactions, Machine Learning algorithms can filter incoming transactions and reject the ones exhibiting the characteristics of fraudulent transactions. However, these algorithms do have some downsides, especially when transaction volumes grow rapidly. If a fraud goes undetected in the training data, the Machine Learning algorithm may ignore that type of fraud.
- **Efficiency:** Machines perform repetitive tasks efficiently. Likewise, algorithms can handle complex data analysis and only escalate decisions to humans in specific cases. Machine Learning can often be more effective at detecting subtle or non-intuitive patterns that can identify fraudulent transactions. Moreover, unsupervised Machine Learning algorithms can continuously analyse and process new data and then autonomously update its models to reflect the latest trends.

Case Study: Visa (Debit and Credit Card Fraud Detection)



Visa launched an initiative called Visa Advanced Authorization (VAA), which is a real-time predictive analytics application for detecting fraudulent transactions. VAA uses Deep Learning techniques such as neural networks and gradient boosting algorithms to produce one of the most powerful tools for predictive fraud detection currently in use today.

VAA considers up to 500 attributes for each transaction. These attributes are evaluated, and a predictive score is generated in less than a millisecond – a process repeated up to 56,000 times per second. The software can also detect if a transaction is with a high-value seller, such as an electronics dealers or jewellery stores. The time of day and the amount of money spent are also factored in, and all this information is compared to all aspects of the customer's spending patterns. This may include fluctuations in customer spending patterns during the holidays or vacations.

Visa states that the software uses the detected risk attributes, or aspects of customer behaviour that correlate with fraud, to score transactions based on risk of fraud. In this system, the number 1 poses the least risk and 99 poses the most risk. If a transaction's score passes a certain threshold, the system will decline the payment to prevent the fraud from occurring.

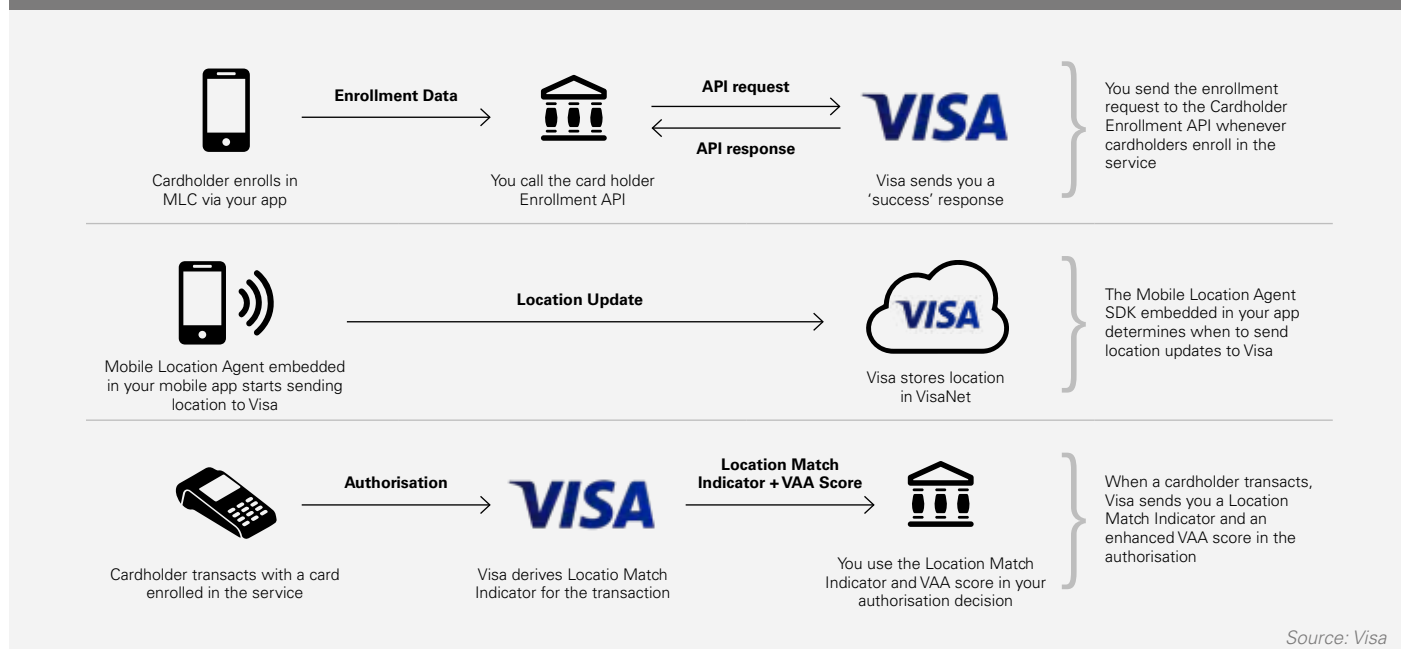
5. Artificial Intelligence in Financial Services

Visa Advanced Authorization can compare transactions against two years of a customer's transactional data. This facilitates the ability to detect non-fraudulent to reduce the number of false declines issued by the software.

The Advanced Authorization technology is also bolstered by Visa's Mobile Location Confirmation feature. The feature allows customers to opt in on their mobile device and allow Visa access to their geographical location. This location information is then used to prevent Visa Advanced Authorization from declining the user's card just because they are travelling and possibly buying something out of the ordinary.

Below is a graphic that illustrates how their mobile location confirmation feature works in conjunction with Visa Advanced Authorization:

Figure 26: AI-powered card payment authorisation



Case Study: Fraugster



Fraugster, a German-Israeli payment security company, has launched a fraud prevention solution, Fraud Free Product, using AI technology that it claims can foresee fraudulent attacks before they happen.

The Fraud Free Product is connected to the largest payment gateways, requiring no additional integration or setup for online merchants – merchants have full protection within seconds. Some of the world's largest payment companies such as Ingenico ePayments, Wirecard or Credorax are using the product today.

One of the first payments company to partner with Fraugster is Ingenico ePayments, the online and mobile commerce division of Ingenico Group. With over 65,000 online businesses from all over the world relying on Ingenico ePayments to accept and process online payments, providing strong fraud detection and management is critical to the company. To that end, Ingenico is augmenting its service offering for its customers with Fraugster's Fraud Free Product.

According to Fraugster, **online merchants lose on average over 1.5% of their annual revenue to fraud. To remedy this, Fraugster launched which takes full liability for every payment transaction, based on their high conviction of being able to correctly detect fraudulent transactions. Fraugster's technology adapts to new fraud trends seamlessly so that merchants can focus on their core business. Not only is Fraugster protecting its clients from the risk of fraud, it is also giving them a heavy revenue uplift by reducing their false positive ratio significantly.**



5. Artificial Intelligence in Financial Services



Credit

Collecting and combining large amounts of data about potential borrowers from a broader set of diverse data sources is fast becoming a key part of the credit underwriting process. Beyond traditional credit bureaus, alternative data sources include spending and shopping behaviour, bank account activity, online and social media activity, mobile phone battery life (which anecdotally was found to have one of the highest correlations with repayment behaviour – the lower the battery life on average, the higher risk of late payment or default), geolocation information, contact lists, call logs, to name a few.

