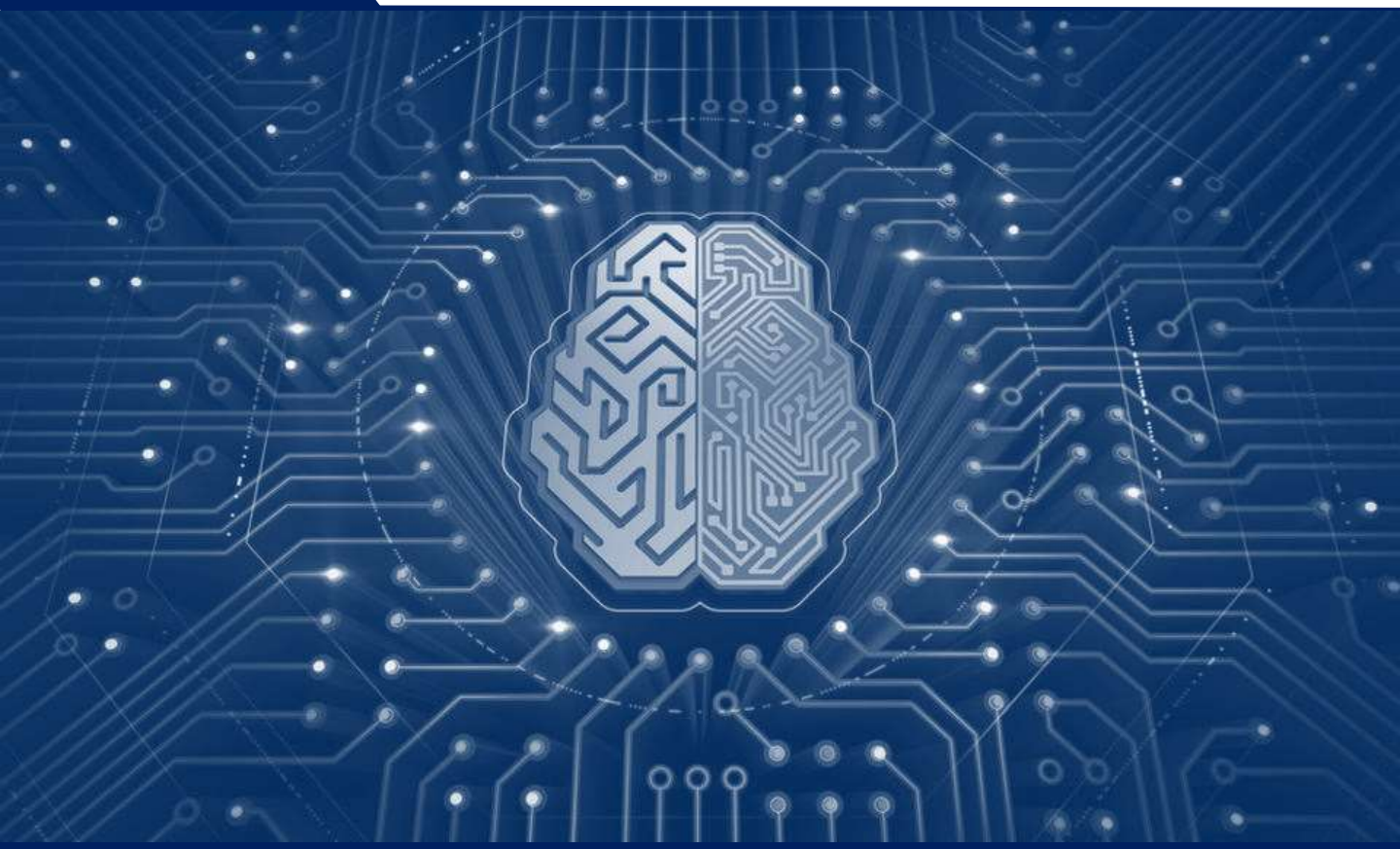

A Guide to US Artificial Intelligence

The Rise of Artificial Intelligence

The US artificial intelligence industry is quickly becoming one of the fastest growing segments within the software industry. Many industries including healthcare, cybersecurity, fashion, and logistics are implementing AI to achieve a competitive advantage by improving the efficiency of their operations and outcomes for consumers. Despite a slowing economy due to several macro-economic headwinds, AI continues to attract capital from major players and remains an important part of the interconnected world we live in today.

