New technologies, New sustainable pathways.

Investing in the future's resources

BLACKHORN
VENTURES

Moving Faster Together

2020 was an unprecedented year. As COVID-19 challenged the economy's resilience, a groundswell of concern around climate change, social unrest, and corporate responsibility dominated news headlines. This built momentum for policy makers, the general public and corporate leaders to push for solutions. Meanwhile, the impacts of the global pandemic forced many industries to pivot and adapt, and, in many cases, companies redefined how they relate to both customers and employees.

Alongside this, environmental, social, and governance (ESG) and sustainable investment strategies continue to gain traction across almost every asset class. Employers are engaged in transparent and concerted efforts to elevate equity, inclusion, and diversity initiatives throughout their organizations. Many of the world's largest companies made public commitments in 2020 to meet ambitious carbon emission reductions, with some committing to go beyond net zero as they work to offset their historical carbon emissions.

Blackhorn Ventures is emboldened by the change we've seen over the past year, and we are inspired by the entrepreneurs we partner with. These individuals are tackling problems on the front line, while advancing social and environmental outcomes.

Thank you to the portfolio company founders and team members who contributed to this year's Blackhorn Ventures Industrial Impact Report. We are honored to collaborate with like-minded investors and peers who believe that generating real change requires us to move faster together. We are proud to be on this journey with you.

Driving Impact Through Action

There is increasing consensus that ESG issues are interrelated, and a growing community of investors is confident that companies which commit to improving ESG outcomes will be the biggest winners.

Blackhorn believes that there are tremendous opportunities to improve business model resilience and help companies adapt to changing conditions in both a given market and the broader economy. We believe that investors who use social and environmental impact-based theses are anticipating and tapping into future value creation. These teams will have a clear advantage in what continues to be a rapidly evolving world.

As a firm, we have strengthened our conviction that deep sector and sub-sector expertise has never been more important. The more clearly we understand our target sectors and the rapid changes occurring within each, the more clearly we see opportunities to facilitate change and benefit from macro tailwinds transforming these sectors.

Additionally, we have seen an unprecedented and rapidly growing demand to capture, process, and leverage data and intelligence that support businesses trying to understand how market and/or customer preferences are shifting. As investors focus on industrial resource efficiency driven by the Industrial Data Revolution, we believe that our investment thesis has never been more timely and mission-aligned.

Our Sectors

Energy

Transportation
and Logistics

Built
Environment

These sectors form a foundation that drives the U.S. GDP, includes much of the physical asset base, and possess excellent opportunities to improve their resource efficiency. As such, these sectors make an attractive space to support disruptive solutions during a period of transformation. Additionally, they account for almost 70 percent of the total U.S. GHG emissions, giving an outsized impact to the resource efficiency improvements Blackhorn targets. The following sections briefly describe a subset of the opportunities that we see in these sectors.

Over the past year, climate scientists have directly linked natural disasters to human activities. Heat waves, droughts, violent storms, hurricanes, and floods have touched virtually every community. Collectively, these "outlier events" have become the "new normal," and, in turn, there is enormous strain on legacy infrastructure. Blackhorn sees tremendous potential in solutions that improve operational and system resilience in response to these disruptions and future uncertainties. Equally encouraging are technologies that show the potential to dramatically improve resource efficiency in the transportation, built environment, and industrial sectors through electrification. Generally, increased electrification often leads to a reduction in core resource consumption, frequently lower pollution and/or emissions, and overall risk mitigation.

Utilities are not known for being early movers; consequently, they are being forced to play catch-up in response to rapid changes in public sentiment and recent clean energy directives. These energy providers are mandated to deliver both resiliency and reliability, irrespective of these evolving and heightened pressures. Consequently, there is massive opportunity to enable the sector to proactively address these immediate threats through various technology tools and partners. Fortunately, there is unprecedented movement among early adopters to explore and deploy these solutions more rapidly. These essential shifts are converging with historic need to electrify the transportation, built environment, and industrial sectors. This combination of forces is creating a strong national and global opportunity for technology startups to address near-term "pain points" that address resiliency and reliability, while fielding retrofits and updates that meet the visible market demands of the near future.

Like many areas of the economy, the transportation and logistics sectors have experienced major impacts throughout 2020 and into 2021. COVID-19 removed people from the workforce, changed how and where customers bought and expected delivery of goods, and dramatically accelerated remote work. Additionally, major impacts were felt through cyberattacks on key transportation infrastructure and a series of natural disasters. With this context, many major governments were pushed to look for longer-term, more sustainable pathways, which led to rapid policy adoption in support of electric vehicle conversion and other broad commitments to help mitigate the impacts of climate change.

In parallel to the challenges faced over the past two years, an impressive wave of technological innovation has helped fuel a set of high-quality investment opportunities. As solutions continue to be developed that enable the transportation and logistics sectors to meet their rapidly arriving future, Blackhorn's team believes we are seeing a once-in-a-generation investment opportunity.

Historically, the built environment has faced significant hurdles to innovation, and its adoption of burgeoning technologies has lagged behind the rest of the economy. However, as many companies are starting to deploy technology solutions that leverage accessible data, the industry is realizing that these technological advancements have the ability to generate valuable business insights. Moreover, this leap forward has created a catalytic movement for other innovations throughout the built environment sector. An example of this is the new capital-efficient supply chain integration business models that employ radically outsourced manufacturing and assembly, enabling efficient and resilient startups to prefabricate housing, hospitality, medical office buildings, and other constructed facilities. This has the potential to generate massive efficiencies and enhanced safety, compared to onsite construction.

