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ARTIFICIAL
INTELLIGENCE

TECHNOLOGY
NEWSLETTER
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CONTENTS

1. INDUSTRY SNAPSHOT

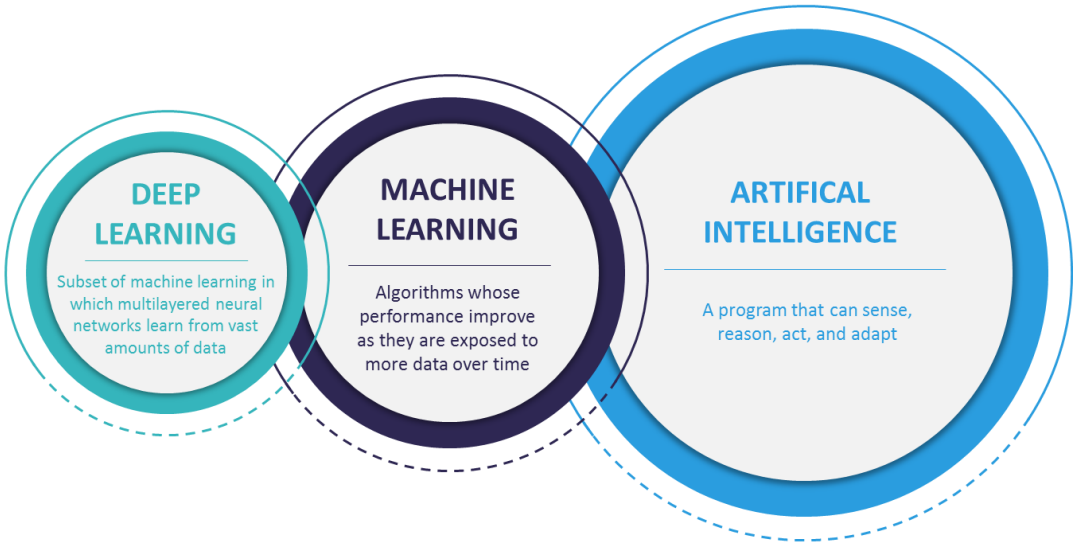
Introduction

Artificial Intelligence (AI) could be the next force of digital disruption. It refers to systems or machines which can work or react like humans. AI includes multiple technologies, the most prominent among them are machine learning, deep learning and natural language processing (NLP). Early evidence points to the fact that AI can deliver real value to end users and can be a serious force of disruption. It is already being used across multiple industries including retail, healthcare, manufacturing, defence and education. It is anticipated that the impact of AI is likely to grow significantly over the next five years as it become more mature and easily deployable commercially.

There has been a spurt in the deal activity around companies with Artificial intelligence (AI) capabilities. According to CB Insights, the number of acquisition of AI start-ups increased by 44% to 115 in 2017 from 80 in 2016 and has continued at a similar pace in 2018. According to the 2018 M&A trends report by Deloitte, technology acquisition is the no. 1 driver of M&A pursuits.

New AI technologies such as deep learning is surpassing the limits of previous machine learning. Though, machine learning has been attracting largest share of investment till now, it is likely that deep learning will take over going forward. Machine learning algorithms need to be trained by feeding large sets of data to them. This requires some form of human intervention and are therefore prone to human biases. However, deep learning, which uses artificial neural network to make decisions does not need any human training and are capable of learning on their own.

AI and its Subsets

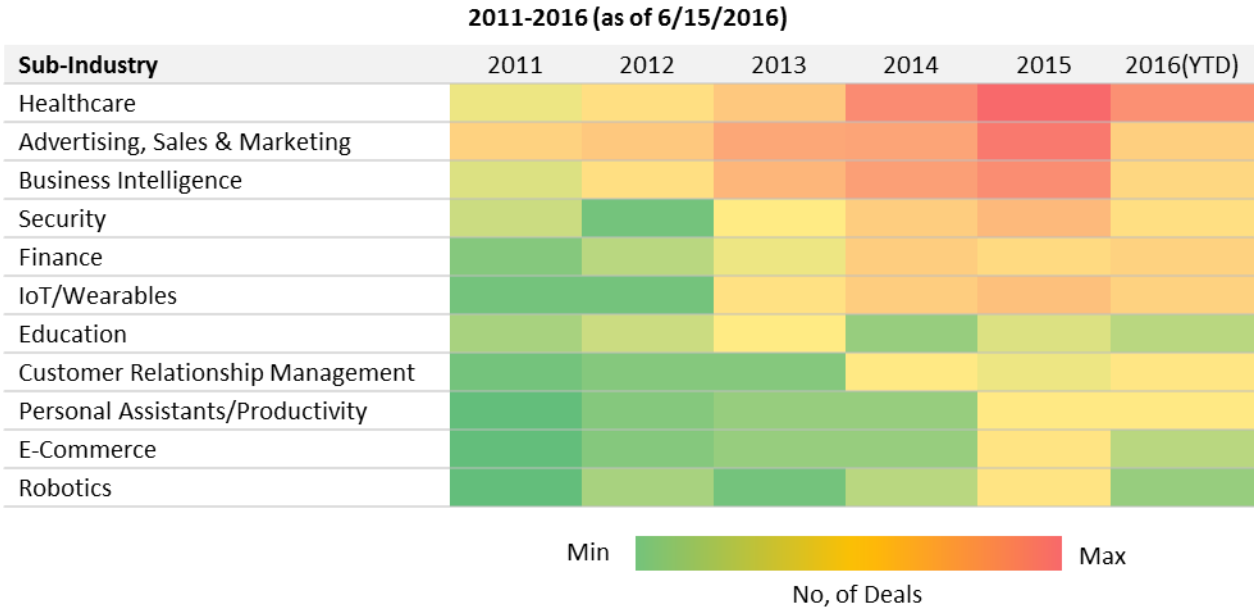


Source: Intel, Acquisdata

Some of the early applications of AI include self-driving cars, industry robots, chatbots, AI-enabled cyber security systems, wealth management systems, and AI powered drones. A combination of elements including massive distributed computing power, the decreasing cost of data storage, and the rise of open source frameworks is helping to accelerate the application of artificial intelligence. Further, improving IT infrastructure, rising penetration of smartphones and internet as well as growing use of connected devices in emerging countries such as China, India, Malaysia, Thailand, and Brazil are expected to drive the growth of the AI market.

The largest opportunities for AI applications are expected to be in healthcare, finance, automotive, retail and manufacturing sectors. As seen in the figure below, healthcare has seen the largest flow of funding and deal making activity over the last few years. According to Frost and Sullivan, AI has the potential to improve medical treatment outcomes by 30-40% and reduce costs by as much as 50%. The research firm also estimates that AI and cognitive computing could generate more than $150 billion in savings for the healthcare industry by 2025.