The benefits of using AI capabilities to assess the ever-expanding list of data-sets are in, among others, allowing companies to source increasing data that can be processed in a structured or unstructured manner using Machine Learning. This data may reveal non-traditional credit worthiness behaviour and could either reduce the cost of developing each credit score for a borrower (e.g. by accessing non-traditional lower cost data) or better complement existing customers (e.g. thin-file customers).

Case Study: ZestFinance



When car loan defaults in the United States started rising across the industry toward the end of 2016, Prestige Financial Services (“Prestige”) sought to minimise the impact on its US\$1.1 billion loan portfolio. However, in doing so, **the company raised its underwriting thresholds to the point where 70% applicants were being turned down for a loan.**

Prestige started to investigate the use of Machine Learning in its underwriting process to reduce portfolio risk without a falloff in loan volume. The company liked the concept, but with only a handful of risk analysts, they did not have the technical expertise and resources to build and train a model efficiently.

In July 2017, Prestige engaged ZestFinance to help execute its plan. To start, ZestFinance analysts requested the necessary data – historical loan performance data, credit bureau data, and alternative scoring statistics that Prestige had relied upon in the past. But just as important, they took the time to understand the business and held weekly conference calls with Prestige risk managers, IT personnel, and compliance staff. By the time the data analysis phase was complete, **ZestFinance’s analysts had identified more than 2,700 unique borrower characteristics, more than 100 times the 23 indicators that Prestige had traditionally used to underwrite loans.**

Leveraging Zest Automated Machine Learning (ZAMLTM) software, ZestFinance’s programmers were able to build and train a robust, new model in three months. By October 2017, **the test model yielded substantial savings for Prestige; a one-third reduction in credit losses over the lifetime of the portfolio.** The application of Machine Learning had enabled Prestige to rank-order risk more effectively across all types of borrowers, allowing them to swap out risky borrowers and replace them with thin-file and new-to-credit consumers who were more creditworthy than a traditional credit score might suggest.

Based on those initial results, Prestige signed a long-term contract with Zest and fast-tracked the production of a permanent model that went live a few months later. Since then, Prestige’s lending volume has doubled, driven by a 36% increase in new applicants and a 14% increase in borrower approvals. The new loans underwritten on the Zest platform are performing at least as well as, if not better than, those Prestige had previously issued. That has allowed Prestige to achieve their original goal of approving more borrowers without taking on more risk.

Case Study: Branch



Branch **is among the largest smartphone-based, digital lending companies in Growth Markets, providing small unsecured personal loans via a smartphone app to borrowers in Kenya, Tanzania, Nigeria and Mexico.** Through its app, Branch is able to build a credit profile by applying data science to smartphone data, such as SMS & call logs, contact lists and GPS data, and then disburse and collect funds via mobile money. As users build their credit history with Branch and positive repayment behaviour is observed, they can “move up the product ladder” to higher loan amounts, at better terms / pricing.

5. Artificial Intelligence in Financial Services

Since inception, Branch has acquired more than 3 million customers and has processed 13 million loans and disbursed more than US\$ 350 million.

Branch provides small unsecured personal loans ranging in size from US\$ 2 – 1,000 to borrowers via a mobile application downloaded to a smartphone. Once downloaded, the user can apply for a loan after a simple registration process consisting of just 3 questions, which is then submitted for review. **By scraping mobile phone data with users' explicit permission (i.e. handset details, SMS logs, repayment history, GPS data, call logs, contact details, mobile money usage, social network data) in conjunction with some external data (i.e. national databases, credit bureau data), Branch's Machine Learning algorithms process the information to calculate a tailored credit score for each customer in seconds.** Eligible loan offers are then displayed to the customer via the app based on this credit score, and subsequently deposited to their mobile wallet or bank account within minutes.

Over time, users can unlock larger loans based on their repayment history and risk profile, with continuous re-scoring allowing Branch to optimise how quickly borrowers move up the loan ladder; better borrowers progress faster and are therefore able to borrow larger sums of money. As more data is compiled and incorporated into Branch's underlying credit model, its Machine Learning algorithms can make even better assessments and more informed lending decisions, leading to lower default rates over time.

Case Study: Tala



Tala launched Kenya's first mobile-based lending application in 2014 and expanded to Tanzania, the Philippines, and Mexico. As of April 2018, through its mobile platform, Tala had delivered more than 6 million loans to nearly 1.3 million customers and originated more than US\$ 300 million.

Tala's proprietary credit scoring technologies use Machine Learning to process thousands of alternative data points from a customer's mobile phone, including texts and calls, merchant transactions, app usage, and personal identifiers. These signals serve as a proxy for traditional financial data, helping Tala expand credit access to customers with little or no formal financial history. Loan applicants download the mobile application and grant Tala access to key pieces of data on their smartphone. Tala disburses loans between US\$ 10 and US\$ 500 to a mobile wallet or via payment rails of the customer's choosing.

According to Tala, the data they used would not be found on a paper trail or in any formal financial record. By looking beyond income, Tala can see that people in emerging markets that may seem risky and unpredictable on the surface are willing and have the capacity to repay loans.



Insurance

Insurers have accelerated their focus on embedding AI across the value chain with higher adoption of AI in underwriting, sales and distribution. The primary purpose of the insurance business is the spreading and mitigation of risks. Because the risks associated with different policies are not perfectly correlated, the total risk of a portfolio of policies is smaller than the sum of the policies' risks. Thus, insurance functions as a mechanism to diversify risks. The activities of insurance companies include (i) underwriting insurance policies (including determining the acceptability of risks, the coverage terms, and the premium), (ii) billing and collecting premiums, (iii) investigating and settling claims made under policies and (iv) investing the accumulated funds and managing the portfolio. By leveraging AI through the value chain, **insurers will be able to improve data capture, analytics and risk management capabilities and achieve superior cost-efficiency, specifically through improving the consumer digital experience.**



5. Artificial Intelligence in Financial Services

Figure 27: AI Uses Cases: Insurance Value Chain

Product Development	Sales & Distribution	Underwriting	Policy Administration	Claims Management
<ul style="list-style-type: none">• Leverage real-time and usage-based data to develop customer-focused products• Suggestions to customers on their required insurance plan and the sum insured• Predict success of new products	<ul style="list-style-type: none">• Electronic KYC and automated form filling• Virtual agents for guided online buying processes• Use natural language processes• Use natural language processing to address customer queries on policy components	<ul style="list-style-type: none">• Real-time risk assessment for automated underwriting and direct policy purchase• Machine learning to improve the traditional statistical models for claims forecasting	<ul style="list-style-type: none">• Face and voice recognition and digital signatures to fill forms• Auto reminders for policy updates triggered by life events	<ul style="list-style-type: none">• Claim validation and loss determination through video and image analysis• Algorithms to automate pay-out calculations for policyholders, thereby reducing the manual effort

AI's underlying technologies are already being deployed in businesses, homes, and vehicles, as well as on our person. Four core technology trends tightly coupled with, and sometimes enabled by AI, will reshape the insurance industry over the next decade.