A second new business model for offsite manufacturing of housing and other constructed facilities, called "fractal prefabrication," is being driven by digitization of design and advances in robotics and AI. In this business model, startups examine parts of the value chain for a single construction trade, like wood framing, metal framing for interior partitions, or rebar cage production, that are labor intensive, face skilled worker shortages, and can be automated with very high, SaaS-like gross margins. By dramatically speeding up onsite construction for the trades involved (and for the overall project, if the trade's work is on the critical path), the sector can reduce labor costs and materials waste, enhance worker safety, provide new, higher-paying jobs for low- or moderately skilled workers, and address the growing skilled labor shortage.

Throughout Blackhorn's target sectors, there have been a growing number of catalytic technologies that benefit a multitude of our sectors through efficiency-enabling breakthroughs. These opportunities offer newfound potential for growth and innovation, creating broad implications across the electrification, transportation and logistics, and built environment sectors. Oftentimes, these advances lay the groundwork for future opportunities that lead to further impact and change in our core sectors. This has manifested in different ways, ranging from better data optimization models and greater use of edge device computation, to increasing deployment of AI/ML and robotic. Often, there are multiple use cases across our sectors, including the logistics of various supply chains and the energy infrastructure that supports our cities and various means of production. There will be continually growing demand for these technologies across the spectrum. In turn, this has led to an impressive opportunity set that creates synergistic outcomes and gives impetus to more radical change.

Industrial Impact Fund in Numbers

YEAR ESTABLISHED

2019

INVESTMENT COMMITTEE

4

NUMBER OF EMPLOYEES

10

COMBINED INDUSTRY EXPERIENCE

108 years

INVESTMENTS REVIEWED

295

INVESTMENTS CLOSED

19

COMMITTED CAPITAL

$100M

Industrial Impact Fund

SDGs

As a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030, the United Nations Member States adopted the Sustainable Development Goals (SDGs), also known as the Global Goals, in 2015.

These 17 SDGs are integrated—meaning they recognize that action in one area will affect outcomes in others, and that development must balance social, economic, and environmental sustainability.[1]

Blackhorn Ventures is working to contribute to the Sustainable Development Goals of **Affordable and Clean Energy (#7), Decent Work and Economic Growth (#8), Industry, Innovation and Infrastructure (#9), Sustainable Cities and Communities (#11),** and **Responsible Consumption and Production (#12).**

AFFORDABLE AND CLEAN ENERGY

GRIDCURE

DECENT WORK AND ECONOMIC GROWTH

ALICE, FORESIGHT, GRIDRASTER, SAFEHUB, SUSTAINMENT, TOGGLE, VECNA ROBOTICS

INDUSTRY, INNOVATION AND INFRASTRUCTURE

BRIQ, LATENT AI, RHUMBIX

SUSTAINABLE CITIES AND COMMUNITIES

APERIA, HUMATICS, LOCOMATION, MODULOUS

RESPONSIBLE CONSUMPTION AND PRODUCTION

AGORUS, DRAWBOARD

[1] "Sustainable Development Goals | UNDP". 2020. UNDP. https://www.undp.org/content/undp/en/home/sustainable-development-goals.html.

AFFORDABLE AND CLEAN ENERGY

OPPORTUNITY FOR IMPACT:

Energy remains a dominant contributor to climate change as one of the top sources for GHG emissions. UN Sustainable Development Goal 7 seeks to provide affordable and clean energy at scale. This is being accomplished through a directed focus on three pillars: **energy access, energy efficiency,** and **level of renewable energy used.**

GRIDCURE'S IMPACT SOLUTION:

Our electrical grid is built upon aging and outdated infrastructure that we rely on every day. Failures are increasingly frequent, as climate events stress the aging infrastructure and the market continues to bring renewables, storage, EVs, and other new technologies online. Over the past 15 years, there has been a 600 percent increase in power outages, and over the next 10 years, there will be an estimated $177B investment gap for necessary repairs to this infrastructure base.

Alternative and distributed energy deployment continues to increase the demand placed on utilities and the energy grid infrastructure that supports distribution. To effectively serve their customers, utilities need access to data and business analytics.

GridCure seeks to bolster the resiliency of our energy system by aggregating data and creating real-time, actionable insights that enable utilities to better design, maintain, and operate reliable, resilient, and cost-effective smart grid systems.

A wave of enhanced AMI metering, new devices and sensors, and externally sourced customer and environmental data is currently being deployed. The resulting data streams are being captured at an accelerating rate to complement a vast and largely undigitized body of historical data that will provide the granular detail needed to support the future design, maintenance, and operation of this increasingly complex ecosystem.

GridCure

KEY SDGS SUPPORTED
PRIMARY TARGETS: 7.3, 12.2

GRIDCURE SOLVES THE SMART-GRID ANALYTICS ISSUE BY BRINGING THE CONCEPTS AND PRACTICES OF BIG DATA TO THE POWER UTILITY SPACE.

GridCure combines advanced analytics, innovative research, and user-intuitive design to offer simple and customizable solutions to utilities. Its technology helps utilities manage their energy more efficiently, incorporate renewable energy resources, and make better operational and financial decisions. It provides modular smart grid SaaS solutions that empower utilities to optimize their operations and customer service. GridCure also securely aggregates data from disparate systems, completes multi-layered analytics, and recommends real-time actionable insights. Finally, it offers simple and customizable solutions to help utilities make sense of their data and implement data-driven change.