AI: Sub-Industry Heatmap Showing Healthcare Witnessing Largest Deal Activity



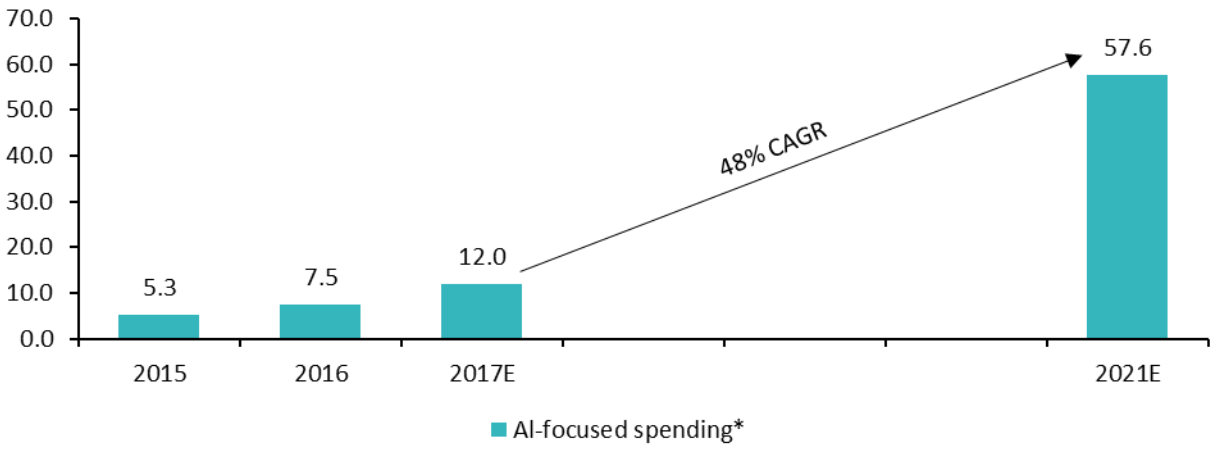
Source: CB Insights, Acquisdata

Market scope

IDC forecasts spending on AI-focused hardware, software, and services to reach $58bn by 2021, up from ~$12bn in 2017, making this one of the fastest-growing technology segments (growing at nearly 50% '17-'21 CAGR). The components of this AI-focused spend include:

- AI applications –applications that learn, discover, and make recommendations / predictions or core AI components
- AI software platforms –tools built on core AI components that enable AI-driven use cases
- AI-related IT & business services –for example: consulting / implementation services provided to an enterprise for deploying AI-related technologies
- AI-dedicated server and storage spending (hardware)

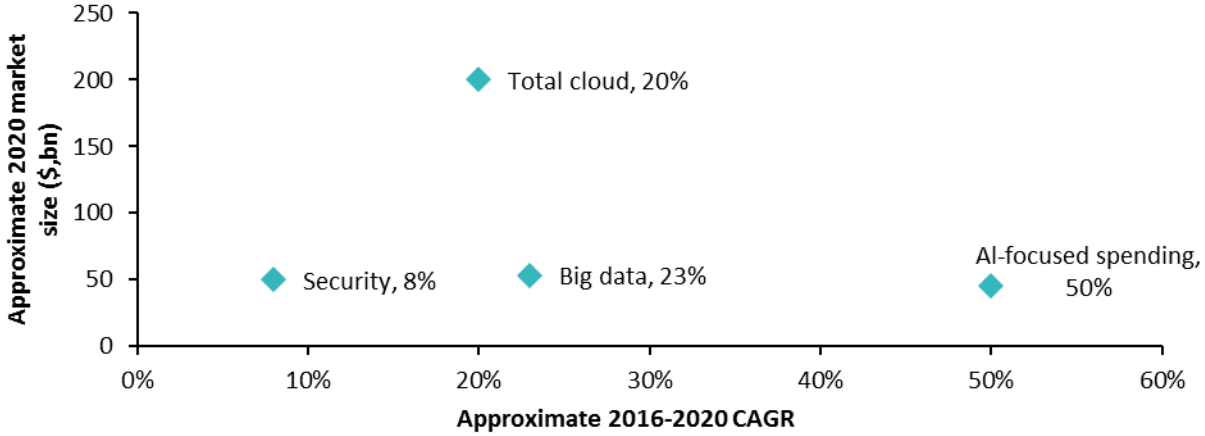
Global AI-focused spending* ($, bn)



Source: AI-spending estimates from IDC, *Includes AI-focused spending on hardware, software (applications + software platforms), and services (IT consulting & system implementation).

To put this spending size into perspective, AI growth projections of ~50% CAGR through 2020/21 are more than twice the growth rate of other high-growth tech subsectors (such as Big Data 23% and Cloud 20%). By 2020, AI-focused spending could be about the same size as the security software market.

AI market growth compared to other high-growth technology segments



Source: Bloomberg, IDC, J.P. Morgan.

Geographical analysis of the AI landscape

On a geographical basis, North America is expected to be the largest region by spend due to the availability of high government funding, the presence of leading players, and strong technical base. According to IDC, the United States is the largest market for AI, with spending of ~$9.7 billion in 2017. Europe, the Middle East and Africa (EMEA) is currently the second largest region, followed by the Asia-Pacific.

By 2020, the Asia-Pacific is expected to overtake the EMEA region and be the fastest-growing market, owing to the rapid improvements in IT infrastructure (storage capacity, high computing power and parallel processing) and growing demand of artificial intelligence technology in end-use industries such as automotive and healthcare.

China has released a blueprint for investing AI and plans to create a $150 billion artificial intelligence sector (includes core AI applications as well as related industries) by 2030. China has made an open-source platform to boost the development of artificial intelligence (AI), as part of a plan to make China a world-leader in this field by 2030. The plan aims to boost production of AI related technology to reach ~$22 billion by 2020, rise to $60 billion in 2025, and $147 billion in 2030. The Chinese Government has committed more than $2 billion worth of funding to build an artificial intelligence research and development presence in Beijing.

Europe is also trying to catch up with China and the US in the race to AI dominance. In April 2018, the European Commission announced €20 billion to AI research funding through 2020. In addition, individual European countries are setting up their own AI plans. French President Emmanuel Macron announced $370 million of annual funding for AI research. While reports suggest that German Chancellor Angela Merkel has set an agenda to bolster support for artificial intelligence in a joint government venture with France. Even the UK government unveiled a £1 billion AI fund aimed at boosting the sector's development.

VC Funding Trends

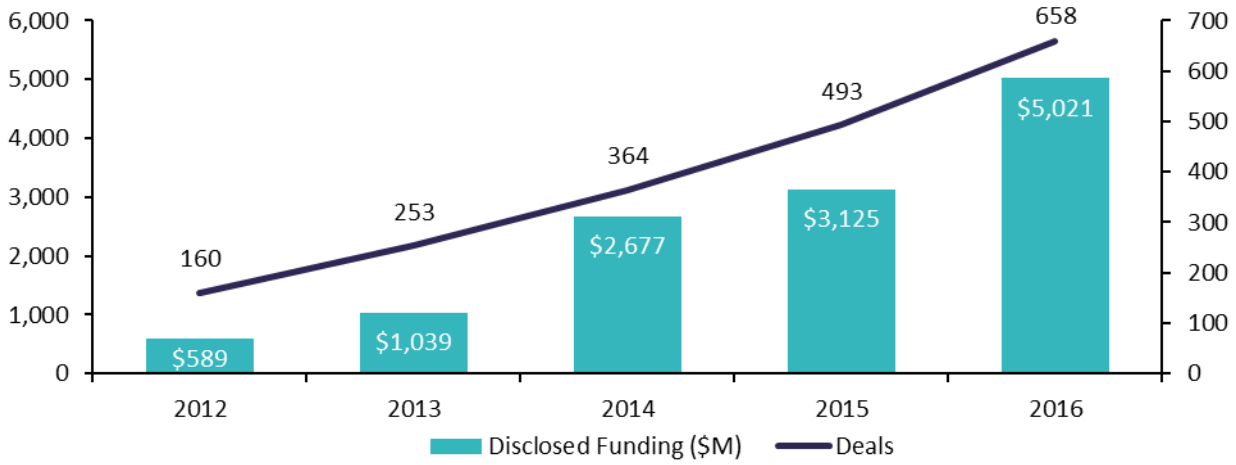
Given the rapid growth in the AI market, both merger and acquisition activity as well as venture capital funding have seen an upward trend. According to CBInsights, the number of financing transactions to AI start-ups increased 10x over the last six years, from 67 in 2011 to 658 in 2016. Accenture states that the total number of AI start-ups has increased 20-fold since 2011. The top verticals include FinTech, Healthcare, Transportation and Retail/e-Commerce.

The start of 2018 has witnessed launch of many AI focused funds.

