Controlling the 'Foundational Data Asset'

AI's Impact on Industry 4.0 and Industrial Decarbonization

SUMMARY

- Breakthrough technological innovations have led to a paradigm shift of new applications leveraging the power of artificial intelligence (AI)

- Industrial enterprises are seeking to establish a competitive advantage by leveraging AI to digitally transform their business while driving greater labor productivity, resource efficiency, and emissions reduction

- As the intelligence layer is commoditized, startups building industrial AI applications need to focus on defensibility through their use of proprietary 'foundational data assets' - the critical data unique to a market, platform, or business outcome

- While the space is evolving rapidly, below are our emerging hypotheses of what will shape and drive successful industrial AI startups:

  1. Companies that control the 'foundational data asset' can provide outsized leverage for model refinement and training that will drive operational savings, labor productivity and emissions reductions

  2. Portability across cloud, hybrid, and on-premise environments paired with a walled garden model will ease adoption barriers for customers

  3. Vertical specific platforms and operating systems can deliver significant value through the integration of AI and a general intelligence layer that acts on proprietary data assets

  4. Positioning needs to be centered on solutions and outcomes rather than AI itself

  5. Significant opportunity exists for new infrastructure and tooling platforms that enable companies' data science, engineering and product teams to build and scale AI and ML models

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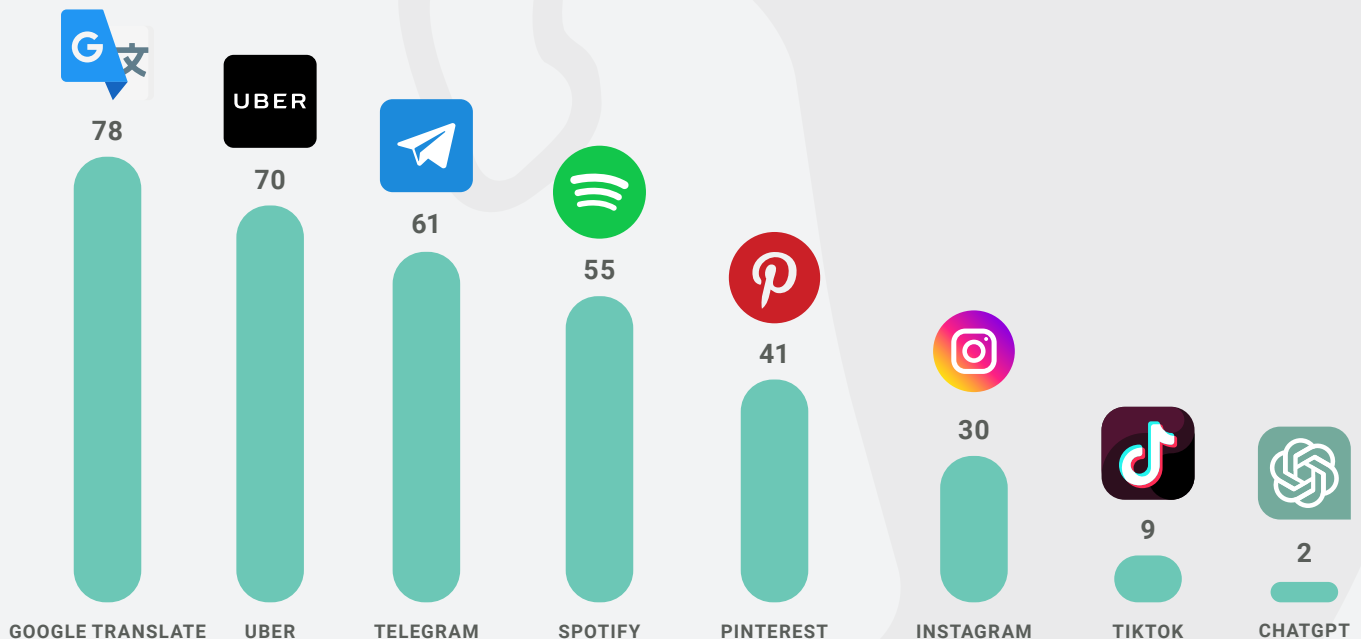omar@blackhornvc.com