Explosion of data from connected devices: The penetration of existing devices (such as cars, fitness trackers, home assistants, smartphones, and smart watches) will continue to increase rapidly, joined by new, growing categories such as clothing, eyewear, home appliances, medical devices, and shoes. **The resulting new data created by these devices will allow insurers to understand their clients more deeply, resulting in new product categories, more personalized pricing, and increasingly real-time service delivery.** For example, a wearable that is connected to an actuarial database could calculate a consumer's personal risk score based on daily activities as well as the probability and severity of potential events.

Increased prevalence of physical robotics: The field of robotics has seen many achievements recently, and this innovation will continue to change how humans interact with the world around them. **Additive manufacturing, also known as 3-D printing, is expected to radically reshape manufacturing and the commercial insurance products of the future.** By 2025, 3-D-printed buildings will be common, and carriers will need to assess how this development changes risk assessments. In addition, programmable, autonomous drones; self-driving cars; autonomous farming equipment; and enhanced surgical robots will all be commercially viable in the next decade. By 2030, the proportion of autonomous vehicles on the road could exceed 25 percent. Carriers will need to understand how the increasing presence of robotics in everyday life and across industries will shift risk pools, change customer expectations, and enable new products and channels.

Advances in cognitive technologies: Neural networks and other Deep Learning techniques have the potential to become the standard approach for processing the incredibly large and complex data streams that will be generated by insurance products tied to an individual's behaviour and activities. **With the increased commercialisation of neural networks, insurers will have access to models that are constantly learning and adapting to the world around them—enabling new product categories and engagement techniques while responding to shifts in underlying risks or behaviours in real time.**

Case Study: Cytora



Cytora, is a London-based insurance software company that uses Machine Learning algorithms, insurers' internal data and open source data to help insurers lower loss ratios, grow premiums and improve expense ratios. When a leading property and casualty insurer began to experience a spike in losses, they turned to Cytora. By using Cytora Underwrite to achieve accurate information at the point of quote, the insurer has been able to improve the loss ratio of their commercial property portfolio, while growing premium in target segments.

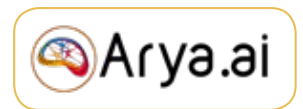
5. Artificial Intelligence in Financial Services

The insurer worked closely with Cytora to benchmark their portfolio frequency, severity and loss cost against the wider population. They found that their portfolio losses were driven by higher than expected losses in eight segments and set about shrinking or removing these segments from their appetite. The insurer also identified six sectors in which they were outperforming average losses – a signal to grow in these segments. They identified twenty micro-segments as having desirable loss trends, which had reduced by more than 50% over last 24 months, had low volatility in a 3-year time span and a market penetration held by the insurer of less than 5%.

After defining the target portfolio mix and outlining segments to grow and shrink, the insurer worked closely with Cytora to integrate Cytora Underwrite into their existing underwriting workflow. Powered by the Cytora Risk Engine, Cytora Underwrite provides a score and technical price for every risk, enabling the insurer to achieve accurate risk assessment and pricing at the point of quote and renewal. The insurer's IT underwriting systems were augmented to display Cytora risk scores and other outputs for each submission, enabling underwriters to harness information outside of question sets and base risk selection and pricing on market-wide experience. The insurer was able to complete the integration process in less than 4 weeks. To continuously monitor book performance and size as the new strategy was implemented, the insurer used Cytora to establish a tight feedback loop between market trends, portfolio strategy, and on-the-ground underwriting operations.

By using Cytora Underwrite, the insurer's underwriters are able to obtain a more accurate score and price for every risk at the point of quote or renewal, enabling them to immediately determine whether risks are within target appetite, and focus on winning the most attractive risks. **Based on initial modelling results, the insurer is projected to reduce their commercial property loss ratio by 8 percentage points – from 65.7% to 57.7%. Through having this information, they have also been able to grow premium in target segments by nearly 8% annually.**

Case Study: Arya.ai



Arya.ai helps financial institutions through the processes of planning, deploying, maintaining and integrating complex neural network-based Machine Learning systems to enable existing business processes to become even more efficient.

As an example, **Arya.ai is assisting ICICI Lombard, one of the largest private sector insurance companies in India, in the processing of health insurance claims in under a minute with its Deep Learning and neural networks platform for customers needing hospitalisation.**

Through this platform, VEGA, Arya.ai is also automating a host of operational processes for the broader banking, financial services and insurance industry. Still awaiting patent approval, the VEGA platform simplifies the development and manages the deployment of deep learning-based applications.

Arya.ai's end-to-end solution provided by Arya.ai simplifies complex claims processes with plug-and-play ease. **According to ICICI Lombard's head of customer service, operations and technology, it previously took an hour on average to approve cashless claims before the company adopted Arya's AI technology.** This can be considered a leap, given the complexity of understanding medical diagnosis during the claim process. This improvement in response time is extremely helpful in cases requiring emergency medical attention since the cashless request can be processed without any time lapse and treatment can start immediately.

In addition to automating insurance claims, Arya.ai offers deployment of technology for tasks such as autonomous underwriting, insurance fraud detection, credit underwriting and cheque processing. Companies looking to implement deep learning capabilities can work with Arya.ai's autonomous platform which comes with pre-configured 'AI' autonomous modules to automate or augment decisions. In addition, the cost optimisation achieved using Arya's offerings may eventually lead to affordable premiums and ultimately encourage more Indians to embrace health insurance.

Through a standalone enterprise module on the platform, businesses can train algorithms directly by providing training data for the specific task in the business. These modules can then learn autonomously and optimise for better performance. Some of the platform's features include tools simplifying deep learning for enterprises through features like a Graphical User Interface framework, which aims to make it easy for beginners to build complex neural networks easily.



5. Artificial Intelligence in Financial Services



Capital Markets

There are increasing opportunities for investment banks and technology providers to use AI to reduce costs, mitigate risks and optimise decision making. AI will come to be considered a routine business function, through the increased deployment of AI in production environments across multiple functions, predominantly in trading and risk; targeting capabilities such as:

- Speech recognition (for example using machines to listen to earnings call to detect any emotion that may give additional insights into the company's performance)
- Optical character recognition (OCR), such as the ability to read unstructured (e.g. handwritten) documents; and
- Trading risk analytics, and social networks analysis.

In addition, it is likely that the supervisory arms of regulators will begin to use AI technology to monitor and process data from capital market companies, allowing greater oversight and assessment of market trends and risks. This has the potential to allow regulators to react more quickly to market developments, and design regulation based on highly accurate market assessments, which will directly benefit capital market companies.

Artificial intelligence is also making inroads in the field of portfolio management. **Recent years have seen the growth of AI-powered robo-advisers that move customer funds in and out of index funds and other investments based on the customer's investment objectives, risk tolerance and market performance.** The services provided by these automated investment advisers recently expanded to include dividend reinvestment, portfolio rebalancing and tax-loss harvesting capabilities. Further growth in this area may be expected as institutions continue to invest in AI and introduce automated advising services capable of making more sophisticated investment choices.