- Baidu Venture Capital (BV), the early-stage investment unit of Baidu Inc focused on artificial intelligence investments, has raised ~$317 million
- Coursera co-founder raised $175 million AI fund. The AI Fund is backed by Japan's SoftBank Group and Silicon Valley venture capital firms New Enterprise Associates (NEA), Sequoia Capital and Greylock Partners
- Workday Inc announced launch of a $250 million fund, which will focus on emerging technologies, including AI and machine learning
- Chinese venture capital firm Sinovation Ventures has established a $391 million artificial intelligence fund in Guangzhou
- Samsung has announced Samsung NEXT Q Fund, an early stage venture fund focused on AI investments. Q fund will provide Seed and Series A financing to start-ups solving AI problems
- Sequoia Capital China is teaming up with China state-owned VC fund and e-commerce firm JD.com to raise a new $6 billion fund focused on late-stage technology companies including AI firms

The second quarter of 2018 saw quite a few large funding rounds. In April 2018, SenseTime an AI based facial recognition technology developer raised ~$600 million in funding. This was followed by another round of $620 million funding in May 2018. Overall for 2Q18, US-based AI companies received a funding of $2.3 billion across 124 deals. There were eight mega-rounds ($100+ million) of funding during the period. Some of these mega deals were – 1) Dataminr raising $393 million in Series E funding, 2) CrowdStrike raising $200 million in Series E funding, 3) Tanium raising $175 million, 4) Cylance raising $120 million and 5) Autolab AI raising $113 million.

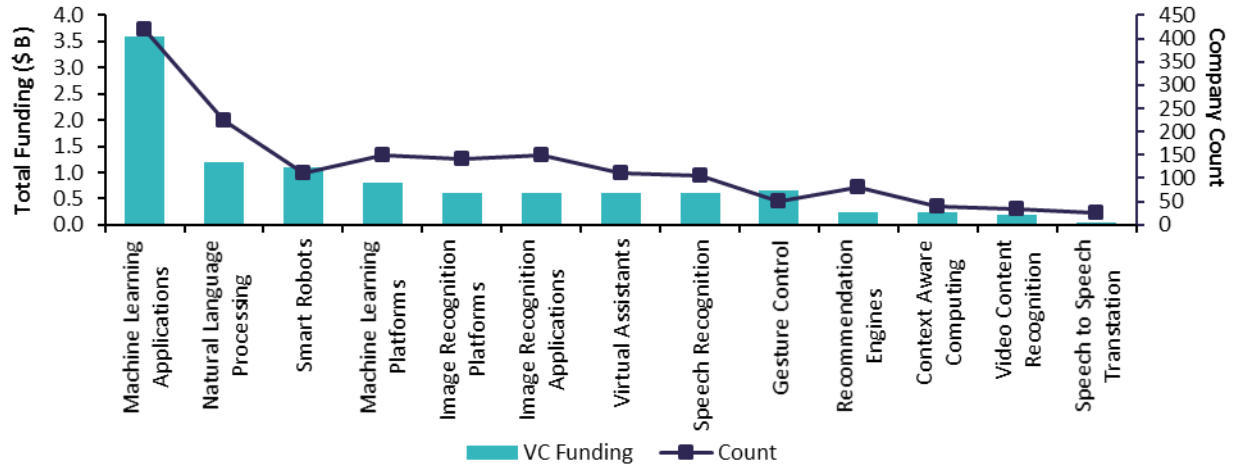
AI Annual Funding



Source: CB Insights, Acquisdata

Machine Learning (ML) is predicted to generate the most revenue and is attracting the most venture capital investment in all areas of AI. Venture Scanner found that ML raised $3.5B to date (from 400+ companies), far ahead of the next category, Natural Language Processing, which has seen just over $1Bn raised to date (from 200+ companies). Venture Scanner believes that Machine Learning Applications and Machine Learning Platforms are two relatively early stage markets that stand to have some of the greatest market disruptions.

Venture Investing in Artificial Intelligence



Source: Venture Scanner

Growth drivers influencing the AI demand

Growth in Data Driving AI Demand

Growth in the volume of data being generated from different end-use industries is expected to provide traction to the technology adoption. The increasing amount of digital data (in the form of speech, videos, and images, from different social media sources such as IoT and consumer analytics) is driving the need for data mining and analytics. While humans using their phones are expected to generate up to 1.5GB of data each day by 2020, a single autonomous vehicle will generate approximately 4,000GB of data in the same period of time.

Making sense of such large volumes of data is labour intensive and time consuming and therefore corporations are turning to AI solutions which can scan through large and complex data sets automatically. AI can be used to extract meaning, determine better outcomes and enable faster decisions from massive big data sources.

Autonomous Vehicle Market Driving the Growth of the Artificial Intelligence

The growing autonomous vehicle market and further investment into research and development are acting as major demand originating segments for artificial intelligence. HIS Automotive estimates there may be 21 million self-driving cars on the road by 2035.

These vehicles rely on enhanced image and voice recognition capabilities, areas where AI can play a significant role. Advanced AI algorithms, machine learning and deep learning systems are key to ensuring that self-driving cars can quickly and automatically adapt to changing scenarios. High demand for self-driven cars and unmanned aerial vehicles are anticipated to fuel growth in artificial intelligence market across the globe.

Many companies such as Tesla Motors, Google, Apple, etc., are expected to launch the driverless cars on a mass scale. September 2017, the ride hailing app company, Lyft, announced partnership with AI based driverless car technology start-up drive.ai to offer self-driving cars to passengers in San Francisco. In September 2018, Uber announced investment of $150 million in Toronto to expand its self-driving engineering efforts.

Growth in Healthcare AI Applications

Healthcare AI applications have attracted the attention of large technology giants as well. For instance, IBM, Alibaba, Tencent, Google have all jumped in to leverage machine learning and deep learning algorithms to improve accuracy of diagnosis, medical imaging and reduce drug discovery times.

Healthcare dominates the deal activity for AI. Healthcare AI start-ups have seen nearly 500 deals in the last five years. A total of more than $1 billion was invested in the healthcare sector, with a total of approximately 150 or more deals in 2017. Even in the first quarter of 2018, close to $500 million was invested in more than 60 deals.

Tencent's AIMIS, an AI medical imaging software is already being used in more than 100 hospitals in China. Alibaba's ET Medical Brain, an AI healthcare system can aid doctors in medical imaging, drug development and health management. Facebook has partnered with NYU's medical school to make MRI exams ten times faster using artificial intelligence. Facebook's AI aims to use NYU's 10,000 datasets to improve processing time for MRI results.

Growth in Connected Devices

The number of IoT devices is projected to grow to ~50 billion by 2020. This presents humungous opportunity for deploying AI solutions. IoT devices which interact with each other are likely to generate massive amount of data. AI applications can use the data to provide real-time actionable information as well can conduct predictive analysis. The data generated can be used by AI to predict traffic snarls, crimes, give doctors real-time insight to patients' health and optimize productivity across industries.

Chinese smartphone maker Xiaomi announced plans to integrate its IoT devices with South Korean based Naver's AI platform. According to Deloitte, AI-based IoT start-ups attracted significant funding and deal making last year. The venture-capital funding of AI-focused IoT start-ups stood at $705 million in the first eight months of 2017. There were 21 acquisitions of AI-focused IoT start-ups during the first eight months of last year, compared with 24 in all of 2016 and 11 in 2015.

Key AI vendors

As is characteristic of any nascent market, the AI vendor landscape is in a state of flux, spanning across large technology firms to fledgling start-ups. Although vendors such as Google, Facebook, Baidu, Apple, Microsoft, and Amazon may have taken early advantage of their large data sets and established platforms, the large enterprise software vendors (like SAP, IBM, Oracle, salesforce.com, Sage, etc.) are gradually embedding AI into multiple aspects of their offerings. In addition, we expect certain revolutionary aspects of AI to bring to market new and/or specialist vendors.

