

PitchBook Data, Inc.

John Gabbert Founder, CEO

Nizar Tarhuni Vice President, Institutional Research and Editorial

Paul Condra Head of Emerging Technology Research

Institutional Research Group

Analysis

The Emerging Tech Research Team

Paul Condra, Jonathan Geurkink, Rudy Yang, Rebecca Springer, Ph.D., Alex Frederick, John MacDonagh, Derek Hernandez, Brendan Burke, Robert Le, Eric Bellomo, Aaron DeGagne, CFA

pbinstitutionalresearch@pitchbook.com

Publishing

Designed by **Caroline Suttie**

Published on May 1, 2023

Contents

Introduction: The dawn of AI-transformation	1
Mobility tech	3
Supply chain tech	4
E-commerce	5
Fintech	7
Healthcare IT	9
Digital health	11
Gaming	12
Agtech	14
Foodtech	16
Climate tech	18
Enterprise SaaS	20
AI & ML	22
Infosec	24
IoT	26
Crypto/Web3	28
Insurtech	30
Appendix	32

EMERGING TECH RESEARCH

Emerging Tech Future Report: Generative AI

A review of how new AI models could impact emerging technology sectors

PitchBook is a Morningstar company providing the most comprehensive, most accurate, and hard-to-find data for professionals doing business in the private markets.

The dawn of AI transformation

The launch of ChatGPT has prompted broad recognition within the tech community that the maturation of transformer-trained large language models (LLMs) are likely to have wide-ranging impacts across many industries. While the technology is not necessarily new—it was first conceived by a Google team in 2017—the introduction of open-source foundational models has made it widely accessible for the first time, and this is prompting organizations to more seriously consider the potential opportunities and threats posed by these new capabilities.

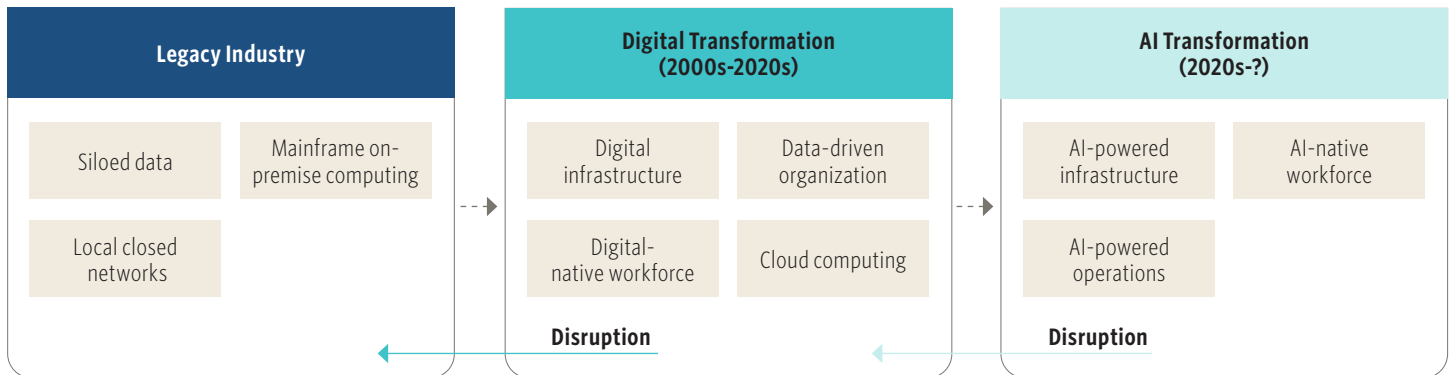
At its core, ChatGPT represents the evolution of AI into an easy-to-use consumer-focused product with immediately apparent return on investment. The technology enables even the most unskilled worker to conduct advanced AI-powered research through a simple chat-based interface. For enterprises, LLMs could have broad implications for many operational functions including customer support, analytics, research & development, and software engineering, to name just a few—potentially driving a step-function lift in productivity and efficiency in ways that could transform organizational structure. Natural language chat bots are poised to revolutionize



Paul Condra
 Head of Emerging Technology
 Research
 paul.condra@pitchbook.com

how consumers interact with products and services and will be capable of providing hyper-personalized on-demand digital experiences that currently do not exist. While nimble startups may be well positioned to adopt and integrate LLM technology into existing processes and workflows, larger enterprises are likely to move more slowly as they evaluate an emerging set of risks and implications related to privacy, intellectual property rights, security and data quality, the growing costs of running AI infrastructure, and the emerging regulatory landscape.

A new disruption cycle emerges



Source: PitchBook

With expectations high that LLMs will gradually alter the enterprise landscape, investors are focused on how to position themselves to benefit from the next generation of generative AI winners and losers. To provide some perspective, our analysts have provided some initial reactions to how these new technologies could impact the various industries and areas of technology across our coverage areas.



Jonathan Geurkink
 Senior Analyst, Mobility Tech
 and Supply Chain Tech
 jonathan.geurkink@pitchbook.com

Mobility tech

Near-term applications and use cases:

- Infotainment:** Car infotainment systems could get a big upgrade. Like a more robust Tesla Voice Command, ChatGPT provides a conversational interface to cabin controls, navigation, entertainment, communications, shopping, and other experiences.
- Automotive software:** Automakers have struggled developing and implementing software—ChatGPT code assist could boost productivity.
- Transit routing and scheduling:** Public transit scheduling and routing could get a more conversational interface for passengers and trip planners.
- Ridehailing apps:** Uber India is exploring the use of ChatGPT to enhance booking and user experience in ridehailing.

Long-term implications:

- Design and development:** Along with improvements in customer service, marketing, and sales, product design and development can benefit from unique and customized insights.
- Production line optimization:** As automakers face a massive overhaul of manufacturing to build electric vehicles, ChatGPT could assist in manufacturing optimization.
- Conversational booking:** Mobility as a service could become more conversational, offering booking and confirming an array of options, while querying and controlling a vehicle could become like a conversation with Jarvis from Iron Man.