SDG IMPACT

The U.S. Energy Information Administration predicts that the world's power demands will increase by nearly 60 percent between 2010 and 2040, making the distribution and transmission of the energy supply more complex. Even the most sophisticated utilities are unable to quickly synthesize their existing data sets, which limits their ability to generate meaningful insights and share key findings across their businesses. GridCure helps utilities plan for the generation, distribution, transmission, and storage of energy to address increasing energy needs. This contributes to SDG target 12.2 of achieving sustainable management and efficient use of natural resources, and ensuring the rate of improvement in energy efficiency required for SDG target 7.3.

Beneficiaries
- Customer service and AMI service workers
- Energy supply management professionals
- Distributed energy resource managers

Target Outcomes
- Meet and match increasing energy demand more cost-effectively and reliably, with more variable supply side resources.
- Support mandates to more effectively expand renewable resources.
- Increase reliability, safety, and performance/cost transparency for operators and their customers.
- Enable utilities to proactively monitor, manage, and purposely reduce their carbon footprint.

Contribution
- GridCure's out-of-the-box software has proven to reduce utilities' operating expenses by up to 70 percent, while simultaneously increasing their reliability by up to 60 percent.

Risk
- Without the GridCure platform, even the most sophisticated utilities are challenged by their inability to quickly synthesize data to investigate complex system challenges in the energy domain.

DECENT WORK AND ECONOMIC GROWTH

SDG 8 seeks to achieve higher levels of economic productivity through diversification, technological upgrading, and innovation, including a focus on high-value-add and labor-intensive sectors. In addition, through 2030, SDG 8 seeks progressive improvements in global resource efficiency related to resource consumption and production, as well as in relation to endeavors to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programs on sustainable consumption and production, with developed countries taking the lead.

BLACKHORN VENTURE'S CASE STUDIES

ALICE

Foresight

GRIDRASTER

safehub

SUSTAINMENT

TOGGLE

VECNA robotics

FORESIGHT'S IMPACT SOLUTION:

Foresight's Safesite solution is a mobile-first safety management platform. With more than 45,000 live safety data points collected daily from more than 4,000 heavy industry companies, the Safesite solution drives improvements to workforce engagement tied to safety and facilitates behavior change on construction job sites. During the first six months of its offering, the Safesite application showed a 31 percent average incident reduction rate for the 351 companies using the solution.

In addition, Foresight also offers an insurtech product focused on workers' compensation, reduces the incidence of accidents and injuries on job sites, and rewards safety-focused customers through four pathways:

1. **Sustainability:** For medium-sized businesses with 10 to 500 employees operating with single-digit profit margins, Safesite's tool allows more businesses to keep their doors open by discounting premiums. Driving down insurance premiums by up to 50 percent adds meaningful incremental savings.

2. **Human-centric Approach:** Use of the platform reduces the cost of claims under an insurance claim, while allowing injured employees to obtain their claims more quickly. Using a human-centered approach, a third-party claims representative works to better understand the claimant's life, family, and financial situation, reducing the average number of days away from work.

3. **Total Human Help:** By helping to improve other aspects of employees' working conditions, including mental and physical health and flexibility, the app helps decrease incident rates and increase the workforce's general well-being.

4. **Reducing Job Transfer:** Often when workers are injured, they are forced to change their type of work. By decreasing the number and severity of injuries, companies may be able to help workers maintain their current work or trade.

ALICE Technologies

KEY SDGS SUPPORTED
PRIMARY TARGET: 8.2

HELPING CONTRACTORS ANSWER "WHAT IF?" IN JUST MINUTES.

Rescheduling construction projects is both time-consuming and error-prone, and leads to significant inefficiencies in cost, labor, equipment use, and energy consumption.

ALICE provides a powerful AI-powered schedule simulation and optimization platform that parametrically runs thousands of scenarios to help large general contractors understand the time and cost trade-offs of utilizing different sequences and resources. ALICE explores schedule sequences and gives teams the power to explore "What if?" scenarios that assist them in evaluating changes to plans or schedules in just minutes. By creating alternative schedule scenarios and making it easy for users to weigh their options, ALICE helps projects achieve greater efficiency in labor, equipment, material, and energy savings.

SDG IMPACT

The ALICE platform allows general contractors to quickly simulate thousands of schedule scenarios. With ALICE, users develop a construction plan that best matches their specific business goals, and, if circumstances changes along the way, they can re-sequence their scheduling during the construction process. Through this work, ALICE contributes to its primary SDG target 8.2 of achieving higher levels of economic productivity through technological innovation in labor-intensive sectors.

Beneficiaries
- Contractors
- Subcontractors and workers

Target Outcomes
- The planning process is reduced to a matter of days versus traditional methods that take three to four months.
- In recent case studies, firms saw on average:
  – Less than a week to train and implement
  – Construction durations reduced by 17 percent
  – Construction costs reduced by 11 percent

Contribution
- Currently, manual approaches to construction scheduling can evaluate only a small subset of scenarios. Through AI, general contractors can consider numerous possibilities, with increased visibility and improved understanding of the various trade-offs of cost, time, and resource needs.

Risk
- With the status quo, contractors risk dramatic schedule and cost overruns.
- According to McKinsey & Company, large construction projects are typically completed 80 percent over budget and take 20 percent longer than originally scheduled.

Foresight

TRANSFORMING THE WAY COMPANIES IN HIGH-RISK INDUSTRIES MANAGE THEIR EVERYDAY SAFETY AND COMPLIANCE NEEDS.