Key vendor categories (and sample vendors) include:

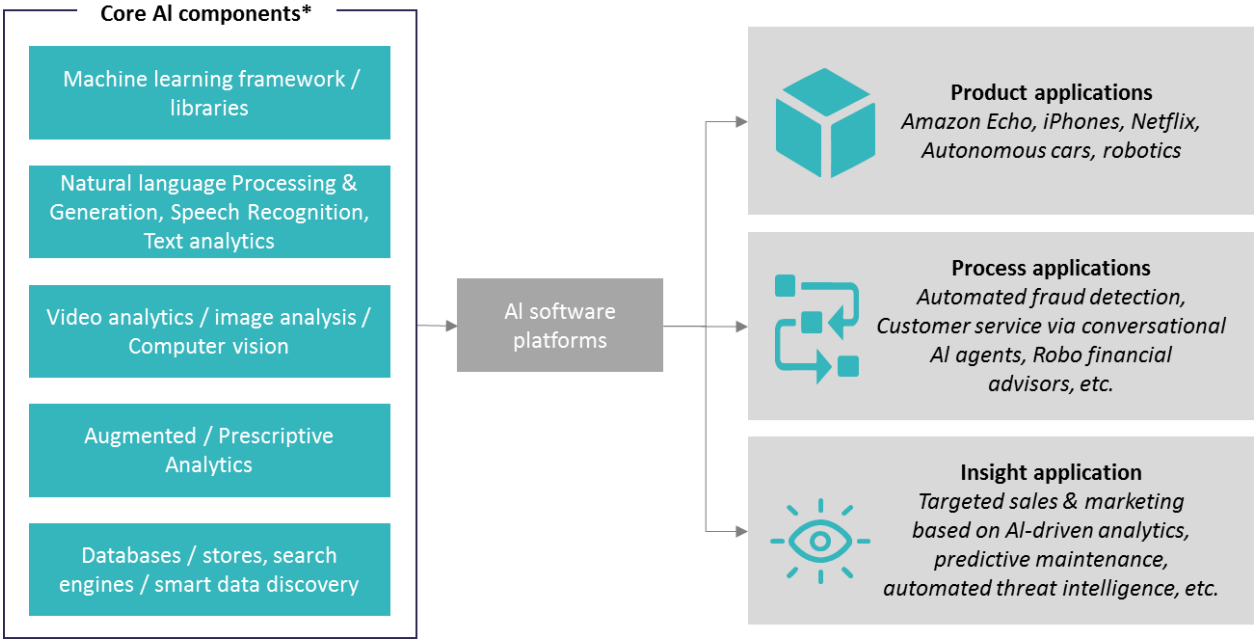
AI Platform-as-a-Service	amazon, Google, Microsoft, Baidu 百度, Alibaba.com, IBM
Enterprise software vendors	SAP, ORACLE, Microsoft, salesforce, Adobe
Data analytics vendors	ORACLE, tableau, Qlik, Informatica, SAS, SAP, MathWorks, Palantir Technologies, IBM
Specialist AI / Vertical-focused / Niche players	clarifai, kore.ai, aspect, IPSOFT, 科大讯飞 iFLYTEK, 商汤 sensetime
Industrial IoT + AI	SIEMENS, ptc, GE, SAP, amazon, software AG
IT Services	accenture, IBM, Capgemini, Atos, Cognizant

The AI application ecosystem

While the gamut of available AI applications is enormous, it is useful to think of the entire application ecosystem as one that is built on core AI components such as machine learning, computer vision, natural language processing / generation, augmented analytics, etc. AI software platforms are built on one or more of these components depending on the targeted application.

Broadly speaking, AI applications can be categorized into three key segments – Product, Process, and Insight.

Simplified AI application ecosystem



Source: J.P. Morgan. *Not an exhaustive list.

Product applications: Incorporating AI in a product or a service to provide end customer benefits. Examples include: Amazon Echo (a wireless speaker equipped with Alexa, a virtual personal assistant), Netflix's recommendation engine, Google's search engine, iPhones (equipped with Siri), autonomous cars (and smart robots in general), etc. From a solution-provider's perspective, offering AI embedded in a product platform or via a cloud-based service not only enhances the value of the underlying offering but also creates new business opportunities that can generate high-margin & recurring revenue streams (Software-driven revenue streams are much more recurring in nature (pay-as-you-use model or subscription-based) and carry higher margins vs. hardware-based revenue streams).

Further, traditional hardware-focused companies are now facing stiff margin pressure driven by the rise of low-cost companies based in Emerging markets such as China, the high cost of innovation (such as investments in truly flexible display), and uncertainty around end-demand. Against this backdrop, conventional hardware companies are racing ahead with investments in AI-related applications (either driven by in-house development or acquisitions of tech start-ups –Samsung's Viv acquisition is one such recent example).

Process applications: Incorporating AI into a business's process flow to improve productivity or automate tasks. Examples include deploying AI-enabled systems for fraud detection, processing credit card applications, customer service (via chatbots / virtual conversational agents), surveillance, warehouse management, automated investment advisors, etc.

Insight applications: Aiding operational and strategic decision making based on insights generated by AI-enabled systems. Examples include customizing sales & marketing efforts based on insights gleaned from prior customer buying behavior, automated threat intelligence, predictive maintenance (to reduce operational downtime) enabled by AI-driven systems, etc. This remains one of the top AI application initiatives undertaken by enterprises.

Challenges

Lack of Skilled Workforce

The implementation of AI systems involves embedding complex algorithms which requires highly skilled workforce. There is clearly shortage of talent when it comes to AI skills. The current impact of this factor is prominent in the market. However, it is expected to decrease over time due to rise in training and development of skillsets.

Job Loss

The prospect that many jobs will be automated out of existence due to AI systems is one of the biggest challenge. AI is likely to eliminate or vastly reduce jobs across industries, thereby leading to massive transformation of the labor force. Many basic jobs such as personal assistance, cab drivers, cashiers, call center employees and accounting could be at risk.

According to CB Insights, ~10 million jobs in the US in service and warehouse industry could be at risk due to AI in the next five to ten years. This could lead to huge social unrest in societies. As a result, governments and corporations are beginning to consider initiatives such as Universal Basic Income (UBI), to all citizens.

2. AI IN ENTERPRISE SOFTWARE

Introduction

In time, AI is likely to exert a profound impact across the enterprise software landscape. AI is expected to drive the next leg of automation in Enterprise software, spanning across Intelligent Bots acting as the first point contact for Customer Service use cases, to cataloguing huge volumes of data (text/images) to Robotic Process Automation (Robotic Process Automation is the use of software robots, created using Machine Learning and AI, to imitate humans to handle high volume, repeatable tasks). However, the true impact of AI in software stretches beyond automation, into revenue generating/cost saving functions by predicting actions based on historical patterns, thus enabling customers to do things like increasing customer retention (by predicting churn) or preventing downtime (via predictive maintenance on machines/infrastructure).

Discussion of AI is spreading like wildfire among enterprise software companies. The incorporation of AI can be seen across the entire stack, from the application layer (SAP, Salesforce, HubSpot) to the platform layer (Microsoft, Cloudera) to the Infrastructure layer (Nutanix). Among enterprise software companies, the cloud computing companies are in a unique position to take advantage of AI due to the massive volume of data that these companies store and process, which is a crucial component for delivering effective AI solutions.

Market scope

Tractica projects that that annual revenue for enterprise applications of AI will increase from $3.7 billion worldwide in 2017 to $80.7 billion in 2025. Some of the key industry sectors already utilizing AI include business services, government, automotive, retail, and advertising. However, it is clear that AI is being adopted by a much broader range of industries, many of which use similar use cases and strategies for harnessing AI to solve specific business problems.