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WELCOME TO THE AI SUPERCYCLE

The exponential pace of development within artificial intelligence (AI) is taking the tech ecosystem, and the planet at large, by storm. Just this year alone breakthrough advances in machine learning infrastructure, vector databases, natural language processing, and generative AI have created a new technological paradigm shift: **the AI supercycle**. This paradigm shift - which we believe is on par with past supercycles like mobile, cloud, internet, and the personal computer - has created a cambrian explosion of new software applications leveraging the power of AI across every sector. While some companies will not survive, as is common with every supercycle, we expect this platform shift to create significant and enduring enterprise value. A recent McKinsey report found that generative AI applications can deliver $2.6T - $4.4T of annual economic benefits to the global economy. Depending on the rate of adoption, generative AI could enable labor productivity growth of 0.1% to 0.6% annually through 2040. With historical annual labor productivity at 2.1% and productivity since 2019 slowing to 1.4%, generative AI alone could account for 30% to 40% of total productivity growth.

TIME TO REACH 100M USERS
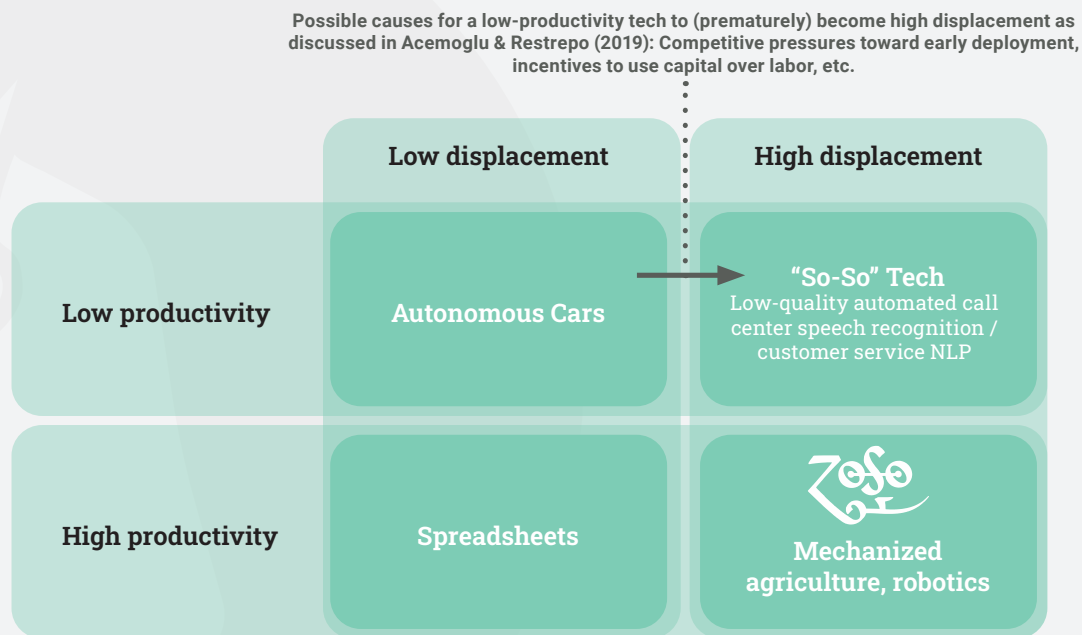Months to get to 100 million global Monthly Active Users

Source

GOOGLE TRANSLATE	UBER	TELEGRAM	SPOTIFY	PINTEREST	INSTAGRAM	TIKTOK	CHATGPT
78	70	61	55	41	30	9	2

AI has the potential to rapidly transform and modernize how industrial businesses operate, make decisions, and deliver products and services. Despite the profound disruptive potential AI possesses, we are bumping up against the limits of the current generation of AI: from compute power to cost limits for training data, and a challenge around how automation and AI is impacting productivity and worker displacement.