Kenneth Wang | Kieran Bovingdon | Anna Ni | Hersh Bale | Aryan Arora

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THE RISE OF ARTIFICIAL INTELLIGENCE

Introduction

Industry Overview

Artificial Intelligence is the simulation of human intelligence processes by machines. The industry is expected to be $1.6T in size by 2030 with a CAGR of 38%.

Artificial Intelligence constitutes three different types of processes:

Learning Processes draw inferences from data, which form rules that direct computers. Machine learning is the most common example, which has many applications including facial recognition, speech recognition, etc.

Reasoning Processes focus on employing the right algorithm to achieve an outcome (ex. Siri)

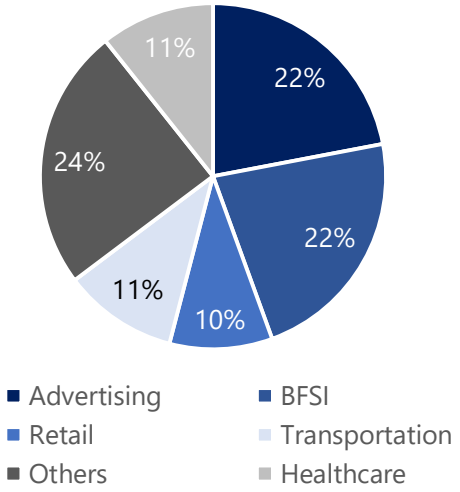
Self-Correction Processes work to fine-tune processes and adjust to new problems (ex. Grammarly)

Healthcare, Logistics, Banking and Financial Services (BFSI), and Autonomous Vehicles comprise the major industries worldwide.

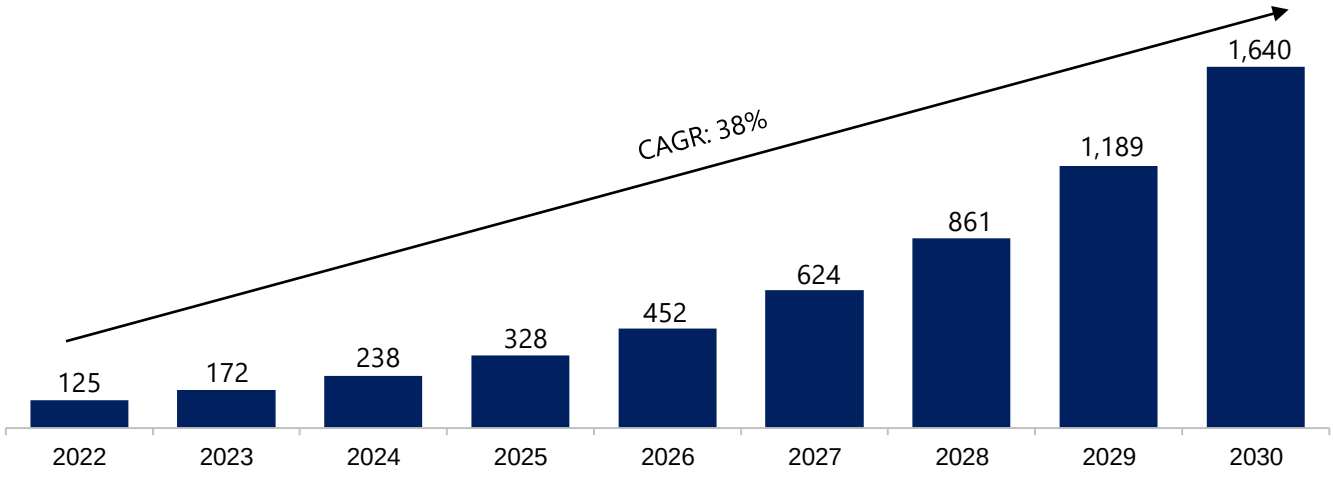
Importance of Data for AI

AI requires input data in order to function. For example, with supervised machine learning, the AI requires a training set of data. With this training set, the AI develops rules that it then applies to new data. This means that accessing and tailoring data is one of the most important inputs for AI. In fact, several companies, such as Databricks, have entered the market to tailor data to organizational needs.