How can AI add value to the Enterprise?

Artificial Intelligence is a buzzword in every boardroom, and enterprises want to use AI for multiple purposes; mainly:

- **Drive sales and customer engagement:** AI can improve the overall customer experience in a multi-channel world. Applications include recommendation systems, virtual assistants, chatbots and voice bots. AI-managed marketing platforms can automate digital marketing and target high-value customers (for example, when launching a new product, AI can identify characteristics of previous high-value customers and the products purchased, plus feedback or other data, to target the highest probability customers for new products). AI assistants or agents can also handle higher volumes of customer service issues (especially repetitive or routine tasks), thus improving customer satisfaction and supporting customer intimacy overall.

- **Operational efficiencies:** Within the organization, AI functions are enhancing quality control, predictive maintenance and prescriptive responses. Efficiencies can range from reducing operational costs and churn and to increasing legal/regulatory compliance and improving machine and process performance.
- **Enhancing products with embedded AI:** Incorporating AI into a product or service can provide end-customer benefits.
- **Generating new insights and enabling new business models:** Better data analysis is allowing companies to think differently and often more creatively. Employees are spending less time in routines, and more time thinking of new products, new go-to-market strategies and engaging with and understanding customers at a higher level.

Examples of AI in Enterprise Software

- SAP's Leonardo Machine Learning tools embed AI into existing enterprise applications – like Service Ticket Intelligence which processes inbound social media posts and emails, or the Customer Retention application which can anticipate customer behaviour
- Salesforce has incorporated AI (called Einstein) into the application layer to drive higher value to customers across its stack of clouds in Sales, Service, Marketing, Commerce and Platform. Based on the data that salesforce already stores in its platform, Salesforce Einstein can predict the likelihood of a deal closure, can allow its customers to build a marketing campaign to engage with the customers at the right time to have the maximum impact, or provide product recommendations to end customers using AI built into the salesforce Commerce Cloud.
- SaaS companies such as HubSpot are using AI to offer such capabilities as Predictive Lead Scoring or allowing customers to create intelligent bots, while companies like Workday or Cornerstone are using AI to improve employee retention and recommend learning content
- Microsoft is one of the very few companies that is offering an AI platform as a service as part of Microsoft Azure. Microsoft not only offers a set of Machine Learning services including an ML studio, workbench (free), data prep and model management capabilities, it also offers a set of cognitive services such as Image recognition and Speech recognition, which can be incorporated by developers into their applications

How are enterprises thinking about AI? Build, buy or outsource?

As with most IT solutions, enterprises typically have the choice of several ways to obtain AI capabilities: build, buy or outsource. The method will be dependent upon several functions: internal capabilities (the biggest challenge today being the availability/cost of data science skills), availability and pricing of packaged solutions currently available, urgency and desired time-to-market, amount of agility and customization needed, perceived uniqueness/differentiation of the solution envisioned, and other factors in ROI calculations.

Build

Organizations are likely to build their own AI solutions if they believe it will create significant differentiation for the business, few off-the-shelf alternatives exist in the marketplace, they need the higher level of agility and control, and the company has existing internal IT and data science resources to utilize for the project. Mainly larger enterprises will pursue the build option, and some smaller companies which have few other options than to build.

Buy

Over the mid-term, the bulk of organizations will buy existing packaged applications for AI. The cost and time-to-market are more favourable; however, customization (and differentiation) will be lower. Given the early stage of the market, only a handful of AI solutions are truly available off-the-shelf today, but software vendors and start-ups are working quickly to fill this gap. In addition, some organizations will have no choice but to purchase AI functionality because it may be tied to proprietary data owned by a third-party, or perhaps the computing power is being rented from a cloud provider (which requires the use of its own AI tools).

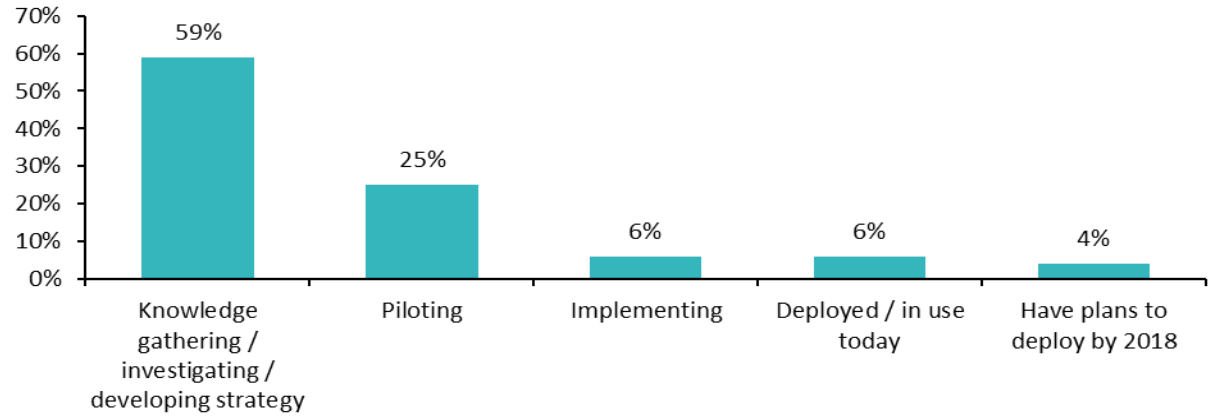
Outsource

Outsourcing is typically used by organizations which need a more bespoke solution, but do not have their own IT resources or appropriate data science skills sets in-house to build the AI solution. Accenture, Capgemini, Atos and other IT services vendors are keen to engage their customers on bespoke projects (and for that matter, to implement packaged solutions, too, where available).

Enterprise AI adoption still in its infancy; growing digitization and awareness to spur growth

Contrary to the amount of media coverage surrounding AI and its associated benefits, surveys from several research firms (such as Gartner, McKinsey, etc.) suggest that enterprise AI adoption is still in its infancy. Many organizations are in the knowledge gathering / pilot phase of AI adoption, with very few actually using AI in 'live' enterprise applications / products.