Given Blackhorn's investment thesis: predicated on the adoption of digital infrastructure as a driving catalyst for resource productivity and decarbonization across the industrial economy, we believe that AI will be a critical component of this transformation and will help accelerate the clean energy transition. Across

our network of corporate partners and enterprise technical leaders, industrial companies, manufacturing businesses, utilities, and OEMs are actively exploring the possibilities of AI with the goal of reducing operating costs, increasing customer choice and convenience, and empowering frontline workers. At the same time, startups building applications for Industry 4.0 must ensure that they align to the data, privacy, compliance, security, and deployment requirements of the enterprise segment. While it remains early within the adoption cycle, it's clear that enterprises must adopt AI in order to stay competitive in this rapidly changing technology landscape.

Possible causes for a low-productivity tech to (prematurely) become high displacement as discussed in Acemoglu & Restrepo (2019): Competitive pressures toward early deployment, incentives to use capital over labor, etc.

	Low displacement	High displacement
Low productivity	Autonomous Cars	"So-So" Tech — Low-quality automated call center speech recognition / customer service NLP
High productivity	Spreadsheets	Mechanized agriculture, robotics

One way to visualize the different regimes that different kinds of tech might lie in when it comes to their impact on labor.

Source

INDUSTRIAL AI APPLICATION USE CASES

While not comprehensive, below are a few notable examples of AI applications for industrial resource efficiency and decarbonization use cases we've evaluated over the past year.

1. GENERATIVE DESIGN FOR SUSTAINABLE PRODUCTION:
Generative AI is being applied to the design of materials, circuit boards, and critical components. These applications are streamlining architectural and design processes and creating products that are more resilient, and use less materials during the manufacturing process.

2. PREDICTIVE MAINTENANCE:
AI-driven predictive maintenance models analyze real-time sensor data from manufacturing equipment. These models forecast equipment failures, allowing for proactive maintenance that reduces downtime, energy waste, and greenhouse gas emissions.

3. ENERGY OPTIMIZATION FOR SMART GRID:
Generative AI is playing a pivotal role in optimizing energy distribution in smart grids. By analyzing

data from IoT sensors and weather forecasts, AI models adjust energy flow to reduce inefficiencies and accommodate renewable energy sources, fostering a more sustainable energy ecosystem.