Notable mobility tech startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Inrix	Traffic management analytics	\$595.0	\$203.0
Via	Public transportation	\$3,500.0	\$887.0
Optibus	Mass transit optimization	\$1,300.0	\$263.0

Source: PitchBook • Geography: Global
 *As of April 19, 2023



Jonathan Geurkink
 Senior Analyst, Mobility Tech
 and Supply Chain Tech
 jonathan.geurkink@pitchbook.com

Supply chain tech

Near-term applications and use cases:

- Queries and order tracking:** ChatGPT could be used to improve queries and order tracking in supply chain management, providing a more conversational tone.
- Data and API access is key:** Much of the data in supply chains is proprietary and closed, whereas ChatGPT is trained on open data. To benefit from optimization, prediction, and automation, firms would have to open data access, which is already a major issue.
- Productivity boost for freight forwarders:** Third-party logistics and freight forwarders could see a significant boost to productivity from optimized scheduling, planning, and pricing via ChatGPT.

Long-term implications:

- Incentives to open data and APIs:** The potential to optimize global supply chains with ChatGPT is enormous, as are the challenges. Any given tier in a supply chain is often reluctant to share data about its suppliers. For ChatGPT to be effective it would need access to data up and down the chain. Finding the right mix of incentives has been elusive to date.
- Third -party logistics productivity gains:** In shipping and logistics, much of the work is still manual. As systems become more digital and connected via APIs, ChatGPT has the potential to turbocharge productivity in booking, pricing, processing, and tracking.

Notable supply chain tech startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Flexport	Freight forwarding platform	\$8,000.0	\$2,500.0
Uptake	Asset tracking management	\$2,300.0	\$323.0
Nuro	Autonomous delivery	\$8,600.0	\$2,100.0

Source: PitchBook • Geography: Global
 *As of April 19, 2023



Eric Bellomo
Analyst, Emerging Technology
eric.bellomo@pitchbook.com

E-commerce

Near-term applications and use cases:

- **Individualized shopping assistants:** OpenAI's first batch of plugins for ChatGPT included merchants spanning travel, groceries, dining, and more, which enables popular prompts—such as creating a vacation itinerary or recipes for a dinner party—to become purchases on Kayak or Instacart. An integration with Shopify could yield hyper-specific queries for small and medium-size businesses or niche products, and as the collection of plugins grows, consumers will have a powerful shopping assistant at their disposal.
- **Content creation:** Generative AI will impact merchant workflows throughout the product lifecycle. Shopify and JungleScout, an Amazon seller platform, use AI to automate product descriptions and listings. Levi Strauss & Co. recently announced plans to create AI-generated clothing models, while Greylock-backed Treat generates personalized creative assets. A flurry of other startups are landing deals to generate website and email copy, videos, and more.
- **Customer support:** Customer retention is mission-critical amid rising acquisition costs. Service teams, often perceived as cost-centers, are positioned to experience a step-function increase in productivity aided by chatbots and generative AI that can deflect, contain, and automate service interactions. Intercom and Ada have announced integrations with ChatGPT and generative AI features. HubSpot applying ChatSpot to ServiceHub is also a logical extension.

Long-term implications:

- B2B adoption:** B2B e-commerce growth has accelerated but remains a step behind B2C use cases, and generative AI is much the same. Moving forward, startups can help B2B sellers improve email outreach (Coldreach) and call support (Fabius), among others. Across all industries, chatbots will support data analysis queries, supply chain risk simulation, and more.
- Deeper individualization:** For years, estimates suggested outsized financial returns would flow to merchants who can effectively leverage personalization in online shopping journeys. With generative AI, the overlap in the Venn diagram between personalization and generated content is increasingly scalable. Merchants can create user cohorts, tailor product descriptions or storefront layouts to an individual's preferences, and generate and apply discounts.
- Legal questions:** Litigation surrounding generative AI is under way. Getty Images has recently filed a lawsuit against Stability AI,¹ while other major media outlets have flagged concerns over how their articles are used to train ChatGPT. Additional questions are emerging related to slander, libel, copyrights, and consumer data protection.

Notable e-commerce startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Anyword	AI copywriting	\$66.0	\$32.4
Treat	Personalized creative assets	\$28.1	\$23.1
Copysmith	Product descriptions	N/A	\$10.0

Source: PitchBook • Geography: Global
*As of April 19, 2023

1: "Getty Images Lawsuit Says Stability AI Misused Photos to Train AI," Reuters, Blake Brittain, February 6, 2023.



Rudy Yang
Senior Analyst, Emerging
Technology
rudy.yang@pitchbook.com

Fintech

Near-term applications and use cases:

- **Complexity reduction:** Models can be used to both automate and assist with querying data, processing documents, drafting memos, and analyzing intricate scenarios. For example, a portfolio manager asks an AI, “What would the duration impact be to our portfolio if we reallocated 2% of our high yield industrial bonds?”
- **Enhanced marketing:** Tailored advertisements and messages for specific audiences could be quickly generated through trained models to boost sales. For example, a bank advertises one of its credit cards with a personalized message that accounts for a customer’s spending habits and rewards preferences.
- **Sales assistance:** As optimizing customer acquisition costs remains critical for fintechs, many companies will likely leverage AI to improve sales workflows. For example, a SaaS fintech incorporates an AI assistant to help its salespeople conduct more targeted outreach and automatically update their CRMs.
- **Relationship management:** Trained models can be leveraged to optimize chatbots as tools to assist customer service representatives, allowing customers to receive quick and helpful responses. Relationship managers can similarly utilize these models to better service clients. For example, a wealth manager uses AI to suggest various changes to an investment plan in real time as a client communicates new financial goals.

Long-term implications:

- Generative AI as a component:** Fintech companies that can successfully embed AI as an offering within their products are likely to obtain a competitive advantage—especially those that can fine-tune their models with unique and valuable data sets for specific use cases. For example, a budgeting and forecasting platform for e-commerce businesses uses AI to help make sophisticated estimates in real time.
- Optimized personalization:** A model with access to data on an industry-wide scale will be capable of recommending the most suitable products and steps to achieve financial goals. Reaching this stage will be challenging, however; consumer data will first need to be widely accessible—a known challenge within the financial industry—and models will need to be fully accurate before this occurs. For example, a financial management app creates a personalized budgeting plan based on a consumer’s spending data from multiple sources.
- Regulatory transparency:** Companies will be able to accurately monitor whether they remain in compliance with models that are well-trained on regulations. Simultaneously, regulators could quickly access the impact of their policies if data becomes openly shared in the future. For example, a policymaker uses generative AI to assess how a new restriction imposed on banks has affected consumer spending.
- Price wars:** In an open finance environment, consumers could prompt AI models to recommend the most affordable financial products for their needs without spending time researching. This could lead to greater fee transparency. For example, a consumer asks a pocket banking AI, “What is the best credit card for people similar to me?”