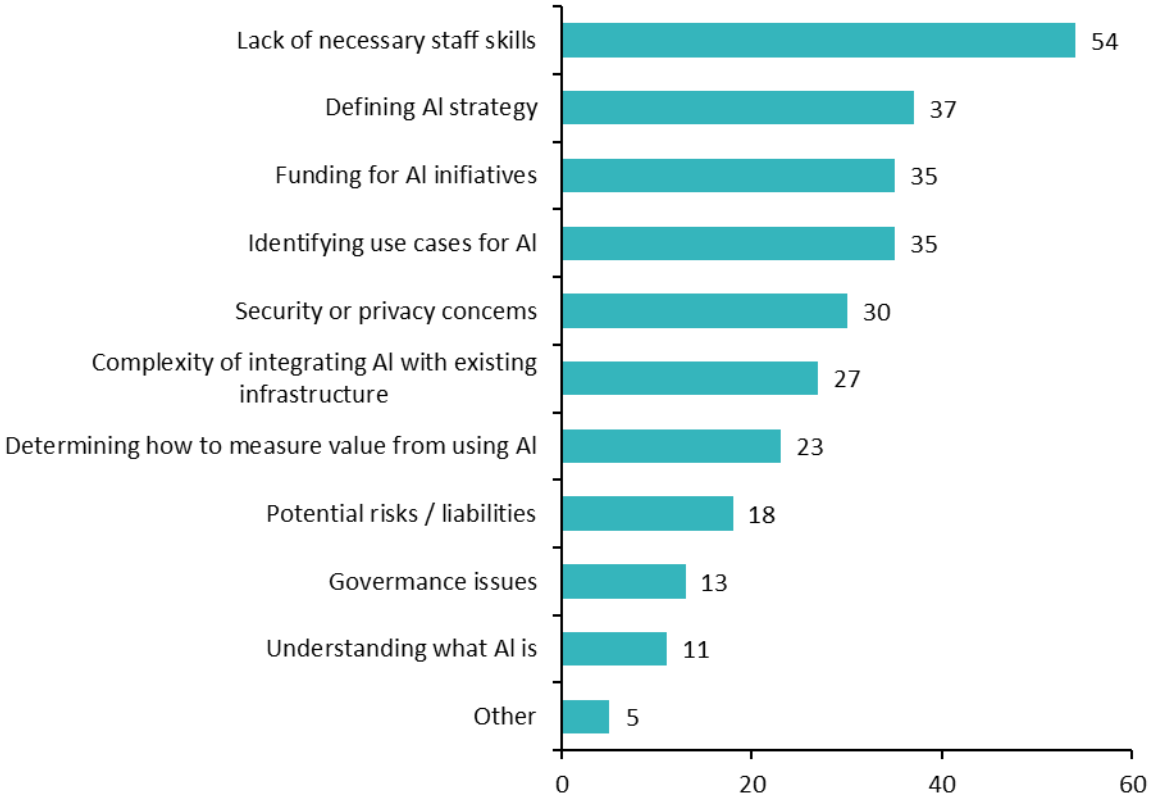
Current stage of enterprise AI adoption



Source: Gartner survey. Responses: What is the current stage of artificial intelligence solutions adoption within your organization?

Some of the key challenges impeding the adoption of AI across enterprises include a shortage of available 'AI-talent' (data scientists, machine learning experts, etc.), difficulty in porting existing infrastructure to AI-ready infrastructure, challenges in quantifying value derived from deploying AI solutions, and lack of a strategic directive from top management (C-level management, business unit heads, etc.). In addition, there are concerns surrounding the 'black-box' nature of AI algorithms (the way Machine learning algorithms interpret data to produce an outcome or a set of outcomes is often not known), which hinder its adoption (especially in highly regulated industries, such as financial services).

Key challenges for enterprise AI adoption



Source: Gartner survey results, November 2017, Survey results in response to the question: What are the top three challenges to the adoption of artificial intelligence within your organization?

The growing enterprise digitization, increasing awareness of AI solutions and their direct/indirect benefits, and the rising sophistication of AI algorithms will help drive enterprise AI adoption. Further, as the market matures, we expect consolidation across the AI software vendor landscape and this should help enterprises select vendors more effectively for AI-related initiatives, aiding adoption of AI. While adoption may be a point of discussion at this stage, AI will be ubiquitous across all the industry verticals and all digitally mature enterprises in the future.

Leading Enterprise AI Use Cases by Industry

Sample AI Use Cases Across Different Industry Verticals

Industry vertical	Industry as a % of total global IT spend*	Sample AI Use Cases
Banking & Securities	19%	Automated trading & investment discovery, trading strategies, robo-advisors, voice-based commerce, customer behaviour analysis, chatbots for customer services, identity verification, fraud detection.
Government	17%	Smart surveillance, threat detection, Smart Cities and Utilities, AI-enhanced and personalized education and training, chatbots for info distribution and citizen engagement.
Manufacturing & Natural Resources	17%	Predictive maintenance, machine learning driven insights for yield improvement, optimization.
Communications Media & Services	16%	Customer analytics, forecasting and customer demand trends, video analytics, computer vision interactivity (e.g. in video games and other immersive media).
Retail	7%	Customer analytics, forecasting, anticipating demand trends, reducing revenue churn, supply chain management, warehouse automation, chatbots for customer services, conversational commerce.
Insurance	7%	Claims management and fraud detection, analysing customer behaviour and reducing revenue churn, automated underwriting, pricing, conversational platforms for customer services, complying with regulations, trading strategies.
Utilities	5%	Enhanced supply-demand management based on AI-driven analytics, predictive maintenance, dynamic pricing based on consumption analytics (provided by smart meters, for example), chatbots for customer service.
Healthcare Providers	4%	Diagnostics, image analytics for early disease detection, drug discovery, patient monitoring (pre-emptive warning systems), personalized medicine and treatment.
Transportation	4%	Self-driving vehicles, Advanced driver assistance systems, personalized content delivery / productivity enhancement tools used by providers of transportation services
Education	2%	Customized / adaptive learning programs, skill upgrade programs based on real-time insights gleaned from job market trends.
Wholesale Trade	2%	Warehouse automation, inventory management based on insights gleaned from demand analytics, autonomous delivery.

Source: J.P. Morgan, *Gartner, Capgemini

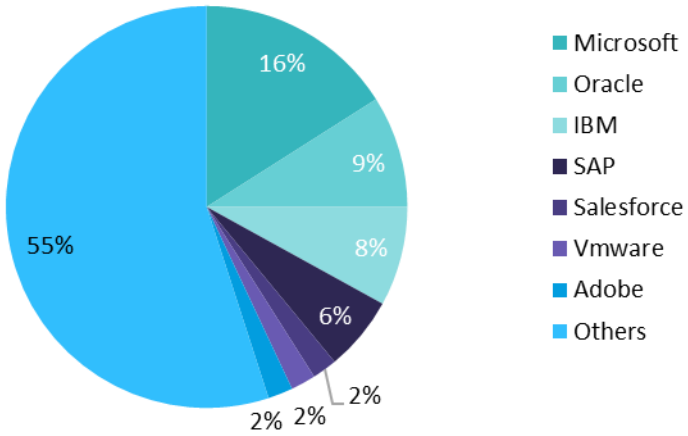
Traditional enterprise software vendors

Traditional enterprise software vendors are embedding AI capabilities into multiple aspects of their software offerings. They are well-positioned to promote AI functionality within enterprises because: they are known brands, which already understand and can contextualize the enterprise-generated data, and they can link automation back into the workflow.

- SAP (Leonardo)
- Microsoft
- IBM (Watson)
- Oracle
- Salesforce (Einstein)
- Adobe Sensei and Cloak

AI-based features already include virtual assistants, bots, advanced analytics and numerous other specialist features.

Global Enterprise Software Market Share, 2016



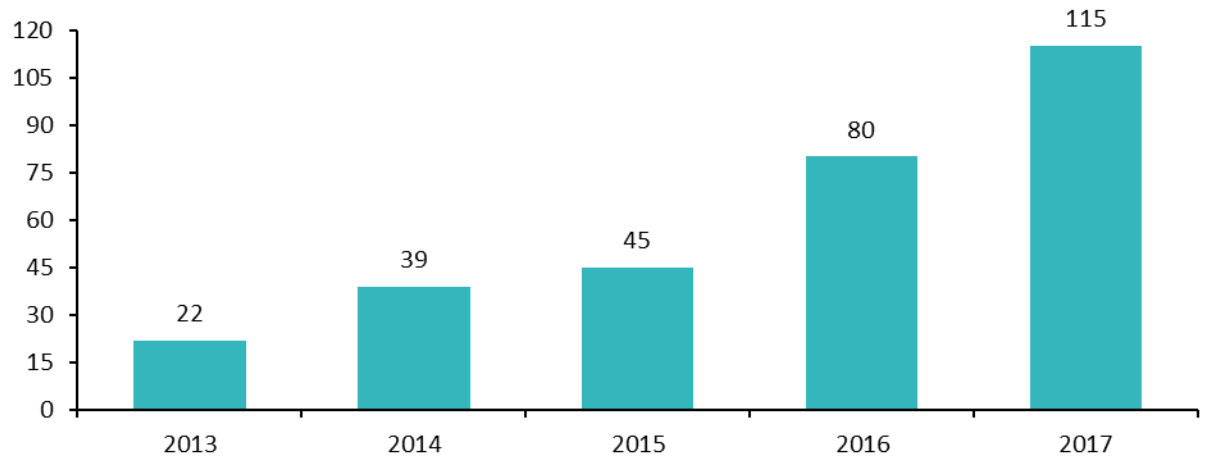
Source: Gartner, J.P. Morgan

3. KEY M&A TRANSACTIONS

Big corporations across every industry, from retail to agriculture, are trying to integrate machine learning into their products. At the same time, there is an acute shortage of AI talent.