Foresight's Safesite product is a cutting-edge risk-management technology that creates a safer work environment by digitizing paper-based safety and compliance processes, leading to a reduction in worker safety incidents and lost costs associated with these incidents. In addition, Foresight is a new, technology-driven commercial insurance provider for the U.S. heavy construction industry.

Foresight's platform prioritizes safety and technology, rewarding safe businesses with more performance-based pricing. The Safesite solution promotes best practices and reduces safety incidents by up to 57 percent, while reducing loss ratios and collected premiums. This enables users to pass significant savings on to customers. The industry's current loss ratio stands at 79 percent, due to the high cost of claims. Safesite brings loss ratios to below 55 percent, which yields significant savings for customers.

SDG IMPACT

Foresight allows the construction industry to utilize mobile technology to reduce risk, increase compliance, and generate valuable data that can be used for corrective measures. With relation to SDG target 8.8, Foresight's system enables the construction industry to create a safer and more efficient work environment. Its data collection, ML/AI technologies, and mobile application improve safety and risk management, resulting in fewer and less severe incidents on the jobsite.

Beneficiaries
- Small and medium-sized contractors
- Insurance actuaries
- Insured workers

Target Outcomes
- Mobile-first safety management solution that prevents injuries, saves lives, and makes the construction workplace more sustainable.

Contribution
- Foresight has reduced insurance premiums by up to 60 percent, standing at approximately 9 percent for several mid-sized businesses. In such cases, there are net margin improvements for these companies, leading to profit increases of 25–33 percent.
- On average, Safesite has generated a 57 percent reduction in workplace incidents.

Risk
- Without external audits and compliance checks, the construction industry puts workers and managers at high physical risk.

GridRaster

SCALING THE EFFICIENCY OF CLOUD PROCESSING POWER FOR VR/AR/MR.

As virtual reality, augmented reality, and mixed reality (VR/AR/MR) enter the market and are increasingly adopted, they are creating new challenges to managing large environment models with high complexity. These models require significant processing power, which suggests the need for a cloud-based approach. But data latency often leads to delays in displaying graphics on a headset, causing users to experience extensive wait times—impeding real-time user review potential and even leading to user disorientation.

GridRaster provides a platform solution that is hosted on edge computing resources that are geolocated near the user to allow for the power of cloud processing, but with a minimization of the latency that is commonplace with VR/AR/MR. Its solution enables more efficient scaling of VR/AR/MR by decoupling processing from the user's viewing device. This also opens the door to less expensive VR/AR/MR devices, as the core rendering hardware can be located in an edge server that is more efficient to run rather than in the device itself.

SDG IMPACT

GridRaster's platform allows firms to utilize AR technology more effectively, giving workers real-time instruction overlaid on surfaces or materials that allows for remote review and processing. These processes significantly increase organizational throughput and productivity while reducing errors, and it decrease the need for excessive travel that can be associated with the team review process. This technological innovation works toward increasing both the capability and economic productivity of workers in high-value-add, labor-intensive sectors, which contributes to SDG targets 8.2 and 9.5.

Beneficiaries
- Workers using the system
- Companies adopting the platform
- Downstream consumers of products produced with GridRaster's assistance

Target Outcomes
- Customers are experiencing a 40 percent increase in productivity and an 85 percent decrease in training time through the use of VR/AR/MR applications.

Contribution
- Although similar solutions exist, GridRaster is focused on offering a greater level of precision and expansiveness than other current market players.

Risk
- Without VR/AR/MR technology, industrial sectors will continue to spend excessive resources training employees, while experiencing errors in assembly and longer completion times on projects.
- GridRaster allows for faster technology adoption, reducing environmental impact through creating efficiency gains and increasing human capital more immediately via technological augmentation.

Safehub

KEY SDGS SUPPORTED

PRIMARY TARGET: 8.8

8 DECENT WORK AND ECONOMIC GROWTH | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | 11 SUSTAINABLE CITIES AND COMMUNITIES

IOT SENSOR-BASED ANALYTICS PLATFORM TO REDUCE BUSINESS INTERRUPTION LOSSES FROM CATASTROPHIC EVENTS.

Catastrophic events like earthquakes and hurricanes can also cause significant disruption to operations and supply chains, resulting in long-term economic impacts. This can have major downstream effects, as evidenced by the major business interruptions created by COVID-19 and events like the Suez Canal blockage by the *Ever Given*.

Through a combination of proprietary sensors, analytics, and third-party data, Safehub is building the world's first IoT sensor-based analytics platform to provide building-specific structural damage information, with an initial focus on earthquakes. The platform analyzes data and deploys actionable information through a web-based dashboard, text messages, and email alerts used to estimate damage to buildings and real estate portfolios, gauge business interruption losses, and inform customers within a matter of minutes.

SDG IMPACT

Safehub's data capture and risk modeling dramatically improve the accuracy and awareness of building management teams and insurance underwriters, enabling higher levels of economic productivity through more efficient use of capital and greater risk reduction and prevention. With relation to SDG target 8.8, Safehub's products enable building construction and management to monitor risk with much greater accuracy, supporting the goal of ensuring a safe and secure working environment. This leads to great savings in upfront insurance costs and a reduction in business interruption losses due to increased reporting and risk reduction capabilities.

Beneficiaries
- Structural engineers
- Insurance underwriters
- Building owners
- Risk managers

Target Outcomes
- Companies more accurately monitor the safety and operational viability of their buildings and become more aware of potential risks within their operational footprints.
- More accurate and competitive insurance underwriting leads to more efficient use of capital in relation to disaster-related insurance products.