Notable fintech startups*

Company	Core product	Valuation	Total raised
Stripe	Payment facilitation	\$50.0B	\$8.7B
ComplyAdvantage	Anti-fraud detection	\$445.0M	\$141.4M
Kasisto	Customer service	\$120.0M	\$81.5M

Source: PitchBook • Geography: Global
 *As of April 19, 2023



Rebecca Springer, Ph.D.
Senior Analyst, Healthcare Lead
rebecca.springer@pitchbook.com

Healthcare IT

Near-term applications and use cases:

- **Clinical documentation:** Microsoft-owned Nuance’s DAX Express ambient clinical documentation platform is the frontrunner standalone solution. DAX is cost-prohibitive for smaller hospitals, but open source models like ChatGPT could enable competition on price and scale. The technology interprets natural conversations between provider and patient and enters notes using medical terminology into the electronic health record (EHR). Iterations could include the integration of patient histories, clinical images, diagnostic images, and waveforms as inputs, as well as the creation of custom visit summary/patient education text and videos.
- **Patient history summaries:** Integrating these summaries into EHR workflows could facilitate care coordination, rounding prioritization, and shift handovers. Generative AI will also be used to mine academic literature and clinical data for on-demand answers to specific clinical questions regarding drug interactions, treatment outcomes for specific demographics, and more. Azure-native EHR giant Epic has announced an OpenAI partnership and will undoubtedly lead in this category.
- **Revenue cycle automation:** Generative AI also has several immediate revenue cycle applications, including generation of prior authorization submissions and denial appeals and accelerating speed-to-implementation for existing rules-based automation products—such as ingesting payer contracts and creating coding and submission templates.

Long-term implications:

- AI trust gap:** Healthcare will be extremely cautious in implementing generative AI for care decisions. Concerns include explainability, bias replication, and whether AI-prescribed care will be appropriate for local clinical resources and the patient’s social/financial ability to receive care. The industry has developed a cautious stance after prominent missteps—such as IBM’s Watson. We believe the slow progression of use cases will include the following: synthesizing and presenting information at point of care; suggesting care and compiling supporting evidence for physician review; directing care according to specific, pre-approved care pathways; directing care outside of care pathways.
- Claims review:** In revenue cycle automation, clear generative AI use cases include medical review of prior authorization requests and complex claims. However, these processes are politically sensitive and directly affect patients’ ability to receive care; adoption will be slow and cautious.
- Legacy infrastructure:** Besides the industry’s automation trust gap, the greatest barrier to adoption will be data siloes and archaic technology infrastructure. For instance, only 37% of healthcare insurance companies build APIs at scale.²

Notable healthcare IT startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
AKASA	Revenue cycle automation	\$1,020.0	\$205.0
Infinitus	Eva Lightyear (AI voice prior authorization)	\$280.0	\$51.0
Deepscribe	AI medical scribe	\$180.0	\$37.3
RamSoft	Medical imaging patient portal	N/A	N/A (PE growth)

Source: PitchBook • Geography: Global
 *As of April 19, 2023

2: “Wired for Transformation: The State of Healthcare APIs,” Change Healthcare, n.d., accessed April 20, 2023.



Aaron DeGagne, CFA
 Analyst, Emerging Technology
 aaron.degagne@pitchbook.com

Digital health

Near-term applications and use cases:

- **Care management and symptom checkers:** Artificial intelligence is being used in care search solutions and first-line symptom checkers, and generative AI could enhance these solutions to provide more detailed medical guidance, specific provider contact information, and immediate next steps in cases of critical care incidences. While care search functions are an easy win for generative AI, liability and coverage issues remain for medical guidance applications. For now, solutions in this area would either need to fall under heavy disclaimers or be used under supervision by a licensed healthcare provider.
- **Mental and behavioral health:** Chatbots can use Generative AI to provide companionship and digital therapy at a fraction of the cost of traditional behavioral health services. AI-based solutions could improve access for most of the population that can benefit from mental health services without medication or more intensive intervention needs. Digital voice avatars—such as virtual pets—could be used instead of chatbots, and generative AI can provide scripts for human employees to read and adjust and escalate as needed; this is the model currently used by startup Care.Coach and others.

Long-term implications:

- **Personalized medicine and digital twins:** Longer-term, generative AI could integrate with the nascent concept of digital twins, which refers to the idea of having a digital representation of a person’s physical attributes. For digital health applications, a digital twin could keep a record of medical history that could be accessible by healthcare providers through the EHR. This could evolve the concept of an AI symptom checker such that a description of symptoms could generate a highly accurate diagnosis, recommended treatment plan, and/or specialist referrals.
- **Potential risks:** Considering the potential negative impacts of incorrect health information and a currently non-existent reimbursement model for AI medical guidance—apart from medical imaging and specific clinical decision support applications—it may take longer to see widespread adoption and integration of generative AI into consumer and patient-facing digital health compared to provider-facing healthcare technology markets.

Notable digital health startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Woebot Health	Behavioral health chatbot	\$230.0	\$139.0
Wysa	Behavioral health chatbot	\$77.0	\$29.0
Care.Coach	Avatar-based caregiving companion	N/A	\$2.0

Source: PitchBook • Geography: Global
 *As of April 19, 2023



Eric Bellomo
Analyst, Emerging Technology
eric.bellomo@pitchbook.com

Gaming

Near-term applications and use cases:

- **User generated content (UGC) and asset creation:** Generative AI can significantly expedite game prototyping and iteration by producing high quality art, based upon textual inputs, in a fraction of the time historically required. AI also lowers the bar to access creating UGC, which enables personalized experiences and faster content creation but risks commodifying in-game assets.
- **Dialogue and code assist:** Studios are also using AI to generate code and in-game dialogue. Roblox’s Code Assist and Ubisoft’s Ghostwriter are two recent examples. As performance improves, non-player characters (NPCs) can also generate dialogue based on in-game actions—similar to ChatGPT—although this requires performance improvements to drive widespread adoption.
- **Small studios go further:** Human resources are a significant bottleneck for indie studios that lack the capital to compete with larger firms. With AI accelerating character, environment, dialogue, and asset creation, smaller firms can operate more efficiently and do more with less.