Limitations and challenges of AI in Capital Markets

There are, however, some limitations and challenges with AI adoption. A few of them are listed below:

AI driven trading strategies become crowded: If everyone deploys the same technology and algorithms, then AI driven strategies cease to become a differentiator and trading strategies become crowded. This sees the ability to focus on how algorithms are deployed, governed and adapted becoming a core competency for successful market participants.

Lack of auditability and difficulties around error detection: The black box nature of Machine Learning, where it is very difficult to determine the exact steps an AI system took to reach a certain outcome raises major issues around audit trails. With auditability a key aspect of governance for financial institutions this could become an increasing problem that drives significant regulatory scrutiny of AI in the future. This lack of visibility in terms of process also makes error identification extremely difficult in the event something goes wrong. Furthermore, it introduces operational and reputational risk. The flash crashes that have occurred in past years are good examples of when algorithms have caused serious problems.

Regulation: The European Banking Authority recently signalled it is considering closer supervision and regulation of fintech firms. The Federal Reserve has also warned banks against using AI to analyse model risk because the AI algorithm might be another source of model risk. Other regulators may also share this view as the potential for fintech to transform the structure and stability of financial markets increases. Furthermore, data privacy will continue to grow in importance as ownership of vast datasets becomes a key source of competitive advantage.

5. Artificial Intelligence in Financial Services

Case Study: Alpaca



Alpaca is Japanese start-up that builds Deep Learning and Big Data technology for financial markets. The company provides:

1. AlpacaForecast: a platform that predicts market movements
2. AlpacaRadar/Search: a new product that predicts market risk anomalies between different assets
3. AI Prediction Matrix: a software-as-a-service platform available on the Bloomberg App Portal that provides real-time short-term market forecasts

In May 2018, Alpaca announced a partnership with Bloomberg and launched AlpacaForecast AI Prediction Matrix. The application makes use of large-scale data processing technology and deep learning technology to provide users with real-time short-term forecasts for major markets. Alpaca developed this application with the goal of bringing advanced AI market forecasting capabilities to the financial market participants, right at their desks. Alpaca applied Deep Learning techniques with high pattern recognition function commonly used for image recognition/video recognition to time series analysis. **The company's model analyses tick data on market charts which is difficult for human eyes to recognise making market prediction possible.**

Alpaca also has been working on other financial market AI-based solutions. **In March 2018, the company announced a partnership between Jubun Bank, a Japanese bank, and Alpaca to provide a new AI service that targets the bank's customers who would like to make use of foreign currency deposits when exchange rates are most favourable.** The service aims to determine when the exchange rates are best and alerts the customer. Based on account settings pre-defined by the customer, the AI system makes a deposit from a Japanese Yen account to the customer's foreign currency savings account. Jubun's customers have the right to determine upper and lower limits for the exchange rates they deem acceptable.



Marketing & Customer Service (relevant to all financial services sub-verticals)

The rise in AI-powered marketing is taking the load off many marketers, and delegating to machines, allowing marketers to refocus their efforts onto marketing that matters and giving marketers more time to address any challenges that come their way.

AI impact companies' marketing functions in the following ways:

Customer segmentation: In today's digital market, consumers have developed high expectations for a more personalised experience. Marketers need to improve customer interactions and deliver on new needs and desires, or risk losing leads to the competition. Marketers can use customer segmentation to deliver the right message, to the right customer, at the right time. AI technology enables marketers to separate their customers into distinct personas and understand exactly what motivates them. With this information, marketers can focus on the specific needs of their audience and creating a long-lasting relationship with the brand. Most companies view segmentation as a method of clustering similar customers together at a given point in time. **However, with AI it is possible to map the journey that each customer has taken to reach his or her present segment.** By analysing customers based on their movement among segments over time, it is possible to achieve dynamic micro-segmentation, and predict future behaviour accurately. Using micro-segmentation, brands can communicate personally with every customer, optimising customer experiences and increasing loyalty and lifetime value, in today's highly-competitive direct-to-consumer space.

Accuracy: Marketers spend a significant amount of time attempting to gain some insight into their target audience, as they know consumer insights are the key to more strategic marketing campaigns. In the past, the availability of quality data was lacking and fuelled mostly by demographics. We are now entering an era of robust AI-driven data analytics, that opens the doors for marketers to fully understand their audience. **AI predictive analytics aim to make the most accurate predictions by analysing past and present customer behaviour patterns. Using the data gathered, marketers can incorporate insights into their marketing efforts to create an optimised and targeted campaign.**



5. Artificial Intelligence in Financial Services

Improved Customer Interactions: A great way to customise and deliver great customer service is investing in AI chatbots. These virtual assistants can help build stronger relationships and interactions with customers in a cheap, efficient and consistent manner. They use AI to track and predict user behaviour, and with this information, they can implement stronger keywords and personalize customer interactions to make each customer's journey unique to them. Intelligent conversational chatbots, can rapidly and immediately tackle issues as they come. Unlike humans, chatbots work around the clock to deliver strong interactions and improved customer service whenever issues arise.

Case Study: BBVA



In the wake of increasing uptake of digital banking, BBVA's launched its AI voice assistant MIA (Mobile Interactive Assistant), within its Turkish subsidiary, Garanti.

Before commencing development of its AI voice assistant, MIA, Garanti Bank built a robust mobile banking app. The app's popularity lies partly in its user-friendly features such as using eye recognition to verify identity. The eye recognition feature works by scanning the structure of the user's eye and then generating a personalised key that the bank stores.

Then, the bank sought to find out how the app's functions could be most effectively served by an AI-based voice assistant within its mobile banking app. Garanti analysed the commonly used mobile app functions that they thought would be most valuable to customers. They looked at customers' needs and daily routines and defined different use cases. From there, a character was designed to embody the mobile assistant concept and create a companion-like emotional relation with the end user.

As of 2018, MIA is now active, and it allows users of the Garanti banking mobile app to transact through it by speaking. It answers questions about the latest account activity, performs transfers, lets customers buy or sell foreign currency or find out the exchange rate using voice. **As of April 2018, 1.3 million customers had logged more than 12 million interactions with MIA.**

One of the most relevant characteristics of MIA to the customer experience is that it provides a multichannel experience. This means that if users' requests cannot be addressed on a smartphone, MIA can offer other ways to address them. For example, MIA can offer to cancel a lost credit card immediately or provide the option to connect the user with customer service.

Financial services are at the forefront of AI adoption. As the use of AI continues to increase, it is transforming financial institutions' ability to drive business performance and improve access to financial services for underserved segments. **Both new entrants and incumbents are investing significant resources in developing AI based applications for automating or augmenting functions across the financial services value chain.**

5. Artificial Intelligence in Financial Services

Artificial Intelligence regulation in the context of financial services

Regulating Artificial Intelligence in financial services poses a new set of challenges

Whilst AI offers considerable promise in financial services, it also poses new types of risks ranging from data privacy and security, the auditability of algorithms to ethical/legal issues such as bias. This section explores the regulatory considerations for both countries and companies when implementing AI applications. These range from practical considerations such as

AI algorithms may unintentionally discriminate in ways that may not be obvious but may result in legal liability for the financial institutions that use them.