A combination of these factors is fuelling a heated race to scoop up top AI start-ups, many of which are still in their early stages of research and funding. Around 42% of the AI companies acquired since 2013 have had VC backing.

AI start-up acquisitions up 44% in 2017



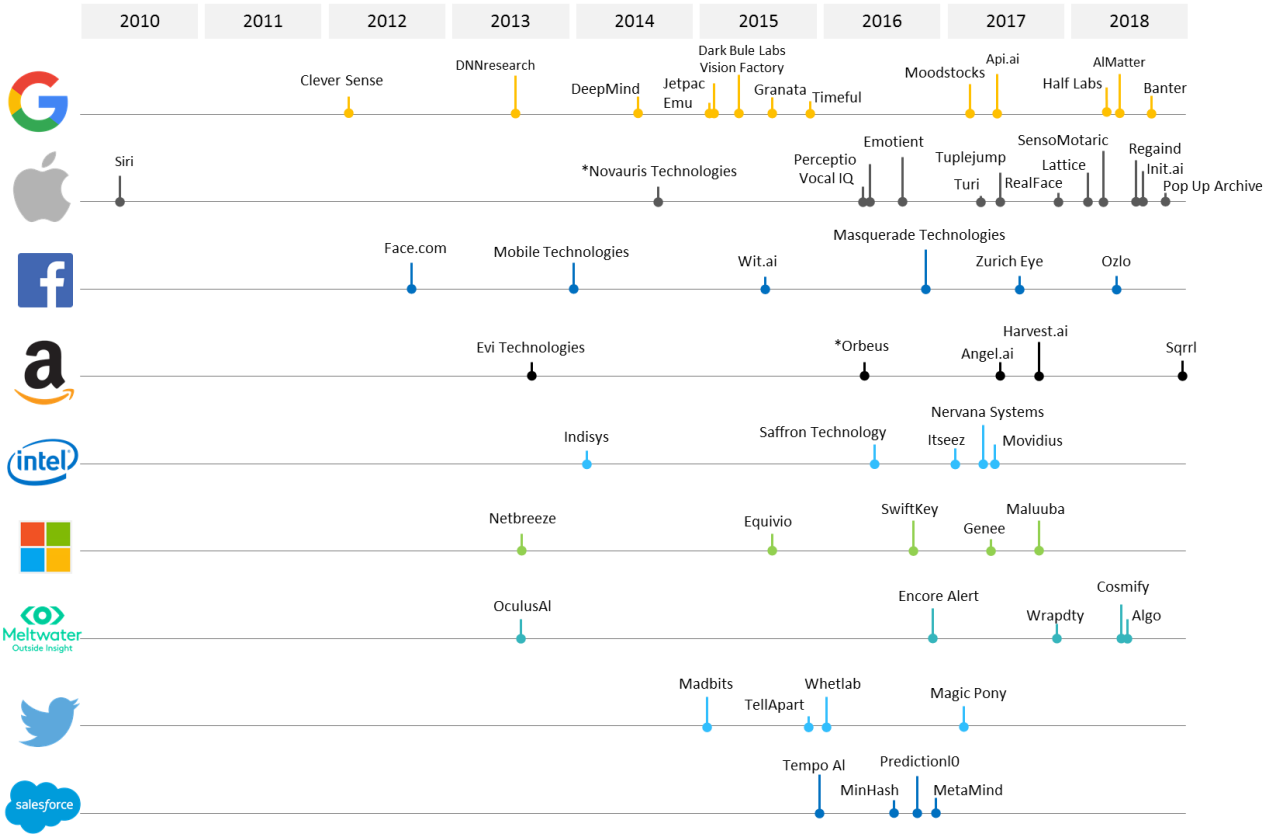
Source: cbinsights.com

In one of the largest M&A deals in artificial intelligence, Roche Holding acquired NY-based Flatiron Health for $1.9B in Feb'18. The only other disclosed $1B+ AI exit was Ford's acquisition of auto tech start-up Argo AI in 2017.

Google is the top acquirer of AI start-ups, with 14 acquisitions under its belt (excluding Kaggle, a data science community that hosts machine learning competitions). Apple is close behind with 13 acquisitions.

The timeline below shows the M&A activity of corporations that have made 4 or more acquisitions since 2010. (Note: The exact dates for Apple's Novauris and Amazon's Orbeus acquisitions are not known. They are plotted on approximate dates of acquisition.)

Race to acquire top AI start-ups heats up



Source: cbinsights.com

Key AI Acquisitions (2012-2018) YTD

Acquirer	Company	YOA	Description
Twilio	SendGrid	2018	API-centric email platform
Oracle	DataFox	2018	Cloud-based AI data engine
Samsung	Zhilabs	2018	AI-Powered Network Analytics and Customer Experience Management
ServiceNow	FriendlyData	2018	Natural language interface for querying databases
Apple	Spektral	2018	Computer vision
Linkedin	Glint Inc	2018	Employee engagement platform
Google	Onward	2018	Language processing and machine learning
Cisco	Duo Security	2018	Unified access security and multi-factor authentication
Adobe	Marketo	2018	Cloud platform for B2B marketing engagement
Oracle	Iridize	2018	Employee training and web users platform
Microsoft	Lobe	2018	Provides vision tools
Google	Tenor	2018	Online GIF search engine and database
Amazon	Tapzo	2018	Aggregate of different apps
Flipkart	Liv.AI	2018	AI-led speech recognition
Intel	Vertex.AI	2018	Deep learning compilation tools and associated technology
Accenture	Mindtribe	2018	Hardware engineering firm
Workday	Stories.bi	2018	Augmented analytics
Google	GraphicsFuzz	2018	Automated reliability testing of GPU drivers
Salesforce	Datorama	2018	Cloud-based artificial intelligence marketing platform
Facebook	Bloomsbury AI	2018	SaaS based virtual assistant
Amazon	PillPack	2018	Online pharmacy
PayPal	Simiity	2018	Multi-layered fraud detection solution
Microsoft	Bonsai AI	2018	AI platform that empowers enterprises to build and deploy intelligent systems
Microsoft	GitHUb	2018	Software development platform
PayPal	Jetlore	2018	Prediction Platform empowers retailers with AI-drlven content
Microsoft	Semantic Machines	2018	Builds conversational AI
Adobe	Magento Commerce	2018	Market-leading commerce platform
Oracle	DataScience	2018	Platform centralizes data science tools, projects and infrastructure