Global AI Market Share by End-User



Projected Market Trajectory ($B)



Sources: Grandview Research, Tech Target

Healthcare

Summary

AI in the US healthcare market is expected to grow at a rate of 37.1% CAGR from 2022 to 2030, expanding from $5.6B to $69.5B.

AI in healthcare can be separated into two separate segments: in-hospital treatment and outside-of-hospital treatment including AI technologies that can improve processes like x-ray examination. For example, through machine learning techniques, AI can identify issues in an x-ray, and reduce strain on radiologists. Given the broad reach outside of hospital treatment, this report will focus on in-hospital treatment.

Growing Role of AI in Telehealth

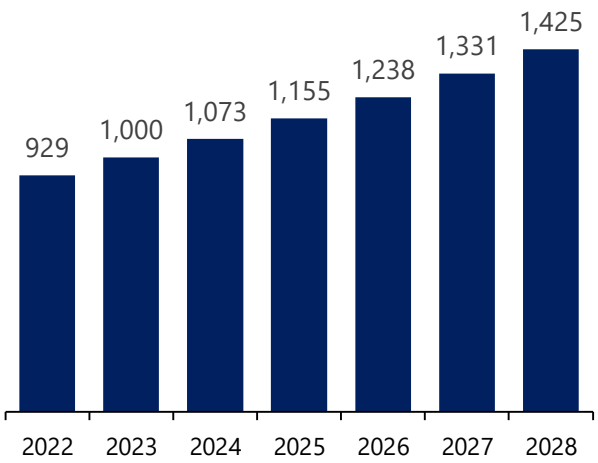
Telehealth is becoming an increasingly popular option for consumers to access healthcare following the COVID-19 pandemic, with AI playing a critical role in this transformation. For example, instead of a physician relying on 2 or 3 pieces of medical information (medical history, exam, lab test), AI can scour big datasets across thousands of patients with similar illness profiles to produce algorithmic patterns that can suggest potential next steps to the physician.

Healthcare Worker Availability

Beyond the technology itself, government spending and healthcare worker availability are key to understanding this market. With the pandemic, 18% of healthcare workers left the field creating a shortage. Such a shortage has incentivized adopting AI to take the strain off remaining workers.

More than 2/3 of current healthcare workers indicate that they have considered leaving the field. The shortage is likely to continue.

MedicaidMedicare Expenditure ($B)



Medicare & Medicaid

Medicaid is health insurance that covers low-income Americans who cannot otherwise afford their health insurance. Medicaid covers approximately 78M people in total. Medicare covers 60M people. Combined, Medicare and Medicaid is projected to account for $929B in spending in 2022, reaching $1.4T in 2028. Critically, private health insurers tend to take their cues from Medicare and Medicaid. If these two cover AI technologies, then hospitals, the main purchasers of these technologies "in treatment", will be more likely to purchase them as the technologies would no longer be costing those hospitals. Recently, Medicare and Medicaid agreed to cover two technologies. The decision sets precedent. One of the tools simply does what a human would but faster. It identifies stroke-producing blood clots.

There is reason to believe that Medicare and Medicaid will continue to support AI innovations. AI is projected to cut US healthcare costs by USD$150B by 2026. In the most expensive healthcare system in the world, with an aging population, such savings are increasingly important.

Sources: Advisory Board, Forbes, Wired, CMS.gov, Globe Newswire, Healthline

Logistics

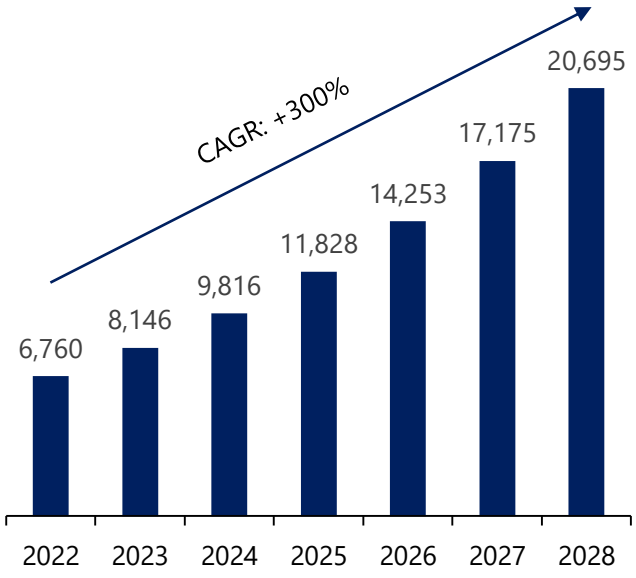
AI Logistics Market Overview

The global AI Logistics market is expected to grow at a CAGR of 20.5% through 2027. AI serves three functions in the Logistics market:

Optimal routes: As in other industries, AI allows companies to generate insights from data. In the logistics industry, this entails the optimal route for shipping.