The regulatory challenges presented by AI include:

1. **Fraud:** While currently being used to enhance fraud protection, AI could potentially be used to circumvent these same fraud detection capabilities. For example, by using AI to impersonate the voice of a customer (technology is rapidly progressing to enable just that).
2. **Integrity of algorithmic decision-making:** Models are only as good as the data underpinning them. AI may compound existing biases through training models with biased data and leading make decisions based on incorrect or fraudulent data. For example, in 2016, the New York Supreme Court ruled in favour of teachers who claimed they had been given unfairly poor appraisals by their AI-based teacher-grading software. Among other issues, investigators found that the software had a 35% error rate. Its rating system failed to factor in performance drivers such as class size and variance of students' abilities among classes.
3. **Role of humans:** A decision-making process informed by models may be unable to provide explanations for decisions or self-correct for biases built into the design without human intervention.
4. **Data privacy:** The volume of data required to effectively develop AI raises data privacy concerns as consumer data is increasingly shared without informed consent. Further, AI's ability to analyse data and identify users may in fact increase the sensitivity of data that was previously considered sufficiently anonymous.
5. **Transparency, auditability and accountability:** The complexity of AI models raises challenges for transparency and auditing of such models, which undermines traditional regulatory frameworks that rely on an expectation of transparency. For example, the United States' Fair Credit Reporting Act requires that companies notify a borrower if consumer report information is used to deny credit. It may be difficult for firms using AI to make credit decisions and to rationales for those decisions.
Inadvertent discrimination: While AI models allow companies to better segment their customer base, regulators may struggle to identify inadvertent discrimination by AI algorithms which may not be straightforward to understand. For example, in the European Union, insurers are not been able to segment based on sex when providing car insurance. AI might make segmentation by sex or similarly discriminatory attributes hard to spot.

This last point is a key area of focus for regulators. As AI becomes more entrenched in companies' operations, the risk is that a perfectly well-intentioned algorithm may inadvertently generate biased conclusions that discriminate against certain groups of people. There are three main sources of bias that could lead to biased or discriminatory outcomes:

1. **Biased input data:** Input bias could occur when the source data itself is biased because it lacks certain types of information, is not representative or reflects historical biases. The indirect influence of bias is present in plenty of other types of data as well. For instance, evaluations of creditworthiness are determined by factors including employment history and prior access to credit — two areas in which race has a major impact in the United States. To take another example, imagine how AI might be used to help a large company set starting salaries for new hires. One of the inputs would certainly be salary history but given the well-documented concerns regarding the role of sexism in corporate compensation structures, that could import gender bias into the calculations.
2. **Training bias:** Training bias could appear in either the categorisation of the baseline data or the assessment of whether the output matches the desired result. There are two main ways that bias shows up in training data: either the data you collect is unrepresentative of reality, or it reflects existing prejudices. The first case might occur, for example, if a Deep Learning algorithm is fed more photos of light-skinned faces than dark-skinned faces. The resulting face recognition system would inevitably be worse at recognising darker-skinned faces. The second case is precisely what happened when Amazon discovered that its internal recruiting tool was dismissing female candidates. Because it was trained on historical hiring decisions, which favoured men over women, it learned to do the same.
3. **Programming bias:** Programming bias could occur in the original design or when an AI is allowed to learn and modify itself through successive contacts with human users, the assimilation of existing data, or the introduction of new data.



5. Artificial Intelligence in Financial Services

Given AI's global implications, multiple foreign governments have presented national AI policies and strategies that highlight their awareness of the ethical concerns surrounding AI and their commitment to developing safe and beneficial AI technologies:

United Kingdom: The UK's strategy specifically considers the economic, ethical and social implications of advances in AI and recommends preparing for disruptions to the labour market, open data and data protection legislation, data portability, and data trusts. It notes that large companies which have control over vast quantities of data must be prevented from becoming overly powerful.

India: India's strategy highlights the importance of AI ethics, privacy, security and transparency as well as the current lack of regulations around privacy and security.

Canada: Canada has a National Cyber Security Strategy for protecting Canadians' digital privacy, security and economy and a commitment to collaborate with France on ethical AI.

China: China has a National Standard on Personal Data Collection which addresses issues like those in the European Union's General Data Protection Regulation (GDPR). The country's New Generation AI Development Plan underlines the need to strengthen research and establish laws, regulations and ethical frameworks on legal, ethical, and social issues related to AI and protection of privacy and property.

European Union: The European Union Legal Affairs Committee recommends privacy by design and privacy by default, informed consent, and encryption, as well as use of personal data need to be clarified.

Regulating AI in financial services poses a new set of challenges for policymakers. **AI algorithms may unintentionally discriminate in ways that may not be obvious but may result in legal liability for the financial institutions that use them.** Given AI's global implications, multiple governments have presented national AI policies and strategies that highlight their awareness of the ethical concerns surrounding AI and their commitment to developing safe and beneficial AI technologies. Much work remains to be done as some of the potential risks from AI have yet to emerge.

6. Investing in Artificial Intelligence

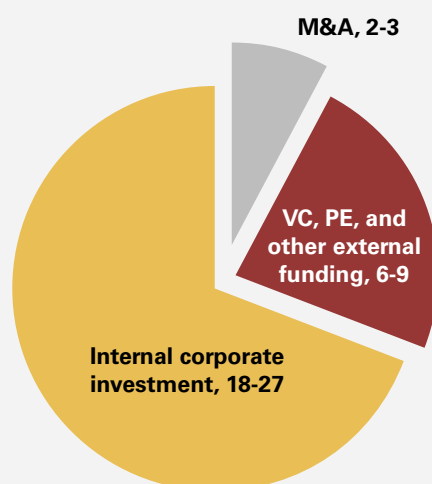
The Artificial Intelligence investment landscape

Having provided a comprehensive overview of AI and its potential applications across countries and industries, with a focus on financial services, in this section we attempt to bring everything together to cast a somewhat informed eye on AI-focused investment opportunities. To do so, we first focus on the AI investment landscape today, to better understand the key players (in terms of both investment and adoption) and barriers to entry. It is in this context that we present our proprietary AI Due Diligence Checklist, as a pragmatic framework to better understand and evaluate AI companies.

Large technology firms are leading investment and adoption in Artificial Intelligence, due to inherent advantages

With data being one of the key ingredients for AI applications, data-rich (and cash-rich) companies such as Google, Amazon and Facebook have become the largest investors in AI, with internal R&D programs that far outstrip external investment into AI. Although, this trend might be shifting. The largest investment in 2019 was made by Softbank's Vision Fund, with a US\$ 940m investment in Nuro, a robo-delivery start-up based in the United States.