4. CARBON EMISSIONS REDUCTION IN HEAVY MANUFACTURING:
Applied AI is helping manufacturers within steel, chemicals, and cement optimize production processes, minimizing waste and energy consumption. AI-driven simulations explore various scenarios to identify the most efficient and environmentally friendly processes, and data taken from connected sensors dynamically update recipes for production based on real time feedback.
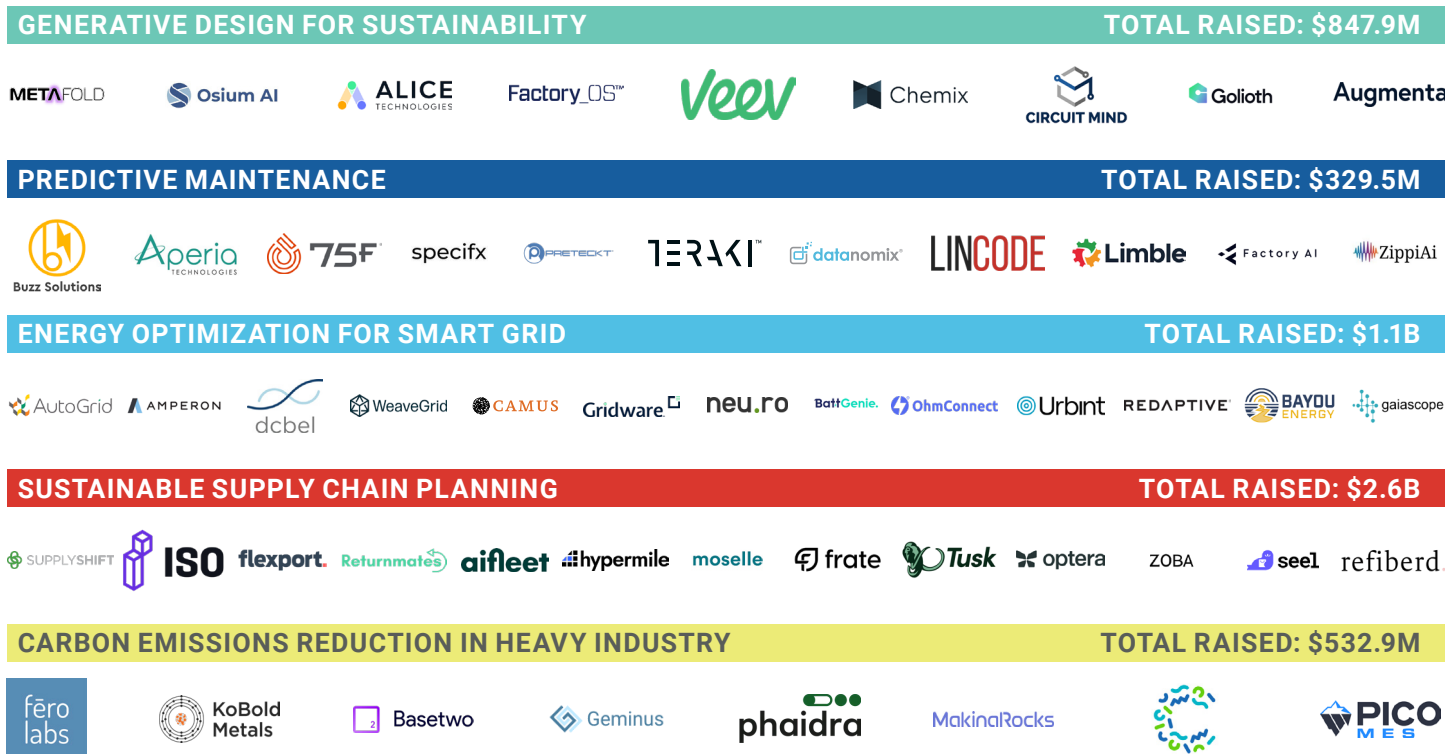
5. SUSTAINABLE SUPPLY CHAIN PLANNING:
AI models are being applied to analyze vast amounts of supply chain data to optimize logistics, routing, and reduce carbon emissions. These models consider factors like transportation modes, routes, and inventory levels to maximize operational efficiency while minimizing environmental impact and greenhouse gas emissions.

INDUSTRIAL AI MARKET MAP

Companies that aggregate unique and critical data will win out in delivering value to industrial enterprises.

- Blackhorn's AI Thesis

GENERATIVE DESIGN FOR SUSTAINABILITY	TOTAL RAISED: $847.9M

METAFOLD   Osium AI   ALICE TECHNOLOGIES   Factory_OS™   Veev   Chemix   CIRCUIT MIND   Golioth   Augmenta

PREDICTIVE MAINTENANCE	TOTAL RAISED: $329.5M

Buzz Solutions   Aperia TECHNOLOGIES   75F   specifx   PRETECKT   TERAKI™   datanomix   LINCODE   Limble   Factory AI   ZippiAi

ENERGY OPTIMIZATION FOR SMART GRID	TOTAL RAISED: $1.1B

AutoGrid   AMPERON   dcbel   WeaveGrid   CAMUS   Gridware   neu.ro   BattGenie   OhmConnect   Urbint   REDAPTIVE   BAYOU ENERGY   gaiascope

SUSTAINABLE SUPPLY CHAIN PLANNING	TOTAL RAISED: $2.6B

SUPPLYSHIFT   ISO   flexport   Returnmates   aifleet   hypermile   moselle   frate   Tusk   optera   ZOBA   seel   refiberd

CARBON EMISSIONS REDUCTION IN HEAVY INDUSTRY	TOTAL RAISED: $532.9M

fēro labs   KoBold Metals   Basetwo   Geminus   phaidra   MakinaRocks   PICO MES

With the advent and rapid adoption of AI, the intelligence layer which used to be a competitive advantage is now a commodity. A battle tested strategy in startups is to build a product that's at least 10x better, 10x cheaper, or 10x easier than what exists and over time layer in defensibility through robust insights and intelligence.