Demand planning: AI enables companies to forecast future demand based on past data. Retail and e-commerce tend to employ this strategy. AI looks both at internal data, pricing and quantity, as well as external data, i.e., weather and economic data etc.

Automated Warehousing: Warehouses, like the Ocado warehouse, can be automated by digitizing processes for cost savings.



Key Drivers

Data Volume	An increase in the amount of data available to companies driven by an increase in the number of devices worldwide provides more incentive to purchase AI solutions to draw insights from that data as well as tailor that data.
Labour Savings	Though wages stagnated in 2022, long-term projections indicate wage growth. Further, increased global competition spurs the need to reduce costs. AI offers this option by automating processes while also eliminating risks associated with labor such as unionization
Supply Chain Disruptions	Increased supply chain disruptions caused by the COVID-19 pandemic and the war in Ukraine might prompt businesses to select AI solutions which can account for a confluence of variables. Supply chain disruptions correlate with, on average, 107 percent drop in operating income.

Sources: White House, Sky News Australia, Globe Newswire, Digital Journal, Supply Chain Brain

Cybersecurity

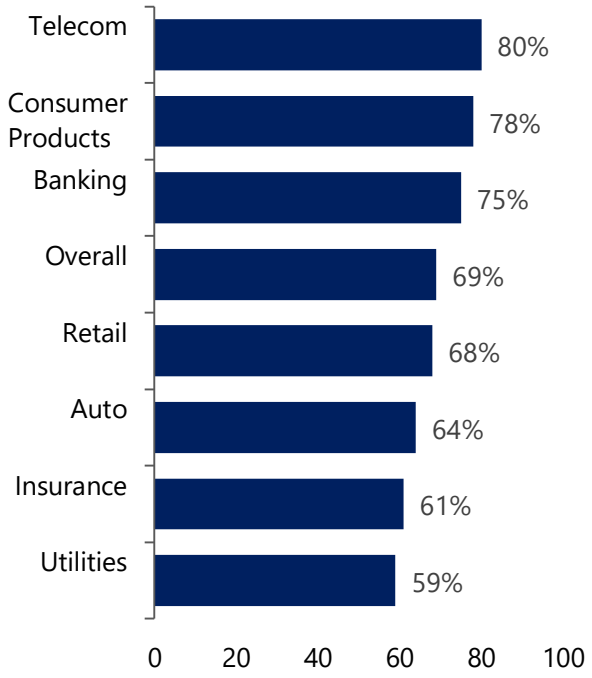
Cybersecurity

Artificial intelligence has allowed for significant advancements in the field of cybersecurity. Large corporations can have thousands of devices and massive amounts of data, all coupled with a shortfall of security staff. Considering that cybersecurity threats are constantly evolving, a simple security software would be unable to handle protection of an attack surface so large.