Figure 28: Investment in AI (2016)



CAGR%

	2010-2013	2013-2016	AI share of total investment category, 2016%
Other			
M&A	55	85	>1
PE	15	20	1-3
VC	35	40	2-3

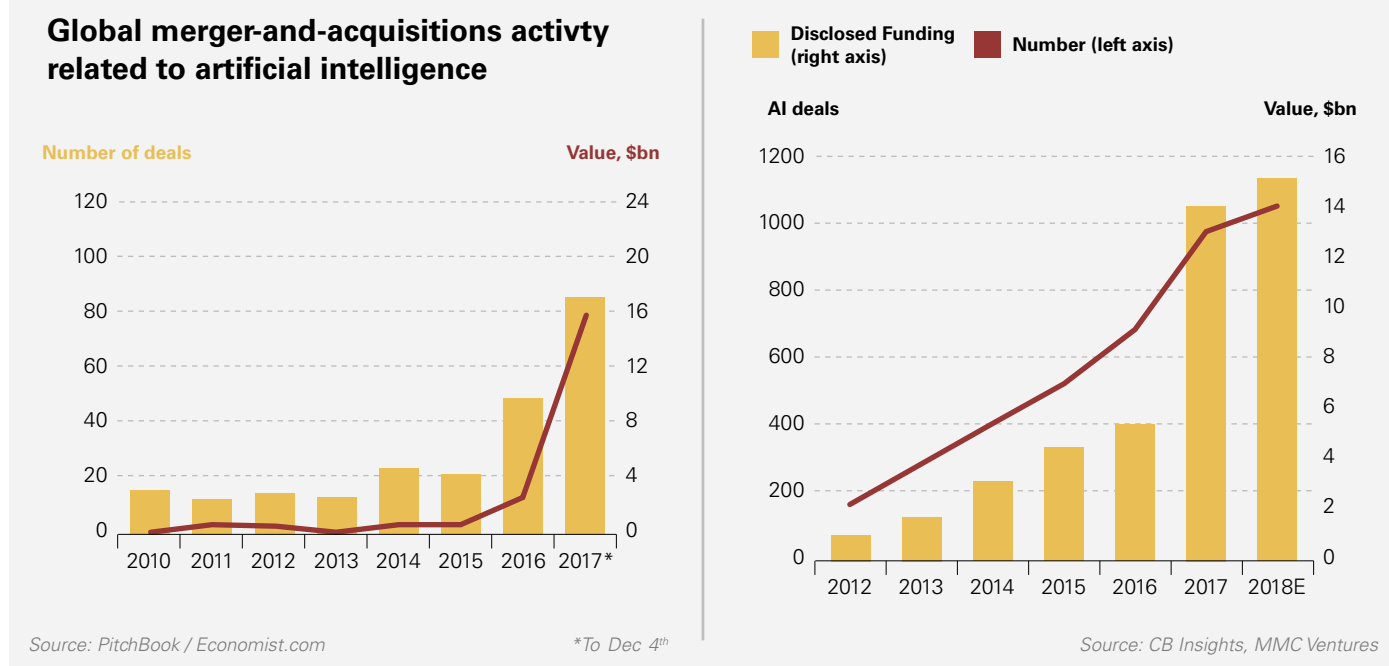
Source: McKinsey

Over the past five years, investment in early-stage companies focused on AI has increased 15-fold. Venture capital firms have significantly increased their investments into early-stage AI companies globally. According to data from CB Insights, total AI funding in 2017 reached US\$15.2 billion (an increase of over 144% versus 2016) representing 1,349 investments. In addition, tech giants including Google, Baidu, Apple, Intel, Facebook and Microsoft have made several targeted acquisitions of early-stage AI innovators. Since 2012, over 300 private firms using AI across different verticals have been acquired.



6. Investing in Artificial Intelligence

Figure 29: AI Investment by VCs and Corporates

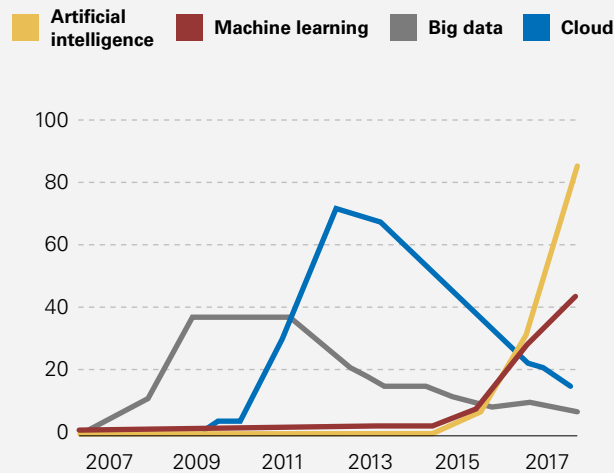


In terms of positioning, technology, healthcare, retail and financial services firms are leading the pack in AI, whilst all other industries are putting a bigger emphasis on the Cloud and Big Data. Google in particular repositioned itself as an AI-first company in 2017 (previously mobile-first) to highlight its growing focus on AI and is currently actively evaluating where AI could replace/automate/improve existing processes, with some analysts commenting that gathering data to improve ML models may come at the expense of customer experience and privacy at Google.

6. Investing in Artificial Intelligence

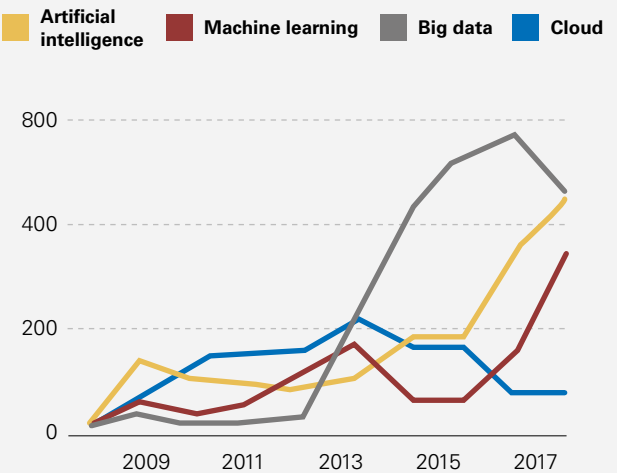
Figure 30: Company earnings calls mentions of AI (2007-2017)

Company earnings calls mentions - IT companies (2007-2017)



Source: Prattle

Company earnings calls mentions - sum of other industries (2008-2017)

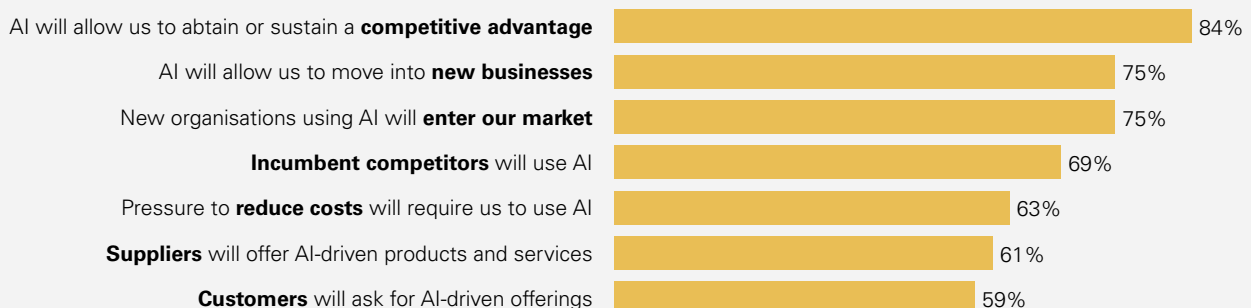


Source: Prattle

This adoption is being driven by several factors including a desire to maintain a competitive edge, moving into new business lines, and improving margins. However, sometimes it is also spurred by the fear of competitors adopting AI first. As described by a professor in AI: *Everyone talks about AI, nobody really knows how to do it, everyone thinks everyone else is doing it, so everyone claims they are doing it.*