Long-term implications:

- Expectations management:** While AI can accelerate prototyping, studios are a long way from generating entire games or levels. While material time savings are feasible, the ideal use-cases for AI are those least-visible to gamers. Separating hype from reality is also critical. The industry is exiting a Web3 hype-cycle and will need to navigate cautiously.
- Displacement:** Like other creative industries, designers and developers voice concern about a future where creative endeavors are outsourced to AI. The industry is chronically short on technical and creative talent, so while supplanting output can be helpful, the nature of the work is also changing.
- Toxicity:** The convergence of gaming and AI raises concerns about oversight, safeguards, and toxic player experiences. Large technology providers, like Microsoft and Meta, have previously struggled to contain hate speech from chatbots and in-game toxicity continues to plague the games industry.^{3,4} Large developers may have AI ethicists on staff, but many teams were downsized during recent layoffs.

Notable gaming startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Inworld AI	AI character development	\$173.0	\$83.3
Promethean AI	World creation	\$98.5	\$39.5
Wonder Dynamics	Game studio	\$37.6	\$11.6

Source: PitchBook • Geography: Global
*As of April 19, 2023

3: "Voice Chat is the Worst for Toxicity, but 2/3 of Gamers Never Report It," Games Beat, Dean Takahashi, March 8, 2020.

4: "Facebook Does Something Right for a Change," Bloomberg, Parmy Olson, August 14, 2022.



Alex Frederick
Senior Analyst, Emerging
Technology
alex.frederick@pitchbook.com

Agtech

Near-term applications and use cases:

- **Crop disease diagnosis:** Generative AI could analyze images of crops to identify early signs of diseases, enabling timely interventions to protect yields and reduce losses. However, the accuracy of disease diagnosis may be limited by the quality of input data and the AI model's ability to generalize across diverse crop types and diseases.
- **Yield prediction:** AI-driven models could analyze historical data and real-time conditions to accurately forecast crop yields, aiding farmers in making informed decisions about crop management and marketing. Nonetheless, yield predictions may be impacted by unforeseen events, such as extreme weather or pest outbreaks, which the AI models may not have been trained on.
- **Precision agriculture:** AI-driven systems could help farmers determine the ideal watering schedules and the type, amount, and timing of fertilizer and other chemical applications based on soil properties, crop requirements, and environmental factors. However, the success of these systems may depend on the availability of high-quality, localized data and the capability to adapt to changing conditions and farming practices.
- **Livestock monitoring:** AI-powered sensors could continuously monitor animal health and behavior, enabling early detection of illness, improved animal welfare, and more efficient livestock management. The effectiveness of these sensors may be influenced by factors such as hardware reliability, sensor placement, and the AI model's ability to differentiate between normal and abnormal behaviors.

Long-term implications:

- Economic benefits for farmers:** Generative AI could lead to reduced costs and increased efficiency for farmers, resulting in higher profits and improved livelihoods. Small-scale farmers in developing countries could also benefit, bridging the technological gap and promoting more equitable economic growth. However, these benefits may be contingent on factors such as access to technology, infrastructure, and affordable financing.
- Rural transformation and job creation:** Widespread adoption of generative AI tools could lead to the emergence of new job opportunities in rural areas, particularly in the fields of data analysis, tech maintenance, and AI farm management. While some traditional farming jobs may be displaced by automation, the overall impact could be positive as new, high-skilled employment opportunities arise, contributing to rural economic development and social transformation. This transition may require targeted education and training programs to equip rural workers with necessary skills.
- Environmental sustainability:** By enabling more precise and efficient use of resources such as water, fertilizers, and pesticides, generative AI could contribute to sustainable agriculture and reduce its environmental footprint. This would help combat climate change and promote biodiversity by minimizing pollution, conserving water, and preserving habitats. Realizing these benefits will depend on the widespread adoption of AI-driven sustainable practices and the ability to overcome potential unintended consequences, such as overuse of technology and neglect of traditional ecological knowledge.

Notable agtech startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Gamaya	Precision ag platform	\$30.2	\$16.0
Hortau	Irrigation management platform	N/A	\$56.2
Cropin	Farm monitoring and management solution	N/A	\$43.0

Source: PitchBook • Geography: Global
*As of April 19, 2023



Alex Frederick
Senior Analyst, Emerging
Technology
alex.frederick@pitchbook.com

Foodtech

Near-term applications and use cases:

- **Interactive cooking apps:** AI-driven cooking apps could offer recipe suggestions based on available ingredients, user preferences, and skill levels, making home food preparation more enjoyable and accessible. The quality of the suggested recipes may be dependent on the AI's understanding of user preferences and the accuracy of available ingredient data.
- **Smart shopping lists:** Generative AI could help consumers create intelligent shopping lists that consider dietary preferences, nutritional goals, and existing pantry items, streamlining grocery shopping and meal planning. The effectiveness of these lists may be limited by the users' input accuracy, as well as the AI model's ability to predict changing preferences and needs.
- **Menu optimization:** Generative AI could help restaurants create unique and appealing menus by analyzing customer preferences, local trends, and seasonal ingredients to maximize customer satisfaction. The success of menu optimization may depend on the availability of comprehensive and up-to-date customer preference data and the AI model's ability to capture evolving trends.
- **Personalized meal planning:** AI-driven platforms could provide individualized meal plans based on user preferences, dietary needs, and health goals, making it easier for consumers to adopt healthier eating habits. The effectiveness of these meal plans may be influenced by the user's commitment to following the plan and the AI model's ability to adapt to changes in user preferences and goals.