Contribution
- Greater accuracy in data capture and risk modeling.
- Creates much more accurate and competitive pricing models for insurance underwriters.
- Decreases losses from catastrophes due to real-time data.
- Greater prioritization and utilization of risk reduction capital improvements.

Risk
- Catastrophic events cause significant business interruption by disrupting operations and supply chains, resulting in major long-term impacts on businesses of all kinds.

Sustainment

KEY SDGS SUPPORTED

PRIMARY TARGET: 8.3

8 DECENT WORK AND ECONOMIC GROWTH | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

LOCALIZING, DIVERSIFYING, AND OPTIMIZING INDUSTRIAL SUPPLY CHAINS.

There is a fragmented ecosystem of more than 20,000 U.S. machine shops with their associated enterprises. These SMBs are typically small, generational businesses that lack websites or business development capabilities, making it difficult for customers to find them. This makes the bidding process on the buyer side time-consuming and cumbersome.

Sustainment is a SaaS platform that connects U.S. machine shops with enterprise customers to enable efficient, secure, and U.S.-first supplier networks. Sustainment estimates that its solution reduces sourcing time and costs by 30–40 percent annually by offering vendor matching, which it plans to further augment to provide predictive models for buyers and vendors and market intelligence services to capture real-time industrial base flows.

SDG IMPACT

Sustainment fulfills its primary SDG target, 8.3, by providing support for decent job creation and supporting the growth of SMBs by bridging the gap between vendors and SMBs looking to transact with them. It targets a massive labor pain point that commonly affects vendors and suppliers in the U.S. manufacturing and material inputs industry. The USAF alone does $7B worth of transactions over 9k–12k sourcing activities annually, with each bid requiring an average of 14 days of vendor discovery per sourcing activity. That is the equivalent of more than 1 million hours lost annually lost due to inefficient vendor matching processes. The platform reduces sourcing time and promotes workforce efficiency for SMBs and vendors that would otherwise struggle to identify each other in what is currently a highly inefficient market.

Beneficiaries
- Small and medium enterprise businesses
- Manufacturing and material input vendors/suppliers

Target Outcomes
- To streamline the vendor discovery experience and support demand planning to provide predictive models for buyers and vendors, in addition to providing market intelligence services.

Contribution
- Sustainment estimates that their solution will reduce sourcing time and costs by an estimated 30–40 percent per year.

Risk
- The average lead time for parts is 550 days, leading to an estimated $1M per day in lost value due to downstream costs tied to delayed repair and maintenance activities.

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Toggle

AUTOMATING THE ASSEMBLY OF REBAR CAGES VIA ROBOTICS.

Rebar is a necessity because of the abundance of reinforced concrete that is used in major construction projects. However, there is a lack of skilled ironworkers to accurately assemble rebar cages from shop drawings. This often leads to delays, increased costs, and a host of safety issues.

Toggle provides a capital-light, software-enhanced robotically manufactured component that requires little skilled labor and can be automated very cost-effectively. By automating the assembly of rebar cages, Toggle helps to more quickly meet the global construction demand for higher-quality, safer, and lower-cost rebar.

SDG IMPACT

Using its state-of-the-art technology and processes to manufacture rebar components, Toggle moves the construction site's complexity into a safe, controlled environment. By boosting productivity and efficiency for the foundational processes required to construct city buildings and infrastructure, Toggle supports SDG 8.4, which seeks to improve global resource efficiency to decouple economic growth and environmental impact. In terms of labor productivity, the company's approach to rebar assembly has demonstrated the ability to reduce the number of labor hours per ton of rebar produced by 50 percent.

Beneficiaries
- Urban development construction project owners
- Renewable energy facilities

Target Outcomes
- Develop technology for the construction industry that will bring a new level of safety, efficiency, and precision to the production of critical construction components.

Contribution
- Toggle's full-stack robotics and automation solution for rebar fabrication and assembly multiplies labor productivity by 3x and allows for an increase of overall production by up to 5x.

Risk
- Reinforced concrete is one of the most used construction products in the world, and it comes with an unnecessary level of worker risk, pollution, time, and material wastage.

Vecna Robotics

A SYNERGISTIC WORKFORCE THAT OPTIMIZES HUMAN AND ROBOTIC COLLABORATION.

E-commerce has altered every step of the supply line, leading to a massive shift in how consumer products are purchased, stored, and shipped,. This creates a logistical nightmare, as warehouses fail to adapt and scale along with current levels of market demand. These facilities are almost entirely staffed by a human workforce; however, the cost of rising wages, lack of efficiency, and high levels of seasonality and variability in demand result in challenging work environments.

Vecna Robotics is developing a platform that provides the hardware needed to automate the warehouse space and pairs this hardware solution with an AI-based platform that orchestrates the warehouse supply chain's entire workflow. This focus on software development allows for more efficiency and coordination by maximizing levels of warehouse automation while keeping humans engaged in the process.

SDG IMPACT

Vecna Robotics' system transforms the intralogistics industry by creating a synergistic, hybrid robotic and human workforce. Its orchestration engine allows the supply chain to be optimized, accounting for multiple variables that fluctuate throughout the year due to inconsistent and seasonal supply and demand peaks. Vecna's supply chain optimization methods directly contribute to SDG target 8.1 by maintaining per capita economic growth in a sustainable and technology-forward manner. Vecna also works toward SDG target 8.2 of achieving higher levels of economic productivity through technological innovations in labor-intensive sectors like the logistics and warehousing industries.