Figure 31: Key reasons cited for AI adoptions

Percentage of respondents who somewhat or strongly agree with each statement



Source: BCG



6. Investing in Artificial Intelligence

Sectors that are not digitally native are generally lagging in AI adoption despite high ambitions

The gap between ambition and execution is large. Based on research conducted by MIT and BCG, while 85% of company CEOs believe AI will allow their businesses to obtain or sustain a competitive advantage, only 20% of companies have incorporated AI into some offerings or processes, and only one in 20 companies has *extensively* incorporated AI. AI leaders are investing in AI talent (data scientists, Machine Learning experts, researchers, etc.) and building strong IT infrastructures, laggards lack analytics expertise and easy access to their data. The leaders are also more likely to have senior leadership support and have developed a business case for AI initiatives. Within the same industry, there can be a similarly large gap between expectations and actual adoption. For example, Ping An, which employs 110 data scientists, has launched around 30 CEO-sponsored AI initiatives that support, in part, its vision “*that technology will be the key driver to deliver top-line growth for the company in the years to come*”. Other large insurance companies’ AI initiatives are limited to “*experimenting with chatbots*,” as a senior executive at a large Western insurer describes his company’s AI program.

The barriers to entry into AI are falling but AI companies still command valuation premiums

The barriers to entry for AI applications are constantly being lowered. ML algorithms are heading towards commoditisation and are widely available on open source AI platforms such as Baidu, Google and Facebook. Given this, businesses and individuals do not need to understand the advanced mathematical models or algorithms and can train the models on their own data. At the same time, high computing power is increasingly available at an affordable cost via cloud services, from multiple providers such as Google, IBM and Microsoft. As such, the differentiators for AI-focused businesses are increasingly being centred around data and talent:

1. Access to proprietary large data sets
2. Advantages in the creation of new data sets
3. Talent with expertise in advanced data analytics (including Deep Learning)
4. Focus on data security and privacy

This is in addition to more traditional sources of competitive advantages such as network effects (large user database), specialisation (focus on niche products and/or markets), economies of scale and superior product and user experience. As such it is our

Implications of the AI investment environment

It is clear that current AI funding is led by corporations (large technology players predominantly) and overwhelmingly focused on developed markets; this in-turn supports **Apis’ view that leading Growth Markets financial services firms will need to develop a strategy around: (i) purchasing / licensing developed market AI products; (ii) building a capability within their operations; or (iii) most likely, a combination of both.** As such, **we wrap up with our proprietary AI due diligence check-list** that supports investment professionals as they consider practical indicators for investment in AI.

6. Investing in Artificial Intelligence

A framework to demystify Artificial Intelligence investing

Artificial Intelligence due diligence checklist

The list we present below is not meant to be exhaustive but rather to serve as a basis for evaluating AI-focused investment opportunities objectively, in addition to customary commercial and financial due diligence. This list can also serve as a guide for our existing and prospective portfolio companies when considering the implementation of AI. The central question when reviewing an AI application remains understanding the advantages provided by AI, particularly as opposed to traditional analytics techniques.

Key Metric	Comments
Performance	
Intervention Ratio	This is the level of human intervention required in training or correcting ML (including DL) models. This ratio is expected to decline over time
Return on Investment	This metric should also be tracked over time and measures how quickly and efficiently sales or margins are improving because of AI implementation. Ultimately fast-tracking AI adoption in a B2B environment requires clear and measurable metrics that increase revenue, decrease cost, lower churn, etc.
Differentiators	
Data Moat	
Acquisition costs	These include the time and cost of acquiring the data but also captures how “AI-ready” it is i.e. is it structured, labelled and is it in a format that can train the algorithm
Barriers to entry	The barriers to entry preventing other businesses from acquiring the same data
Breadth	The quality, diversity, veracity and quantity of data available. Veracity in particular deals with how clean, accurate, and precise the data is. Most of data scientists spend their time getting the data quality-ready to run algorithms
Perishability	The relevance of the data over time
Security & Privacy	How customer (and other) data is obtained, stored and protected
Memory and Intensity	Advanced ML techniques training requires very large data sets and are GPU intensive. Most companies without the ability to scale in those two areas are constrained from going to true AI applications
Talent	
Breadth & Depth	Data scientists and ML engineers have become some of the highest paid positions due to an acute shortage in available talent. As such, performing due diligence on the depth of the AI talent pool in a company is key
Cooperation between AI and business experts	Establishing deep and constant communication between AI experts and business experts is key in order to adapt the models required, as well as implementing the required business changes. Algorithms have to be translated into product/services which requires strong product managers and UX designers in order to achieve successful commercialisation



7. Concluding Remarks

Artificial Intelligence provides a compelling opportunity for Apis to connect the dots between mature markets technology and Growth Markets financial services

The aim of this paper is to provide the reader with a clear and unambiguous overview of the current state of AI with regards to its impact across various segments, with a deep-dive on the financial services industry. Specifically, this paper aims to support five broad conclusions:

1. Despite AI being an emerging technology for several decades, recent changes to the size of data being generated, the ability to process such data at low cost and advances in the statistical techniques underpinning AI (e.g. Deep learning), are currently driving a **rapid acceleration of AI adoption across several industries.**
2. **The financial services industry is likely to be one of the leading adopters of AI technologies** within its value chain due to the dematerialised nature of the products being provided, the large data-sets being created by customers and the existence of talent within the sector to lead the adoption of AI.
3. The majority of Apis' regions of focus – with the exception India, are unlikely to see governments and large corporations drive AI utilisation in the same manner as that being observed in the United States and China. This will create opportunities for **private sector firms who either co-opt best-practice; develop capabilities in house; or purchase services from AI focused providers in other markets to develop a larger “moat” against local competitors.**
4. Today there are several examples of AI playing a role across all financial services verticals (e.g. credit, insurance, payments,) where **adoption of the technology is leading to significant and demonstrable benefits to companies**, including lower costs, additional revenues, as well the bypassing of current infrastructural limitations through the use of alternative data for example.
5. **There is a clear opportunity for a firm such as Apis**, a Growth Markets focused financial services investor, to assist current and prospective portfolio companies with unpacking the opportunities presented by AI for their businesses through leveraging Apis' networks across developed market firms; other growth market firms and other sub-segments within the financial services industry.