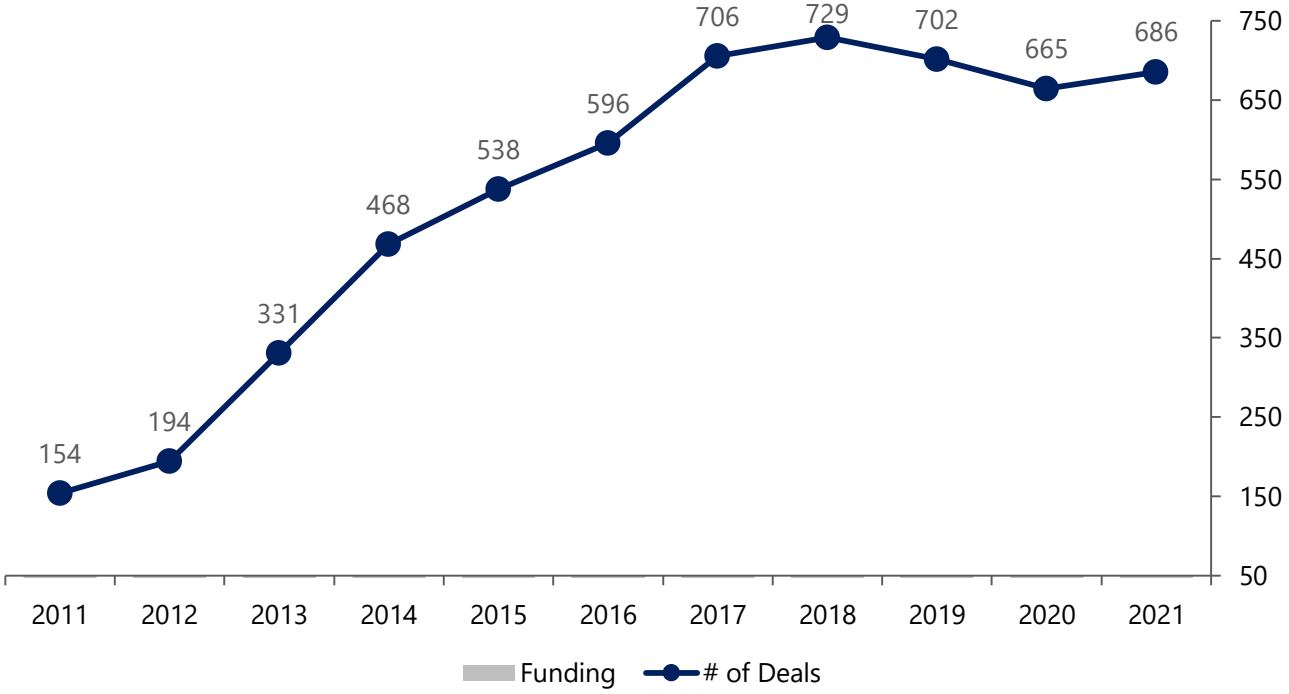
Through predictive analytics and machine learning, security software use large scale data to determine the most vulnerable parts of a network and output specific initiatives that can improve the integrity of the system.

The AI cybersecurity market is currently $15B in size and is expected to grow at a 31.6% CAGR to $134B by 2030. This massive growth is largely going to be driven by the increasing number of cyberattacks and, subsequently, the increasing need for such software solutions.

Utilization of Cybersecurity AI by Industry



Increasing Venture Funding of Cybersecurity Start-ups ($B)



Sources: Acumen Research, Forbes, Statista

AI in Customer Support & Experience

Customer Support & Services

Artificial intelligence has numerous applications in the customer support and services space, primarily through assisting support agents by automatically pulling up pertinent information based on customer inquiries. Also, chatbots can resolve issues before a human agent is required, saving a significant amount of time and expenses for corporations. Machine learning and natural language processing algorithms work to improve this process.

AI has significantly reduced costs related to customer support. In fact, every second a chatbot shaves off average call times results in as much as $1M in savings of annual customer support costs. Given that 15% of customer support inquiries are entirely driven by AI with an additional number of interactions supported by AI, corporations can see up to 30% cost savings in support costs with the implementation of AI.

AI has the benefit of allowing for 24/7 service to customers. With 71% of consumers expecting to be able to communicate with businesses anytime, AI is becoming a vital tool within the customer support space.

Consumer Experience

Consumer experience is the consumer's feelings and responses at all stages of and after the consumption process. Artificial intelligence has made significant contributions to the consumer experience space, especially through predictive analytics.

Through predictive analytics, corporations can find patterns in customer purchases which can be used to make more personalised recommendations in a marketing context. For instance, customers that enjoy online shopping will only receive recommendations for digital sales while customers that enjoy in-store shopping will receive communication regarding sales in nearby stores.

As the applications of AI grow, analysts argue that AI will drive 95% of consumer experience. There is significant incentive for corporations to implement AI technologies as corporations that excel in this area have been shown to grow 6% faster than their market.

Both, the customer support & services and consumer experience segments make up a $7.6B market. These segments are expected to register a 23.6% CAGR to 2030.