Long-term implications:

- Hyper-personalization:** Generative AI could enable unprecedented levels of personalization in food offerings, catering to individual tastes, dietary restrictions, and nutritional needs across restaurants, grocery, and e-commerce platforms. Achieving true hyper-personalization may be contingent upon robust data privacy and security measures to protect user information.
- Increased efficiency and automation:** The integration of generative AI in food service and retail operations could lead to greater efficiency, reduced labor costs, and increased automation in tasks such as food preparation, order fulfillment, and inventory management. This may also result in job displacement and require workforce retraining to adapt to new roles and skills.
- Enhanced customer experience:** AI-driven systems could provide seamless, convenient, and engaging experiences for customers, from personalized meal recommendations to streamlined ordering and checkout processes. The success of these systems may depend on their ability to integrate with existing infrastructure and to address potential technical issues and limitations.
- Reduced food waste:** Generative AI could help optimize inventory management, pricing, and demand forecasting, leading to significant reductions in food waste throughout the food service and retail sectors. The effectiveness of these solutions may rely on accurate data, effective implementation, and collaboration between multiple stakeholders across the supply chain.

Notable foodtech startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Instacart	Online grocery platform	\$12,000.0**	\$2,740.0
Tastewise	Food insights platform	\$43.0	\$29.5
Verneek	Food shopping assistant	\$8.0	\$2.0

Source: PitchBook • Geography: Global

*As of April 19, 2023

**Implied valuation based on internal stock issuance as of April 2, 2023.



John MacDonagh
Senior Analyst, Emerging
Technology
john.macdonagh@pitchbook.com

Climate tech

Near-term applications and use cases:

- **Bespoke guidance from carbon accounting:** Interest in monitoring and managing carbon emissions has grown recently, from both corporations and individuals. Carbon accounting startups provide tools to measure carbon emissions from various processes and suggest follow-up actions to reduce emissions. Generative AI could be implemented to provide more in-depth plans for carbon emissions reduction, incorporating more granular factors about the entity's processes, location, and capabilities.
- **Carbon offset evaluation:** Evaluating the quality of carbon offsets is challenging due to the varied nature of their underlying physical assets. Increasing scrutiny around carbon offset quality is largely based on the realization that many carbon offsets are insufficient in one or more of the following areas: additionality, permanence, exclusivity, and leakage. Applying generative AI to evaluate the quality of existing carbon offsets could speed up the process and increase confidence in high quality offsets' value. Generative AI could also be used to evaluate physical assets, determining their suitability for various carbon offset programs/standards.
- **Green construction approaches:** Generative AI can assist in the design of buildings, potentially being directed to maximize use of green materials and construction approaches, or to incorporate energy saving hardware.

Long-term implications:

- Carbon emissions from computational requirements:** A key long-term implication of generative AI from a climate tech perspective is the potential energy requirements for computational power. This energy requirement comes with a similarly high carbon footprint; There's a significant energy cost in training the model, as well as ongoing energy requirements from each query run. Developers of the most popular generative AI models have not released figures of their energy consumption, which can then be converted to carbon emissions, but estimates of GPT-3's training suggest it released 552 tCO₂e—and consumed nearly 1,300 MWh of energy—from training alone.⁵ Newer models can be trained on more energy-efficient hardware but can also grow in complexity and compute power requirements. Beyond training, ongoing use of generative AI tends to increase computational load relative to alternatives. A common application of generative AI is to replace and enhance search engines, and a single google search is claimed to emit 0.2 grams of CO₂;⁶ per-query estimates for generative AI vary greatly, but tend to fall in the range of 2x to 10x that of a google search.^{7,8} Efforts are underway though to reduce generative AI's carbon footprint, either through more energy-efficient hardware or through model optimization, aiming to replicate strong capabilities using more computationally lightweight models.

Notable climate tech startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
CarbonCrop	Carbon offset project evaluation	\$11.0	\$3.4
BrainBox AI	Building energy optimization	N/A	\$57.2
ClimateAI	Climate risk modelling platform	\$112.0	\$37.5

Source: PitchBook • Geography: Global
*As of April 19, 2023

5: "Carbon Emissions and Large Neural Network Training," Cornell University, David Patterson, et al., April 23, 2021.

6: "Powering a Google Search," Google, Urs Hölzle, January 11, 2009.

7: "The Carbon Impact of AI vs Search Engines," Yard, Chris Butterworth, March 6, 2023.

8: "The Generative AI Race has a Dirty Secret," Wired, Chris Stokel-Walker, February 10, 2023.



Derek Hernandez
Senior Analyst, Emerging
Technology
derek.hernandez@pitchbook.com

Enterprise SaaS

Near-term applications and use cases:

- **Research and first draft content creation:** Generating a first draft is often a major challenge for knowledge workers, whereas editing, correcting, and tailoring a first draft is typically less of a mental effort. ChatGPT and similar LLMs have demonstrated an ability to generate content almost immediately on command. This spans numerous enterprise solutions, including copywriting, emails, and report drafting. These solutions have similarly proven adept at researching topics with general Q&A approaches, freeing up time and energy for more critical deliverables.
- **Perfecting enterprise search:** ChatGPT and similar AI-driven solutions may serve to consolidate and illuminate key business insights that were previously difficult to find and communicate within traditional enterprise search solutions. Creating customer-facing interfaces would also serve to augment traditional customer service and success functions through answering queries, intent identification, conversation summaries, and directing to solutions.
- **Lowering the barriers to entry:** Generative design for architecture, manufacturing, and production solutions stands to revolutionize many industries. While this was previously a developing field of custom-made solutions, generative design will be much more widely available across a variety of sectors.