Beneficiaries
- E-commerce solutions
- Warehousing companies
- Society at large/consumers of e-commerce

Target Outcomes
- Workflow optimization of warehouses through both software and hardware.
- By offering flexible, adaptive automated environments, human-robot teams can operate up to 85 percent more efficiently than either humans or robots independently.

Contribution
- Accelerating the hardware-agnostic approach at the fastest pace

Risk
- Without this level and type of automation, the industry is likely to be on a much longer trajectory to sustainability.
- By operating in a hybrid environment, the industry can save jobs that would otherwise be eliminated and create better, safer jobs.
- Without proper orchestration, customers would not be able to realize the massive efficiency gains stemming from a hybrid human-robotic approach.

OPPORTUNITY FOR IMPACT:

By 2030, UN Sustainable Development Goal 9 seeks to upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.

INDUSTRY, INNOVATION AND INFRASTRUCTURE

BLACKHORN VENTURE'S CASE STUDIES

briq

LatentAI

RMBX RHUMBIX
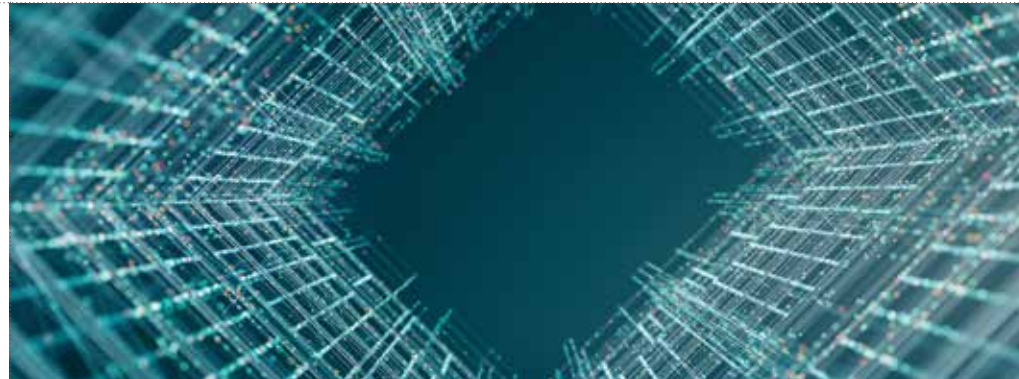
LATENT AI'S IMPACT SOLUTION:

According to a 2020 report by the IDC, there will be an estimated 75 billion IoT devices creating 90 zettabytes of data by 2025. However, today's artificial intelligence and machine learning ("AI/ML") developments are narrowly focused on specific AI models and related types of hardware.

Latent AI's solution enables adaptive AI across the edge continuum of devices, with an end-to-end workflow that manages the life cycle of edge AI models. This is done through four primary modalities: training and compression, compiling and optimizing, running and managing, and continuous connection/monitoring.

Through this work, models can be compressed to use one-tenth the memory with four times lower latency, throttle down to 30 percent utilization, and create significant energy savings. By moving its efficient, smaller models to the edge devices, Latent AI's customers will not only see speed and power optimization, but continual improvement as the model refines itself over time.

Briq

KEY SDGS SUPPORTED
PRIMARY TARGETS: 9.2, 9.3

TURNING DATA INTO ACTIONABLE FINANCIAL INSIGHTS.

Briq developed a set of robotic process automation (RPA) bots that extract data from existing key installed applications, including legacy corporate Enterprise Resource Planning (ERP) systems. From this unified "data lake," Briq derives reports that synthesize data and display it using Briq's visualization tools, or through a data export to apps like Tableau, where customers can create custom dashboards. Briq is also creating a set of machine learning (ML) algorithms to derive actionable insights about market opportunities, project financial performance, and human resources.

With the launch of Briqpay, a payment platform for B2B online sales with instant credit lookups and credit rules, Briq has fully digitized the control of online credit exposure. Briqpay also helps with valuable customer insights that will improve user experience and increase sales via a personalized business-to-business experience on a local or global basis.

SDG IMPACT

Briq products allow for higher levels of economic productivity through enhanced decision making, technological upgrading, and innovation. The company's RPA technology allows firms to understand the wealth of data that is currently unused, giving them better insights into market opportunities, past and future project performance, resource utilization, and increasing resource efficiency. Briq's unique approach supports SDG 9 by promoting inclusive and sustainable industrialization in target 9.2, promoting sustainable industrialization in target 9.3, and providing infrastructure resources to small-scale industrial enterprises.

Beneficiaries
- General contractors and subcontractors
- Project financial planning teams
- Construction laborers

Target Outcomes
- Recently, a Briq client experienced:
  – Freezing overhead costs by revealing operational inefficiencies, leading to up to 82 percent efficiency gains when utilizing automation and analytics.
  – Forecasts were up to 40 percent more accurate in some scenarios.
  – Achieved ROI increases of ~10 percent and winning larger projects.

Contribution
- Most of Briq's competitors are focused on data collection, rather than data aggregation and the provision of business intelligence. Through Briq's approach, companies have new access to their data and the potential to change how they manage their businesses.

Risk
- Without data aggregation and the provision of deeper insights, the construction industry would continue to see less-than-optimal utilization of capital and human resources.

Latent AI

LATENT AI ACCELERATES AI IMPLEMENTATION AND WORKFLOWS FOR ENTERPRISES ON THE EDGE CONTINUUM.