Importance of Customer Service & Experience

$700B Invested

$700 billion will be invested in consumer experience tech by the end of 2022. This money is largely being spent on artificial intelligence and big data analytics.

$1.6 Trillion Lost

US companies lose $1.6 trillion annually due to poor service. 70% of companies are actively working towards better customer support using AI and data analytics.

67% of Customers

67% of customers have a preference of self-service over speaking with company representatives. Through AI-powered chatbots, corporations are making this a reality.

40% of Interactions

Analysts expect 40% of all customer interactions to be handled by AI and machine learning by the end of 2023. Corporations are quickly working towards this goal.

Fashion

Introduction

According to Meticulous Market Research, the use of AI in retail is expected to grow at a CAGR of 34% from 2020 to 2027 to $19.9B. The use of AI in the fashion industry is able to enhance the efficiency and accuracy of different processes and to improve customer service without compromising the creativity driving the industry.

Product Development

Applications of AI in apparel design are growing. Designers can use machine learning like generative adversarial networks to create new designs. AI can also be used to understand what kind of clothing consumers want to see. Zalando, an online European marketplace for fashion, collaborated with Google to create fashion designs, of which 3 were transformed into real clothes and showcased in Berlin in 2016.

Buying and Merchandising

AI can inform buying and merchandising teams on their purchasing decisions through providing analytics on what clothing has performed well and forecasting future trends.

These analytics tell merchandising teams what sorts of patterns, colours, fabric, etc. that consumers prefer. It also collects data from social media to identify trends before they become mainstream.

AI is able to filter through data much more quickly than a worker, not only creating new efficiencies, but also allowing workers to focus on more meaningful and idiosyncratic work.

Customer Experience

Virtual Merchandising	Through augmented and virtual reality, customers are able to try clothes on while online shopping, similar to in-person shopping
Personalized Recommendations	AI gives companies the opportunity to collect data on customers' previous purchases, which can be used to generate more accurate recommendations
Visual Searches	Consumers can look up specific products uploading a picture of that item

Fashion Startups

FINESSE	Finesse is a startup that uses AI to design clothing. It has raised >$4.5mm in seed and pre-seed funding.
ZMO.AI	ZMO.ai creates virtual models that can wear clothing products. It raised $8mm in its latest Series A financing round.
THE YES	THE YES is a shopping app that uses AI to show personalized feed of clothing items from different brands. It received $30mm in Series A funding.

Sources: Meticulous Market Research, Forbes

Autonomous Vehicles

Introduction

AI plays an important role in autonomous vehicles. Autonomous vehicles (AV) need to make decisions based on the surrounding environment, requiring AI to process and interpret data from the AV's cameras and sensors. The global AV market is estimated to grow from USD$27B in 2021 to USD$62B in 2026, representing a CAGR of 18%.

AI in Modern Vehicles

AI is increasingly being adopted in modern vehicles. For example, Tesla innovated a camera powered by computer vision which monitors drivers' eyes to ensure they're alert. Tesla's neural network technology also employs AI for object detection and depth estimation. As of 2020, 45% of cars also had in-car voice assistance, with this number expected to increase to 60% by 2024.

Technological Challenges

A lot of work remains in building the necessary confidence in the safety of AVs.

AVs are currently assessed under a black box standard, as opposed to white box models. AVs are put through simulations that attempt to find failures. There are three tiers: identifying any examples of failure, identifying the most likely failures, and estimating the probability of different failures. Most AI systems are still unable to meet the second two tiers, and are insufficient.

"Every time there is a technical breakthrough, there are challenges. We have the AI, the fast computer chips, the sensors. It's all solvable by fitting all the pieces together smoothly. 99.9% is not good enough to perfect the technology." – James Peng, CEO of Pony.ai

Different Stages of Autonomy

Level 0	Manually controlled cars (Most vehicles currently on the road)
Level 1	The vehicle only has a single automated system that assists the driver, but the driver still has to monitor most things.
Level 2	Advanced driver assistance systems. Steering and acceleration are both automated, the driver can control the car at any time.
Level 3	These vehicles include "environmental detection" features that allow them to react to the environment, but the driver must be alert.
Level 4	These vehicles can intervene if there is a failure in the system and have geofencing.
Level 5	The human is solely a passenger, and the vehicle can do anything an experienced driver can.