Long-term implications:

- Engaging virtual humans:** Over the long term, enterprises may choose to be represented by digital avatars over traditional approaches to marketing, sales, and customer service and success. Digital avatars could provide personalized engagement with a perfect memory, and deftly employ cutting-edge techniques of persuasion to find, secure, and manage deals with prospective and ongoing clients. Virtual humans could also become enterprise assistants and virtual colleagues, aiding and organizing workers throughout an enterprise.
- “Hallucinations” could be costly:** While not often a matter of life and death in the realm of enterprise applications, mistakes and misinformation could be immensely costly to major brands. This was highlighted in Google’s recent rollout of Bard, which included a minor error in an astronomy answer that produced an outsized move in the company’s stock price.⁹ Greater reliance on client-facing AI solutions creates more opportunities for this risk to materialize. Major testing and verification efforts will be required to prevent these instances from being too frequent or too severe.
- Concentrations of power:** Although many generative AI solutions are currently open-source projects or otherwise freely accessible to many participants, the development of these solutions is immense and requires major resources. Current incumbents may decide in the future to ring-fence future iterations of the technology, as well as their proprietary data.

Notable Enterprise SaaS startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Jasper	Content creation	\$1,520.0	\$147.0
Glean	Knowledge management	\$1,000.0	\$156.0
Supernormal	Workforce productivity	\$35.0	\$12.0

Source: PitchBook • Geography: Global
*As of April 19, 2023

⁹: “Alphabet Shares Dive After Google AI Chatbot Bard Flubs Answer in Ad,” Reuters, Martin Coulter and Greg Bensinger, February 8, 2023.



Brendan Burke
Senior Analyst, Emerging
Technology
brendan.burke@pitchbook.com

AI & ML

Near-term applications and use cases:

- **Foundation model operations:** A new tooling stack is needed to support the development of customized foundation models like GPT-4 and Claude for specific use cases. Startups are developing large developer communities around data integration into foundation model embeddings and can yield complementary features to the \$8 billion data integration market.
- **Agentic AI:** ChatGPT can be combined with software agents to carry out tasks or can learn to script agents itself to carry out the results of its suggestions. AutoGPT and Adept's Act-1 model show that ChatGPT can carry out discrete actions on behalf of users.
- **Vector similarity search:** Enterprises want to train their own search models based on their own data. Vector databases calculate the similarity scores of text data in a user's database, enabling AI queries of semantic search spaces.
- **Intelligent process automation:** AI can identify user workflows via imitation learning, analyze new documents, and execute scripts to automate consistent processes. Historically, RPA has been enabled by optical character recognition (OCR) and rules-based scripting bots, which limits the extent of knowledge in these systems. Generative AI models can adapt to user workflows by learning from monitoring software on user endpoints.

Long-term implications:

- **Generative media:** Natural language instructions could be used to create media such as movies and video games, multiplying the productivity of creative workers. Multimodal models are beginning to learn from video to enable bidirectional communication of video-to-text queries and text-to-video generation.
- **Foundation model decacorns:** OpenAI's high valuation demonstrates that companies over \$10 billion in valuation will be created by companies that gain large user bases with generative models. AI companies previously faced an upper bound of \$10 billion given limited market size for standalone AI software, but that marker should be breached with greater regularity.
- **Software 2.0:** ChatGPT can be used to create software applications that perform specific tasks without any human coding. By using the matrix multiplications of neural networks instead of scripts and binary code, ML-powered software can become more reliable and malleable than today's software applications.

Notable AI & ML startups*

Company	Core product	Valuation	Total raised
OpenAI	GPT-4	\$30.0B**	\$11.0B**
Anthropic	Claude	\$4.1B	\$1.3B
Stability AI	Stable Diffusion	\$1.0B	\$101.0M
AI21 Labs	Jurassic-2	\$0.6B	\$98.5M

Source: PitchBook • Geography: Global

*As of April 19, 2023

**Analyst approximation.¹⁰

¹⁰: See "ChatGPT Developer OpenAI in Talks to Raise Capital at Almost \$30bn Valuation," Financial Times, Tabby Kinder and James Fontanella Khan, January 5, 2023.



Brendan Burke
Senior Analyst, Emerging
Technology
brendan.burke@pitchbook.com

Infosec

Near-term applications and use cases:

- **Security data analysis automation:** ChatGPT can query log data for security events. Microsoft's Security Copilot allows users to investigate security attacks with natural language prompts. The tool surfaces descriptions of security events and diagrams. This model integrates both GPT-4 and Microsoft's infosec-specific data model. The infosec-specific model incorporates threat intelligence that enables predictions of security breaches.
- **Automated penetration testing:** ChatGPT can produce attack samples that are similar to known attacks yet modified using ChatGPT to rewrite some portions. This can offer penetration-testing teams additional stress tests for security tools and intelligence into the attacks that ChatGPT might develop in attackers' hands.
- **Privacy documentation:** ChatGPT can review documents for compliance details and fill out forms for standards certification.
- **Secure coding:** GitHub Copilot can be tuned to only select among known secure open-source repositories for code generation. This process can automate security tests that can slow down developer timelines.
- **Identity governance automation:** ChatGPT can help business users automate their queries for identities such as new passwords and log-in issues that IT teams currently issue tickets for, costing person-hours and slowing the business. Users can ask natural language questions such as access requests that directly interface with a process automation platform. At the RSA infosec conference, security automation startup Torq launched a ChatGPT-powered product for identity workflow automation that may expand to other use cases in the future.

Long-term implications:

- **Death of SIEM industry:** Security information and event management (SIEM) platforms were already being disrupted due to their complex query languages and high pricing. SIEM relies on custom data query languages that must be manually configured for individual environments. LLMs could automate this \$5 billion category.
- **Empowering every user to become a security analyst:** Currently, only security professionals have easy access to threat intelligence. With AI interfaces, business users may become aware of security risks in real-time and make better decisions about password sharing and IT decision-making.
- **Self-patching systems:** Autonomous security operations centers could become a reality as AI systems convert new threat indicators to security responses without manual review. This could solve most rote patching operations and encourage security analysts to build better organizational hygiene and look into anomalies.
- **Visual incident response:** AI models could learn from visual data and parse information from diverse environments based both on language and visual interfaces. Data integration can become much faster by integrating visual information from web applications and correlating those images with log data to identify relationships between user actions and security risks.