This process was previously costly and required skilled engineering and data functions to scale. Given how quickly AI development is advancing, a 10x product of last month may be obsolete this month and the barrier to building the intelligence layer has been democratized with greater accessibility to plugins, APIs, and a robust open source community.

Below are our emerging hypotheses of what will shape and drive successful industrial AI startups:

1. **Companies that control the 'foundational data asset' (the critical data unique to a market, platform, or business outcome) can provide outsized leverage for model refinement and training to drive operational savings, labor productivity, and emissions reductions.**
    With the advent of greater cloud capacity and open source models, weaving AI into a central offering is now easier than ever before. Complex machine learning models that previously took teams several years to develop and refine can now be implemented over a weekend. Our perspective is that greater accessibility to an 'intelligence layer' has shifted defensibility to the data that platforms aggregate, analyze, and leverage. Companies with technology that allows them to generate the unique data needed to train and fine-tune models are well positioned to create enduring value and defensibility in the age of AI. The best way of ensuring that companies have proprietary access to a dataset needed to train a model is to generate it themselves.

    a. **Circuit Mind:** [Leveraging its proprietary database of circuit board designs, Circuit Mind's](#) platform enables electrical engineering teams to automatically select optimal components and generate candidate circuit board schematics 9000x faster than current methods. Circuit Mind's electronic design process accounts for critical material shortages, results in a 23% boost in power efficiency, and addresses the electronic engineering skilled labor shortage by providing schematics faster. The $10 billion global electronic design automation market has used a largely unchanged design process for the past three decades, making it ripe for disruption.

2. **Portability across cloud, hybrid, and on-premise environments paired with a walled garden model approach will ease adoption barriers within the enterprise.**
    The adoption of AI within large enterprise organizations, especially in traditionally conservative industries, is a complex endeavor. It necessitates strategic planning, significant investment, and a cultural shift towards data-driven decision-making. Moreover, the roadmap to AI integration must address concerns about security, scalability, and ethical considerations, making it a formidable challenge for many established players. On the other hand, startups with innovative AI solutions have a unique opportunity to drive the transformation of these industries. Developing "enterprise-ready" building products that meet the stringent demands of enterprise-level operations is no small feat. It requires understanding the intricacies of industrial processes, meeting regulatory requirements, ensuring robust cybersecurity, and, most importantly, creating tangible value for end-users. Companies that invest in compliance and have flexibility to deploy their solutions within on-premise and cloud environments have potential to accelerate their enterprise go to market and are poised to more effectively navigate stringent procurement processes.

    a. **Datch:** [Datch](#) is a vertical specific LLM platform that provides manufacturing and industrial companies with an AI-powered asset management voice interface that allows frontline workers to talk through their jobs conversationally while structuring and routing that data to their company's system of record. Their platform reduces downtime 21% by automatically creating

proactive maintenance requests. Facilitating better in-field data collection solves a critical bottleneck for enterprises implementing new digital processes across the $47 billion industrial analytics market. Datch's ability to integrate directly into their customers' enterprise asset management systems and provide robust security and compliance has been key in their ability to deploy quickly.