Consumer Hesitation

According to a 2021 survey by AAA, 14% of drivers said they trust self-driving vehicles, 54% said they would be afraid to ride in one, and 32% are unsure. CEO Greg Brannon said that "transparent, accurate, and frequent information" relating to self-driving vehicles will reduce consumer hesitation. A survey by BRAVe also indicated the importance of transparency in building trust in autonomous vehicles. Visual indications, such as showing that an autonomous vehicle intended to let a pedestrian pass and slowly decelerating from a further distance away, made people much more confident about sharing the road with autonomous vehicles.

Sources: Statista, IHS Markit, CNBC, AAA

Risks and Threats

Data Related Risks

Risks	AI is only as effective as the data and scenarios used to train it. AI can face learning limitations due to a lack of context or judgement that would be essential for interpreting data. Poor data quality can also compromise AI. As the availability of data has increased due to the growth of social media and the Internet of Things, it can become increasingly difficult for AI to ingest and process data.
Mitigants	Ways of managing these risks include having minimum data quality and data/model access requirements, methods of detecting potential quality issues, and ensuring that any personally identifiable information is hidden before it can be used in a model.

AI/ML Attacks

Risks	A lack of strong security measures to prevent people from gaining access to the data AI systems use could jeopardize the reputation and safety of AI. Potential attacks could include data privacy attacks, poisoning training data, adversarial inputs, or model extraction.
Mitigants	Real-time monitoring of the AI system, minimum data-/model-access requirements for internal and external parties, risk tiering of models depending on the severity of the impact from an attack.

Testing and Trust

Risks	The output of the AI model could be unreliable or inaccurate. Gaps in scenario testing could lead to incorrect outputs. Also, from a lack of transparency in AI outputs could lead to a lack of trust should customers be unsatisfied with the results, or if the results are biased. In more severe cases, bias in AI could lead to legal complications.
Mitigants	Independent review and validation of input variables and distribution of model results, specific people assigned with applying regulation to data management.

Compliance

Risks	The implementation of new AI may violate existing regulations and policies.
Mitigants	Monitor the existing regulations and how they apply to the uses of AI and additional policies or policy revision in order to make sure that AI systems are being used appropriately.

Sources: McKinsey, The Wharton School

Recent Transactions and Valuation

Thoma Bravo Acquires Sailpoint

Thoma Bravo announced in April 2022 that they are acquiring Sailpoint in an all-cash deal worth about $6.9B, representing a 13.26x EV/Revenue multiple based on forward 2022 revenue and a 31.6% premium to the share price. Thoma Bravo is a leading private equity firm with ~$70B in AUM, while Sailpoint is a leader in identity security for cloud enterprises. Sailpoint's value proposition is to use AI and machine learning to automate the management and control of access to prevent identity fraud. With nearly 1,300 customers including banks, pharmaceuticals, and federal agencies, this transaction highlights the long-term importance of cybersecurity given the company is not yet profitable and the acquirer is paying a premium as a financial sponsor.

Walmart Acquires Memomi

Walmart and Memomi announced in June 2022 that they have entered into an agreement for Walmart to acquire Memomi. Memomi is an augmented reality optical technology company that holds a patent for their core technology known as "MemoryMirror", which enhances virtual optical try-on experiences, helping customers virtually "try on" clothing and eyewear in real-time for a seamless omnichannel experience. This transaction highlights how Walmart is taking proactive steps to deliver integrated, omnichannel experiences to improve customer engagement by allowing them to access care digitally, in their homes. By acquiring these capabilities, Walmart is maintaining its market-leading position within the industry.

Comparable Companies[1] ($B)

Company	Ticker	Price	Market Cap	EV	P/E	EV/Revenue	EV/EBITDA
Google	NASDAQ:GOOGL	115.13	$1,550.7B	$1,561.6B	21.2x	5.2x	14.5x
NVIDIA	NASDAQ: NVDA	185.26	$470.2B	461.7B	34.4x	15.6x	36.3x
Palantir	NYSE: PLTR	10.92	$22.8B	$20.6B	55.0x	12.5x	NA
SentinelOne	NYSE: S	25.20	$7.4B	$5.9B	NA	23.9x	NA
Upstart Holdings	NASDAQ: UPST	25.44	$2.5B	$2.6B	25.4x	2.5x	14.4x
C3.ai	NYSE: AI	19.47	$2.2B	$1.2B	NA	4.9x	NA
Mean					**34.0x**	**10.8x**	**21.7x**
Median					**29.9x**	**8.9x**	**14.5x**
Max					**55.0x**	**23.9x**	**36.3x**
Min					**21.2x**	**2.54x**	**14.4x**

Sources: As of August 2, 2022

Future Outlook

Short-Term Outlook

Considering a significant portion of AI investment is made with the long-term benefits in mind, the industry isn't overly sensitive to short term changes in the macro environment.