Acquirer	Company	YOA	Description
Google	Velostrata	2018	Cloud migration startup
ServiceNow	VendorHawk	2018	Sevelops software for tracking SaaS subscription
ServiceNow	Parlo	2018	AI startup
Google	Cask	2018	Unified integration platform for Hadoop and Apache Spark
Cisco	Accompany	2018	Relationship intelligence platform
PayPal	iZettle	2018	Mobile credit card readers and other payment platforms
Google	Lytro	2018	Imaging startup
Accenture	Certus Solutions	2018	Cloud implementation service providers
Square	Weebly	2018	Website builder
Meltwater	Sysomos	2018	Social media analytics company
Roche	Flatiron Health	2018	Healthcare technology and services
Salesforce	MuleSoft	2018	Integration platform that connects SaaS and enterprise applications in the cloud and on-premise
Amazon	Ring	2018	Video doorbell and home security camera provider
Amazon	Blink	2018	Provides wireless home security cameras
Cisco	Broadsoft	2018	Cloud-based "call control" software
Amazon	Sqrrl	2018	Cybersecurity software
Google	Redux	2018	Open-source JavaScript library for managing application
Google	Banter	2017	Conversational commerce platform
Ford	Argo AI	2017	Automated driving
Ford	Princeton Lightwave	2017	Lidar startup
Ford	SAIPS	2017	Image and video processing algorithms, as well as deep learning tech for classifying input signals.
Facebook	Ozlo	2017	AI chatbot startup with an advanced knowledge layer
Google	Kaggle	2017	Platform that hosts data science and machine learning competitions. Large data scientist community.
Google	Halli Labs	2017	Recommendation/personalization
Google	AIMatter	2017	Image processing
Microsoft	Maluuba	2017	Natural language processing
Apple	Pop Up Archive	2017	Podcast search startup
Apple	Init.ai	2017	Develop language conversational mobile applications
Apple	Regaind	2017	Computer vision
Apple	SensoMotoric	2017	Computer vision
Apple	Realface	2017	Cyber security and machine learning, specialising in facial recognition tech
Apple	Lattice	2017	Turns dark data into structured data. Human level quality, high scale. Learning via distant supervision.
Amazon	Harvest.ai	2017	Cyber security, uses machine learning to analyse user behaviour, identify threats and prevent attacks
Spotify	Niland	2017	Machine learning startup specialising in music search and recommendations
Splunk	SignalSense	2017	Cloud-based advanced data collection and breach detection solutions, leveraging machine learning
MoneyFarm	Ernest	2017	Fintech chatbot
Jones Media	Verve.ai	2017	Marketing Machine Learning
Element Data	Behavior Matrix	2017	Emotional analytics platform
Amazon	Body Labs	2017	3D Body Model
HubSpot	Motion AI	2017	Marketing bot platform
Cloudera	Fast Forward Labs	2017	AI research, specialises in consulting larger enterprises on emerging ML trends
M-files	Apperento	2017	Natural language
Qualcomm	Scyfer	2017	Builds machine learning solutions for companies in different verticals
Workday	Pattern	2017	Pattern recognition, customer relationships
Lyft	DataScore	2017	Specialises in customer acquisition and retention via a data driven approach
HubSpot	Kemvi	2017	Startup applying AI and ML to help sales teams. E.g. best time to reach out to potential customers.
Amazon	Graphiq	2017	Provides visualisations on complex data. Bought to help improve Alexa.
Meltwater	Algo	2017	Real-time data analytics platform
Meltwater	Cosmify	2017	Knowledge discovery platform
Amazon	GameSparks	2017	Backend-as-a-service for game developers
Baidu	KITT.AI	2017	Machine learning startup - Natural language processing technology
Baidu	Raven Tech	2017	Develops AI-based voice assistant that supports plugins (enabling it to work with other web services)
Sophos	Invincea	2017	Malware threat detection, network breach prevention, and pre-breach forensic intelligence. Leverages ML.
Sophos	Barricade	2017	Behavioural-based analytics engine built around machine learning techniques
Meltwater	Wrapidity	2017	Commercialise web data extraction software
GE	BITSTEW SYSTEMS	2017	Industrial internet application for machine intelligence - data integration, analysis & predictive automation
GE	Wise.io	2017	Machine learning powered solution used to identify patterns and trends in data
Facebook	Zurich Eye	2016	Computer vision
Facebook	Masquerade	2016	Image filtering, with a focus on video
Amazon	Angel.ai	2016	Acqui-hire. Builds chat bots
Apple	Emotient	2016	Emotion-detection technology to improve understanding of customer sentiment
Apple	Turi	2016	AI tech analyses facial expressions to detect emotions
Apple	tuplejump	2016	Applies machine learning concepts and analytics to large complex data
eBay	Expertmaker	2016	Applies machine learning to extract insights from large amounts of noisy data
eBay	SalesPredict	2016	Predictive analytics used to predict customer buying behaviour and customer conversion
Google	Moodstocks	2016	Visual Search Startup
Google	Api.ai	2016	Provides tools to developers to help them build conversational bots
Intel	Itseez	2016	Computer vision and pattern recognition
Intel	Nervana	2016	Deep learning startup developing software and hardware

Acquirer	Company	YOA	Description
Intel	Movidius	2016	Computer vision chipmaker, for use in drones and virtual reality products, among others.
Microsoft	Genee	2016	AI powered scheduling service. Uses NLP and optimised decision-making algorithms.
NICE	Nexidia	2016	Advanced customer analytics
Oracle	Crosswise	2016	Provider of machine learning based cross-device data, supports marketers.
Oracle	Palerra	2016	Data security, user behaviour analytics, with automated incident responses
Salesforce	PredictionIO	2016	Open-source machine learning server
Salesforce	MetaMind	2016	AI-based personalization and customer support solutions for companies
Meltwater	Encore Alert	2016	SaaS platform
Samsung	Viv	2016	AI Virtual Assistant
Twitter	Magic Pony	2016	Machine learning and visual processing technology
Microsoft	SwiftKey	2016	Creates keyboard apps for Android and iOS devices
Amazon	Orbeus	2015	Image recognition, based on neural networks
Salesforce	MinHash	2015	AILA virtual marketing assistant
AOL	Sociocast	2015	Predictive analytics
Apple	Perceptio	2015	Developing advanced AI for smartphones
Apple	Vocal IQ	2015	Speech-processing for improved human-machine interaction
Facebook	Wit.ai	2015	Speech recognition and voice interfaces
Google	Timeful	2015	Smart scheduling app
Google	Granata Decision Systems	2015	Prescriptive analytics initially focused on marketing resource management
IBM	Explorys	2015	Predictive healthcare data analytics
IBM	AlchemyAPI	2015	Natural language capabilities including keyword extraction and categorization
Intel	Saffron	2015	Cognitive computing platform
Microsoft	Equivio	2015	Machine learning powered compliance solutions
Salesforce	Tempo AI	2015	Smart calendar
Twitter	TellApart	2015	Predictive advertising for e-commerce and retail
Twitter	Whetlab	2015	The company claims to have developed a technology to make machine learning better and faster
IBM	COGNEA	2015	Cognitive computing and conversational artificial intelligence platform
Apple	Faceshift	2015	Technology used in animation, capturing facial expressions in real-time
AOL	Gravity	2014	Personalized advertisements
AOL	Convertro	2014	Marketing intelligence
Google	DeepMind	2014	Develops self-learning algorithms
Google	Emu	2014	AI-based instant messaging
Google	Jetpac	2014	Aggregates social media pictures and analyzes their locations to provide a travel guide
Google DM	Dark Blue Labs	2014	Deep learning-based technology for understanding natural language
Google DM	Vision Factory	2014	Object and text-recognition using deep learning
IBM	Cogenea	2014	AI-based virtual assistant
Nokia	Desti	2014	Travel planning application using AI and NLP to build knowledge on destinations
Nokia	Medio Systems	2014	Location based predictive analytics
Twitter	Madbits	2014	Deep-learning-based visual intelligence platform to identify contents of images
Apple	Novauris	2014	Automatic speech recognition
Facebook	JIBBIGO	2014	Speech recognition and machine translation startup
Google	DNNResearch	2013	Use of deep learning and neural networks for image search
Microsoft	Netbreeze	2013	Social-monitoring analytics
NICE	Causata	2013	Provider of real-time Big Data analytics
Yahoo	IQ Engines	2013	Image-recognition software
Yahoo	LookFlow	2013	API for image recognition and categorization
Yahoo	SkyPhrase	2013	Natural-language processing
Intel	Indisys	2013	Natural-language processing
Facebook	Face.com	2012	Facial recognition, with specialty in mobile

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