3. **Vertical specific platforms and operating systems can deliver significant value through the integration of AI and a general intelligence layer that acts on proprietary data assets.**
Vertical operating systems integrating AI into workflow and automation technologies can perform more complex and specific tasks when AI models are trained on proprietary data sets. Vertical SaaS applications stand to increase their market potential and overall average revenue per user (ARPU) through the integration of AI as a means of internalizing more workflows and complex tasks that are specific to a given industry or vertical.

   a. **Specifx Data:** Specifx's vertically focused SaaS model is helping the analog HVAC industry enter the digital age. The founding team spent 10+ years acquiring, structuring and coding HVAC asset data that underlies its core functionality. With this proprietary data asset, Specifx can directly quantify economic and environmental efficiencies across an HVAC portfolio, providing visibility, context, and enterprise-scale scenario planning that saves its customers time, money, and unnecessary emissions. By weaving together various point applications with a highly targeted approach, Specifx is following in the footsteps of vertical SaaS titans like Shopify and Toast.

4. **Positioning needs to be centered on solutions and outcomes rather than AI itself.**
While AI is a compelling conversation starter within enterprise sales cycles, companies still need to reaffirm their value proposition and sell outcomes rather than features. This approach has to be accompanied by a methodical and quantifiable ROI and business value assessment that illustrates the overall impact that AI applications can drive to an organization's bottom line and emissions profile. Corporate buyers understand AI is a means to an end.

   a. **Fero Labs:** Fero Labs is a no-code platform for manufacturing engineers and operators to build a virtual replica of their manufacturing process and then draw on white-box machine learning insights to optimize performance while reducing costs and emissions. Today's factory floor is a highly complex process that requires continuous adaptation to changes in energy supply, raw materials purity, and changing business priorities. By enabling heavy manufacturers to integrate AI, their customers have uncovered over $20 million of savings, reduced more than 100,000 tons of carbon emissions, and saved a million pounds of raw materials. The plant and factory market represents almost $10 billion and drives 25% of global emissions, making factory optimization a massive opportunity for value creation.

5. **Significant opportunity exists for new infrastructure and tooling platforms that enable data science, engineering and product teams to build and scale AI and ML models.**
As the AI boom rapidly transforms industrial sectors, every company will need to consider if and how to integrate AI and ML into their business model. As the intelligence layer is commoditized, infrastructure and tooling platforms can act as a bridge for startups looking to build and scale AI

and ML. Creating domain-specific algorithms capable of delivering highly accurate predictions, such as determining optimal maintenance schedules for equipment on an assembly line, demands an extensive upfront effort in data preparation, experimentation, and model iteration. Tools that can automate this journey will become increasingly important as the pace of AI adoption continues to increase. While these tools are not typically exclusive to any particular industry, they play a pivotal role in alleviating potential bottlenecks for data scientists and engineers, thus reducing deployment time for new models.

a. **Golioth:** Golioth is a developer platform that allows hardware development teams to quickly and effortlessly connect their IOT devices to the cloud. Not only do they substantially decrease the time and cost required to bring IOT devices to market, they also enable new software applications within IOT and connected devices - in a similar way that Stripe enabled an explosion of new application use cases through embedded transactions. The IOT market represents a $200 billion opportunity, and a critical lever in combating climate change

AI IS NOT JUST HYPE, IT'S A PARADIGM SHIFT

With the relentless news attention on AI since ChatGPT launched in November 2022, it's easy to believe AI is just hype. Some of it clearly is, and the sky-high valuations of consumer-focused AI companies will not be sustained. While caution is warranted, we believe AI represents a fundamental paradigm shift for the industrial enterprise segment given the following macro trends:

1. **Step function advances in neural networks, natural language processing and significant development in vector databases, stable diffusion, and transformers**

2. **Innovation within the open source community and new protocols being more widely adopted coupled with the development of new applications for more effective model creation and configuration**

3. **Enterprise IT budgets increasing for digital transformation coupled with accelerated cloud adoption.**

GLOBAL CORPORATE INVESTMENT IN AI
The sum of private investment, mergers and acuisitions, public offerings, and minority stakes*.