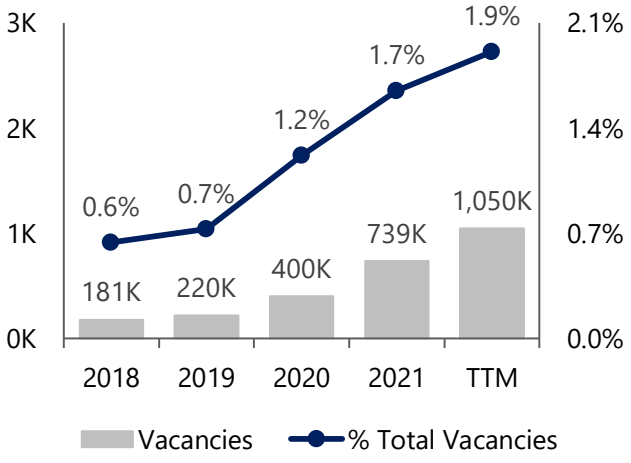
Recession

With US real GDP falling for a second consecutive quarter, investors are fearing a recession. A recent paradigm shift could dictate how the industry fares in recession. AI technologies are now being viewed as revenue drivers, not cost centers. In fact, 75% of tech leaders will increase investment in tech, including AI, in 2022 with nobody decreasing spending, despite recession fears. It seems that in recession, firms will likely maintain or increase spending on AI technologies.

Labour Shortage

In past downturns, firms have replaced employees with automation to reduce costs. Given the current labour shortage, it could make sense to invest in AI to pick up the slack instead of undertaking an expensive search for new employees. In 2030, 73 million American jobs will be displaced by AI and automation. AI replacing workers is already a reality that the labour shortage may exacerbate.

Artificial Intelligence Vacancies



Long Term Outlook

The global AI market is currently $122B in size and is expected to grow at a 38.1% CAGR to $1.6T in the 8 years to 2030.

Enterprise Adoption of AI

AI is increasingly being adopted by large corporations for various applications including customer support and experience, cybersecurity, autonomous vehicles, etc. Continuing growth of the use of AI in these industries will drive growth in the segment.

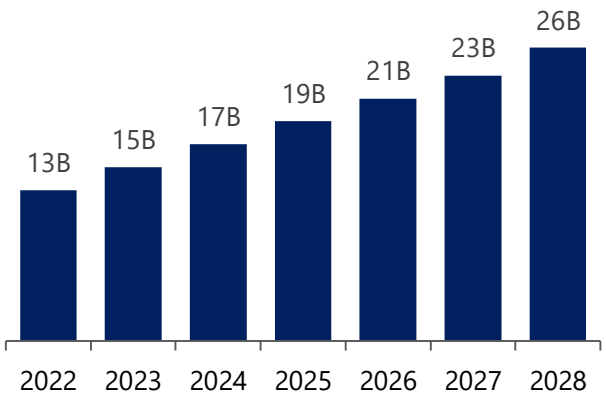
Expanding Applications of AI

As AI develops, more complex tasks can be automated, creating additional applications for this technology. The pace of innovation is speeding up as more, previously inaccessible historical datasets become available for use. Continuing innovation will allow AI to be adopted in wider applications, driving long-term growth in this space.

Growing Number of IoT Devices

The number of global smart and IoT devices will see significant growth over the next decade. Households are increasing their adoption of smart home products as they become more affordable. With the smart home market growing at a 25% CAGR, this will be a significant driver of growth for AI.

Projected Number of Global IoT Devices (B)



Sources: CNBC, Fortune Business Insights, Grand View Research, Lightcast, Statista, TechJury, US BER