Notable ChatGPT-integrated infosec startups*

Company	Core product	Valuation	Total raised
Orca Security	Cloud Security Platform	\$1.8B	\$640.0M
Torq	Hyperautomation Platform	N/A	\$78.2M
LogPoint	Converged SIEM	\$100.7M	\$64.6M
Armo Security	Kubernetes Security Platform	N/A	\$34.5M

Source: PitchBook • Geography: Global
*As of April 19, 2023



Brendan Burke
Senior Analyst, Emerging
Technology
brendan.burke@pitchbook.com

IoT

Near-term applications and use cases:

- **Connected car enhancement:** ChatGPT underlies chatbots in General Motors and Mercedes Benz pilot projects. AI can query the vehicle's information or operating instructions, use programmable functions such as garage door codes, and integrate personal data including users' calendars and contact information into infotainment systems.
- **Industrial documentation discovery:** Industrial companies have reams of equipment documentation that must be reviewable for maintenance and compliance. Intelligent knowledge discovery can make these documents searchable. Search startup Pryon is benefiting from industrial companies wanting to build ChatGPT-like chatbots on their own equipment data to augment IoT data collection.
- **Video surveillance analytics:** AI enables operational staff to query visual feeds including from security cameras and robots with natural language to identify visual data that may otherwise require manual review. GPT-4 enables conversations based on images, making images a valid input to generative AI chatbots.
- **Voice synthesis for smart home:** Generative audio models can take LLM inputs and produce accurate intonations in a variety of languages. Meta and Apple have invested in this technology via M&A over the past 18 months.

Long-term implications:

- Generative industrial design:** Multimodal models will be able to synthesize industrial-grade designs from natural language based on precedents and safety guardrails. Automotive manufacturers have already begun experimenting with computer-driven hardware design including Stable Diffusion. Multimodal models will enable greater customization and creative solutions to difficult electric vehicle design problems.
- Digital twin creation:** Generative models will produce digital replicas of industrial systems based on data feeds to facilitate monitoring and anomaly detection. This will lower the cost and custom engineering required to develop digital twins that can help monitor teams across industries.
- Overcoming IT/OT divide with industrial foundation models:** Experienced operational staff still don't want to use advanced analytics, and younger staff view the industrial field as not innovative enough, limiting the adoption of industrial analytics. A range of operational users can employ natural language to ask analytical systems questions in their own language and receive relevant results, making AI appealing to both new and experienced workers. Additional foundation models will be required to adapt to industrial contexts.

Notable IoT startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Groundlight	Conversational computer vision	N/A	\$10.0
Diabatix	ColdStream Thermal Design	\$6.8	\$2.3

Source: PitchBook • Geography: Global
 *As of April 19, 2023



Robert Le
Senior Analyst, Emerging
Technology
robert.le@pitchbook.com

Crypto/Web3

Near-term applications and use cases:

- **Smart contract development and auditing:** Smart contract programming languages are sophisticated, but ChatGPT through OpenAI's Codex can write code in any language including Solidity, Vyper, or Move. This can help onboard more developers into Web3. Also, ChatGPT can be used to detect errors, vulnerabilities, and inefficiencies in smart contracts by analyzing code and providing suggestions for improvements.
- **Querying blockchains:** Blockchain data are open and transparent, yet the ability to explore the data via providers like Etherscan or The Graph is still highly complex. ChatGPT can let users ask simple questions, like transaction activity within a particular protocol or to which exchange specific funds were moved to.
- **Protocol and tokenomics documentation:** Many crypto protocols require the development team to publicly release white papers, project descriptions, technical guides, and the parameters and characteristics of their tokens. ChatGPT can assist in generating documentation for new crypto projects.
- **Market analysis and trading:** ChatGPT can analyze market trends and sentiment from on-chain activities, social media, news, and other sources. The analysis can help aid in making investment decisions. ChatGPT can also be integrated into trading bots to develop algorithmic trading strategies and/or automatically execute trades.

Long-term implications:

- Decentralized infrastructure:** Web3 and blockchains can help the training and development of new generative AI models. Current models like that from OpenAI are centralized; however, with Web3, the training data, processing power, and data storage can become decentralized, leading trustless, transparent versions of ChatGPT that can be audited for things like harmful content or model bias.
- Tokenization:** Generative AI content like music, videos, and blog posts can be tokenized and licensed via blockchains. IP usage can be tracked and traded, with the licensor earning tokens for copyright access.
- Unintended consequences:** The crypto and Web3 space is filled with scams, hacks, and misinformation, and ChatGPT can be used as a tool to amplify these threats. This can include the automation of creating convincing, false content to affect the price of crypto assets or using generative AI to discover code vulnerabilities in smart contracts and protocols for nefarious purposes.

Notable crypto/Web3 startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Alethea AI	Intelligent and interactive NFTs	\$116.0	\$16.2+
fetch.ai	AI-based layer 1	N/A	\$26.0

Source: PitchBook • Geography: Global
*As of April 19, 2023



Robert Le
Senior Analyst, Emerging
Technology
robert.le@pitchbook.com

Insurtech

Near-term applications and use cases:

- **Enhanced and personalized CS:** Chatbots have proliferated within the insurance industry, with Lemonade first launching its chatbot in 2016. ChatGPT could enhance chatbot capabilities, which are currently limited to low level customer support, aiding in purchasing simple policies, or processing non-complex claims. A ChatGPT-enabled chatbot could structure and offer highly tailored insurance products based on an individual customers' needs, preferences, and risk profiles.
- **Risk assessment and underwriting:** Many insurers have vast datasets yet do not have the capabilities to extract valuable insights from it. Generative AI can be trained on these datasets to help insurers better assess risk, structure policies, and quote. Zurich Insurance Group is testing ChatGPT's ability to extract six years of claims data to identify primary causes of loss to improve underwriting. Insurance broker Paladin Group is working with no-code insurtech platform Dais on an underwriting tool called UnderwriteGPT.
- **Faster claims:** ChatGPT can analyze and process insurance claims more efficiently by scanning claim documents, extracting relevant information, and determining coverage eligibility, thus reducing manual workload and accelerating claim resolution. Generative AI can also be used to detect fraudulent claims and subrogation opportunities.