*Inflation adjusted, in USD

INVESTMENT ($ BILLIONS)

| Year	Value
2013	~16
2014	~41
2015	~25
2016	~28
2017	~61
2018	~57
2019	~70
2020	~125
2021	~178

Source

A September 2023 survey sent out to the Blackhorn portfolio revealed that the majority of companies building in our core thesis verticals of Built Environment, Energy, Supply Chain & Logistics, and Transportation & Mobility are actively adding AI features to their product and that AI is often coming up in customer and prospect conversations.

Do you currently have an AI-powered product and/or offering, or are you actively integrating AI into your product offering?

20% **25%** **55%**
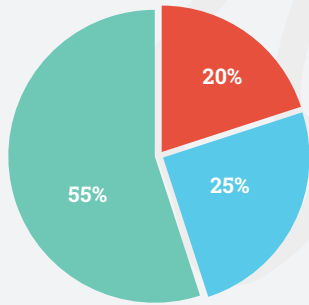
- Yes, we currently have an AI powered product
- Yes, AI is on our roadmap and we are actively integrating it into our offering.
- We are considering integrating AI into our offering but have not started work on it
- We do not have an AI offering and do not plan to integrate AI into our product offering.

Do you see AI as a differentiator within your market?

15% **15%** **70%**
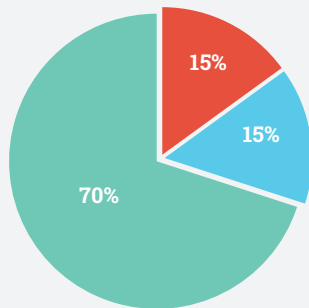
- Yes, AI is becoming a differentiator and a potential competitive moat against our competition
- Yes, we are integrating AI to keep up with our competitors
- No, AI is not relevant in our space

AUTOMATION WILL GENERATE GREATER LABOR PRODUCTIVITY, RESOURCE EFFICIENCY, AND A COMPETITIVE ADVANTAGE

The transformation of our industrial economy requires the rapid adoption of unprecedented levels of new digital infrastructure. Companies part of this new class of digital infrastructure have the potential to drastically increase labor productivity within industrial sectors while lowering greenhouse gas emissions from production, transportation, and materials waste generated. In the wake of the Fourth Industrial Revolution - characterized by the fusion of digital technologies, AI, and the physical world - the manufacturing and industrial sectors stand on the precipice of transformative change. Industry 4.0 applications have the potential to revolutionize the way organizations operate, optimize processes, and deliver products and services to market. At the heart of this paradigm shift lies AI, a potent force driving innovation, efficiency, and competitiveness.

While the manufacturing and industrial sectors have been notoriously slow to adopt new technology, the momentum of digital transformation is accelerating as businesses increasingly recognize the strategic importance of digital technologies. Gartner calculates that IT budgets within manufacturing and industrial sectors are growing at a 5.7% annual CAGR as senior executives prioritize technology investments focused on business composability, improved resilience and portfolio modernization. With specific regard to AI spending and adoption a recent Capterra report found that 71% of enterprise manufacturers expect to increase tech spend by at least 10% in 2024 and 85% of respondents surveyed focused on AI, ML, and automation as key areas of focus.

CONCLUSION

While the AI supercycle is just getting started, the fundamental platform shift has the potential to create enduring value and a new class of generational companies. With specific regard to AI and Industry 4.0 this supercycle is already top of mind for large enterprises who are focused on creating competitive advantages through digital transformation and process modernization. Companies building industrial AI applications need to focus on defensibility within the unique and proprietary data assets they're accumulating in order to refine and customize their models for vertical specific use cases. Startups selling to the enterprise must ensure that they're aligned to necessary compliance, security, and data requirements in order to even be considered by their target segment.

At Blackhorn, we're excited to continue to make investments in this space, and learn alongside our portfolio companies as the market and technology evolves. We are keenly focused on identifying, investing in, and supporting early stage companies that are leveraging AI to drive greater efficiency, cost savings, and emissions reduction to our target sectors.

If you're a founder building within industrial AI or a fellow AI or Industry 4.0 investor looking to collaborate please reach out to us at info@blackhornvc.com. We'd love to hear from you!

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