Latent AI provides a full productization solution for AI/ML models by converting from common development environments to a proprietary format. The Latent AI platform quantizes a model through reductions in numeric precision, allowing systems to minimize performance needed and reduce latency and memory requirements. As AI models are developed for an increasing number of use cases, issues arise that limit productization around models being too large, slow, and power hungry to run on embedded edge processors. As the need for edge processing increases, edge AI allows for more intelligent and efficient computation. This is a crucial evolution, as data generation creates bandwidth constraints, latency slowdowns, and connectivity issues.

In addition, a proprietary runtime manages the model's execution. This allows throttling of a model to be more power efficient and provides an adaptive functionality where a model can push data up the network chain from the edge to the cloud for additional horsepower as required. Finally, a monitoring layer is provided that allows for continual optimization and refinement alongside a management capability to control the deployment of AI/ML models to end devices and the cloud.

SDG IMPACT

Latent AI products enable adaptive AI across the edge continuum, with an end-to-end workflow to manage the life cycle of edge AI models. It is developing a platform to help companies implement and accelerate AI workflows on the edge, and it has developed adaptive AI algorithms that are a philosophy and method for edge AI that improves essential functions. Latent AI supports SDG 9.5, targeting the upgrade of technological capabilities of the industrial sector, through quantization-guided training, continuous optimization, conditionally gated networks, and adaptive runtime.

Beneficiaries
- Communities at large via lowered power consumption
- Companies implementing AI/ML processes

Target Outcomes
- Support the development of intelligent and efficient embedded edge processing.

Contribution
- Its hybrid quantization approach helps reduce 10x memory and achieve 4x lower latency.

Risk
- Without its technology, data generation causes bandwidth constraints, latency, and connectivity issues.
- Continued usage of unoptimized processing methods will have an increasing power draw, leading to excessive energy consumption.

Rhumbix

DIGITIZATION OF WORKER-LEVEL AND FIELD-LEVEL DATA OPTIMIZES THE LABOR FORCE.

In 2014, Rhumbix began building a "worker first" platform to digitize time cards for payroll and production tracking for labor productivity, and it has since expanded into the provision of daily construction reports and the tracking of time and materials (T&M) tags for change order management. Today, Rhumbix is the industry leader in digitizing field data from workers on construction project sites, and its platform is used by several of the U.S.'s top general contractors and specialty subcontractors.

SDG IMPACT

Rhumbix's technology is correlated with the promotion of safe, secure work environments and opportunities for wage-level workers to progress in their training, certification, and career development. Through its data-driven approach, Rhumbix powers the construction industry and allows sustainable, efficient growth within the industry. With real-time reporting, foremen can actively track raw materials needed at job sites, ensuring less waste from unused materials and less time spent coordinating with the central office. Overall, Rhumbix promotes SDG target 9.2 of promoting sustainable industrialization by optimizing labor and materials usage in the construction sector. As a result, it promotes higher economic productivity in labor-intensive industries in accordance with SDG target 8.2.

Beneficiaries
- Foremen
- Workers
- Project owners and engineers

Target Outcomes
- One client realized a 790 percent ROI within a month of deploying Rhumbix, resulting in significant savings in resources.
- 30 percent reduction in time to collect data from time cards.
- Digital timekeeping shows 90 percent accuracy improvement rates.

Contribution
- Many of Rhumbix's competitors offer similar individual product features; however, the market is shifting toward a single-platform, all-encompassing solution.

Risk
- Without access to the field-level data generated on the Rhumbix platform, decision makers are too far removed from daily operations to gain full understanding of the complexity on jobsites that is required for both value creation and maximizing productivity.

SUSTAINABLE CITIES AND COMMUNITIES

BLACKHORN VENTURE'S CASE STUDIES

Aperia
TECHNOLOGIES

HUMATICS

LOCOMATION

modulous

OPPORTUNITY FOR IMPACT:

Cities and metropolitan areas are powerhouses of economic growth—contributing nearly 60 percent of global GDP. However, they also account for about 70 percent of global carbon emissions and over 60 percent of global resource use. UN Sustainable Development Goal 11 aims to reduce the adverse per-capita environmental impact of cities, including paying special attention to air quality and municipal and other waste management by 2030.

LOCOMATION'S SOLUTION:

With the rise of e-commerce and increasing demand for faster delivery times, the need for more efficient and sustainable transportation of goods continues to grow. In addition, the trucking industry is not positioned to meet surging levels of freight demand, largely due to historically steady declines in the supply of trucking laborers.

Locomation seeks to address this market need through an autonomous trucking model that does not seek to fully automate trucking. Instead, it utilizes a semi-autonomous platooning model to create an immediate, near-term solution that helps the end consumer and improves conditions for truck drivers and rest of the supply chain.

This semi-autonomous trucking solution offers customers a compelling value proposition by allowing for twice the amount of cargo to be transported, twice as far and twice as quickly. Locomation's value is further demonstrated by an estimated 30 percent reduction in operating costs, a 31 percent increase in equipment utilization, a 25 percent increase in driver utilization, and an estimated 66 metric tons of CO_2 eliminated per year per convoy deployed.

Aperia

KEY SDGS SUPPORTED
PRIMARY TARGET:11.2

MAINTAINING OPTIMAL TIRE PRESSURE FOR SAFER TRANSPORTATION.

Leaky valve stems, temperature changes, natural leakage, uncalibrated air pressure gauges, and other factors can cause tires to become underinflated, making tractor trailer tire pressure nearly impossible to manage manually. Tires not operating at their recommended pressure experience heating and flexing of the sidewall, which is the primary cause of catastrophic tire failure.