Long-term implications:

- Slow adoption:** Simpler automation tools have been adopted across the financial services industry, yet insurers have been slow to fully adopt these tools. With regulatory and ethical concerns around generative AI, the highly regulated insurance industry is expected to take a similar approach to adoption. Insurtech companies are expected to experiment and first adopt the technology to demonstrate efficacy and derisk the technology before it becomes prevalent in the industry.
- Straight through processing:** Most insurance processes still require a significant amount of human intervention, including in distribution, underwriting, and claims—particularly in specialty and commercial lines. Generative AI could possibly fully automate these processes, saving insurers significant costs.
- New risks:** While generative AI is promising, the technology will likely spawn new risks including IP infringement, data privacy and security, job displacement, and numerous other insurable, unintended damages. This will create opportunities to develop new insurance products to protect from generative AI-native risks.

Notable insurtech startups*

Company	Core product	Valuation (\$M)	Total raised (\$M)
Planck	Commercial underwriting	\$258.8	\$71.0+
omni.us	Claims automation	N/A	\$54.4+
Hyperexponential	Pricing automation	\$106.1	\$15.1

Source: PitchBook • Geography: Global

*As of April 19, 2023

Appendix

Notable generative AI startups by vertical*

Vertical	Company	Core product	Valuation	Total raised
Insurtech	Planck	Commercial underwriting	\$258.8M	\$71.0M+
Insurtech	omni:us	Claims automation	N/A	\$54.4M+
Insurtech	Hyperexponential	Pricing automation	\$106.1	\$15.1M
Crypto/Web3	Alethea AI	Intelligent and interactive NFTs	\$116.0M	\$16.2M+
Crypto/Web3	fetch.ai	AI-based layer 1	N/A	\$26.0M
IoT	Groundlight	Conversational computer vision	N/A	\$10.0M
IoT	Diabatix	ColdStream Thermal Design	\$6.8M	\$2.3M
Infosec	Orca Security	Cloud Security Platform	\$1.8B	\$640.0M
Infosec	LogPoint	Converged SIEM	\$100.7M	\$64.6M
Infosec	Armo Security	Kubernetes Security Platform	N/A	\$34.5M
Infosec	Torq	Hyperautomation Platform	N/A	\$78.2M
AI/ML	OpenAI	GPT-4	\$30.0B	\$11.0B**
AI/ML	Anthropic	Claude	\$4.1B	\$300.0M
AI/ML	Stability AI	Stable Diffusion	\$1.0B	\$101.0M
AI/ML	AI21 Labs	Jurassic Models	\$0.6B	\$98.5M
Enterprise SaaS	Jasper	Content creation	\$1,520.0M	\$147.0M
Enterprise SaaS	Glean	Knowledge management	\$1,000.0M	\$156.0M
Enterprise SaaS	Supernormal	Workforce productivity	\$35.0M	\$12.0M
Foodtech	Instacart	Online grocery platform	\$12,000.0M***	\$2,740.0M
Foodtech	Tastewise	Food insights platform	\$43.0M	\$29.5M
Foodtech	Verneek	Food shopping assistant	\$8.0M	\$2.0M
Agtech	Gamaya	Precision ag platform	\$30.2	\$16.0M
Agtech	Hortau	Irrigation management platform	N/A	\$56.2M
Agtech	Cropin	Farm monitoring and management solution	N/A	\$43.0M
Gaming	Inworld AI	AI character development	\$173.0M	\$83.3M
Gaming	Promethean AI	World creation	\$98.5M	\$39.5M

Source: PitchBook • Geography: Global
 *As of April 19, 2023

Notable generative AI startups by vertical cont.*

Vertical	Company	Core product	Valuation	Total raised
Gaming	Wonder Dynamics	Game studio	\$37.6M	\$11.6M
E-commerce	Anyword	AI copywriting	\$66.0M	\$32.4M
E-commerce	Treat	Personalized creative assets	\$28.1M	\$23.1M
E-commerce	Copysmith	Product descriptions	N/A	\$10.0M
Fintech	Stripe	Payment Facilitation	\$50.0B	\$8.7B
Fintech	ComplyAdvantage	Anti-fraud detection	\$445.0M	\$141.4M
Fintech	Kasisto	Customer Service	\$120.0M	\$81.5M
Healthcare IT	Infinitus	Eva Lightyear (AI voice prior authorization)	\$280.0M	\$51.0M
Healthcare IT	AKASA	Revenue cycle automation	\$1,020.0M	\$205.0M
Healthcare IT	DeepScribe	AI medical scribe	\$180.0M	\$37.3M
Healthcare IT	RamSoft	Medical imaging patient portal	N/A	N/A (PE growth)
Digital health	Woebot Health	Behavioral health chatbot	\$230.0M	\$139.0M
Digital health	Wysa	Behavioral health chatbot	\$77.0M	\$29.0M
Digital health	Care.Coach	Avatar-based caregiving companion	N/A	\$2.0M
Mobility tech	Inrix	Traffic management analytics	\$595.0M	\$203.0M
Mobility tech	Via	Public transportation	\$3,500.0M	\$887.0M
Mobility tech	Optibus	Mass transit optimization	\$1,300.0M	\$263.0M
Supply chain tech	Flexport	Freight forwarding platform	\$8,000.0M	\$2,500.0M
Supply chain tech	Uptake	Asset tracking management	\$2,300.0M	\$323.0M
Supply chain tech	Nuro	Autonomous delivery	\$8,600.0M	\$2,100.0M
Climate tech	CarbonCrop	Carbon offset project evaluation	\$11.0M	\$3.4M
Climate tech	BrainBox AI	Building energy optimization	N/A	\$57.2M
Climate tech	ClimateAI	Climate risk modelling platform	\$112.0M	\$37.5M

Source: PitchBook • Geography: Global
*As of April 19, 2023

COPYRIGHT © 2023 by PitchBook Data, Inc. All rights reserved. No part of this publication may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, and information storage and retrieval systems—without the express written permission of PitchBook Data, Inc. Contents are based on information from sources believed to be reliable, but accuracy and completeness cannot be guaranteed. Nothing herein should be construed as investment advice, a past, current or future recommendation to buy or sell any security or an offer to sell, or a solicitation of an offer to buy any security. This material does not purport to contain all of the information that a prospective investor may wish to consider and is not to be relied upon as such or used in substitution for the exercise of independent judgment.