As we conclude, we also believe it is important to recognise that the AI trend is only just beginning. The field remains widely misunderstood, with some capitalising on this lack of understanding, coupled with increased interest, to make a 'quick buck' during the current AI fever. Furthermore, we are only starting to grapple with the plethora of regulatory and ethical issues that are arising from machines that learn on their own. By the same token, quantifying and addressing the massive potential disruption to industries and the nature of employment remains a complex task. At Apis, we do not claim to have all these answers. That said, we are convinced that for the Growth Markets consumer, AI as a group of technologies, will contribute to lowering the barriers to financial inclusion, sometimes even enabling new business models that we have not yet contemplated. **It is our hope that as a financial services investor with a global network, Apis can contribute to facilitating value-additive AI adoption in the broader financial services industry.**

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- UN E-Government Knowledge Base



Apis Partners



Matteo Stefanel - Managing Partner & Co-Founder, Apis Partners

Matteo has a successful track record in private equity and investment banking spanning nearly two decades and focusing specifically on Growth Markets and Financial Services. He is a Co-Founder and Managing Partner of Apis Partners LLP.

Formerly a senior partner at The Abraaj Group, a leading EM private equity group, where he held various roles including co-Head of Abraaj's PE Investment Team in Dubai (\$7bn), Head of both the Special Situations and the Real Estate Group, as well as being a member of the Executive and the Investment Committees. He was responsible for a number of Abraaj's investee companies (10+), including Network International (payments), Saham Finance (insurance), and Jordan Ahli Bank (banking).

Matteo has been a board director of over 20 companies and completed over 100 transactions in Europe (including CEE), South Asia, the Middle East and Africa, throughout his career at Abraaj, at MIG (\$7.4bn AUM) where he was briefly CIO, and at Deutsche Bank as MD and co-Head of Emerging Markets in the Financial Institutions Group.

Since 2012, Matteo has been a member of the World Economic Forum's Global Agenda Council on Financing and Capital (2012-14 and 2014-16).

Matteo graduated from Queens College, the University of Oxford, with an MA (Hons) in Philosophy, Politics and Economics.



Udayan Goyal - Managing Partner & Co-Founder, Apis Partners

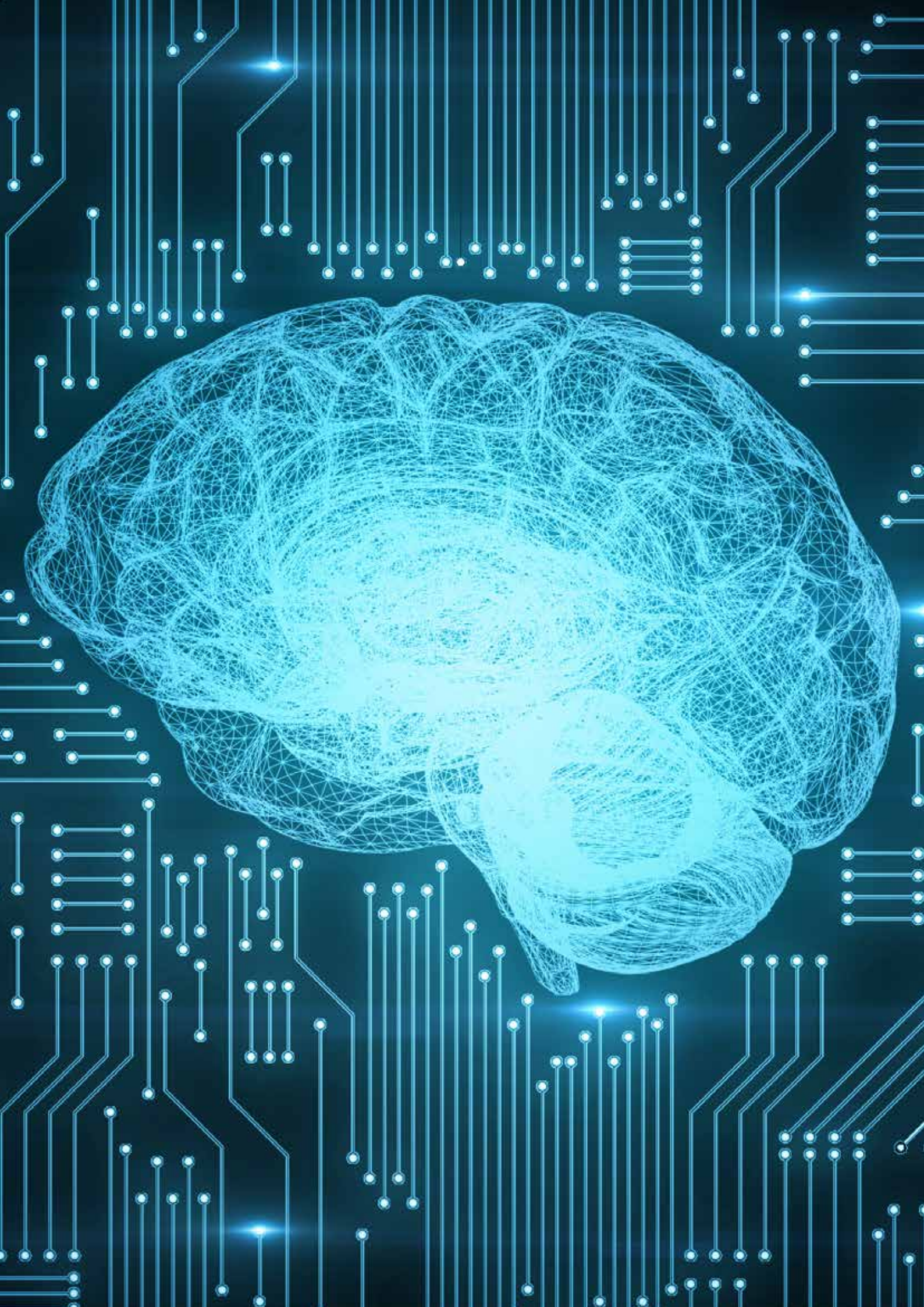
Udayan is a keen proponent of technology driven reformation in banking and financial services and has exceptional domain expertise in the industry. He is a Co-Founder and Managing Partner of Apis Partners LLP.

Prior to Apis, Udayan was a Co-Founder of Anthemis Group, a leading venture capital investor in digitally native fintech companies and advisory firm to large private equity companies investing in the financial technology sector. Here Udayan made a number of seed investments in companies including (Bank)Simple, Azimo, Betterment, Moven and Fidor, whilst also leading a number of innovation projects and private equity-backed transactions.

Udayan was formerly the Managing Director and Global Head of Financial Technology Advisory at Deutsche Bank AG in the Global Financial Institutions Group based in London. Prior to Deutsche Bank, Udayan had specific responsibility for developing the pan-European specialty finance practice of Credit Suisse with a focus on financial technology.

Udayan is a much sought after commentator on digital finance and curates the very popular "Future of Money" annual session at Innosight, SIBOS, where he serves as a member of the Enablers Board.

Udayan graduated from Trinity College, the University of Cambridge, with an MA (Hons) in Natural Sciences (Tripos).



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