Aperia offers the only bolt-on solution for maintaining optimal tire pressure for tractor trailers. The "Halo," Aperia's bolt-on solution, keeps tires at optimal pressure levels for maximizing fuel economy and tire life. Properly inflated tires maximize traction, reduce wear, and reduce rolling resistance. By decreasing tire rolling resistance, properly inflated tires can increase fleet MPG by up to 2.5 percent for every 10 percent a tire was improperly inflated. Fleets may also realize an up to 15 percent longer tire life.

SDG IMPACT

Aperia's bolt-on Halo product dramatically improves trucking efficiency. By maintaining proper tire inflation, trucking companies can extend tire life; reduce tire waste, fuel consumption, and GHG emissions; and experience fewer catastrophic failures requiring downtime and roadside assistance. Aperia makes valuable contributions to SDG 11 of sustainable cities and communities. Specifically it supports target 11.2 of providing safe, affordable, accessible, and sustainable transport systems.

Beneficiaries
- Commercial trucking industries
- Other drivers and motorists on roadways
- Customers of trucking and logistics operators
- End consumers

Target Outcomes
- Estimates show that proper tire inflation could save over 5.5 million tons of CO_2 and over $1.5 billion in fuel savings for the U.S. trucking industry alone per year.

Contribution
- Given the current competition it is unlikely that another solution this simple, yet effective would have likely emerged in the immediate future.
  – Most current solutions can operate only on the trailer and do not function on the hub, but rather from a centralized system.

Risk
- Without this technology, the trucking industry will continue on its path with excessive fuel consumption and tire blowouts that compromise both efficiency and safety of everyone on the road.

Humatics

KEY SDGS SUPPORTED
PRIMARY TARGET: 11.2

ADVANCING AUTOMATION THROUGH ULTRAPRECISE SPATIAL POSITIONING TECHNOLOGY.

High-precision location and positioning data is critical for advancing automation across the built environment, transportation, and other industrial sectors. Currently, outdoor global positioning systems (GPS) or global navigation satellite systems (GNSS) systems provide positioning data but have resolution limits unless they are stationary. Industrial operations inside of buildings, where many industries have heavy automation requirements, are dependent on visual or proximity beacon recognition systems, which generally fall short of user precision and accuracy requirements.

Humatics offers centimeter- and millimeter-scale local positioning systems that are faster, ultraprecise, and more affordable than current technologies. Through the combination of revolutionary sensor technology with machine learning, data analytics, and a location software platform, Humatics' products make it possible for mobile devices to locate, navigate, and collaborate.

SDG IMPACT

Subway systems like the NYC MTA use Humatics' micro-location sensors to gain insights into how subway cars can be operated more efficiently. This has become more imperative during the COVID-19 pandemic, as cities need to operate public transportation systems more safely and efficiently. The ability to precisely locate the position of a subway car while it is underground allows for a higher throughput of traffic within the system and helps the city to continue operating without delays or disruptions to urban mobility. With relation to SDG 11, target 11.2 seeks to provide safe, affordable, accessible, and sustainable transport systems. The Humatics platform enables efficiency breakthroughs to address this goal, while enabling the consumption of fewer core resources to deliver greater output.

Beneficiaries
 • Downstream passengers and consumers

Target Outcomes
 • Enable and improve the efficiency of many
   customer operations, including:
     – Warehousing, manufacturing, port
        operations, rail, and other applications
 • For the rail application, Humatics will assist a
   major transportation authority in improving the
   efficiency and throughput of its operations.

Contribution
 • With adoption, greater efficiencies and
   reduction in emissions can be achieved.

Risk
 • Without increasing automation, accelerating
   technological adoption, and improving efficiency,
   it will be increasingly difficult for cities and
   municipalities to meet their targeted emission
   reductions goals due to continued usage of
   materials and energy tied to massive sectors
   like the transportation sector.

Locomation

KEY SDGS SUPPORTED
PRIMARY TARGET: 11.2

TACKLING THE PROBLEM OF DRIVER SHORTAGES AND TIME EFFICIENCY IN THE TRUCKING INDUSTRY WITH SEMI-AUTONOMOUS PLATOONING.

According to the American Trucking Association, the shortage of truck drivers in the U.S. is predicted to grow to over 100,000 by 2023. In addition, the sector is further challenged by the fact that human drivers are regulated as to how long they can operate a truck continuously.

Locomation's system directly addresses this problem by allowing a lead driver to guide a platoon of semi-autonomous trucks with a simplified automation solution that allows trucks equipped with the system to join a convoy platoon led by a human driver.

SDG IMPACT

Locomation's system allows operators to unlock system capacity, while also generating substantial fuel savings and reducing GHG emissions. By improving the asset utilization of trucking fleets, operators can more effectively optimize the use of their trucking physical asset base. These gains allow trucking systems to be competitive in an e-commerce-driven environment, making trucking competitive with rail-based routes and often with air freight alternatives. Locomation ensures SDG 11.2 by providing access to affordable and sustainable transport systems via its semi-autonomous platooning platform.

Beneficiaries
 • Truck drivers
 • Trucking and logistics operators
 • Supply chain managers

Target Outcomes
 • ~8 percent average fuel saving per truck
   (~5 percent leader and ~10 percent follower),
   equating to >44 tons per year CO_2 reduction
   per truck.
 • Fuel savings combined with 50 percent labor
   savings results in ~30 percent overall OpEx
   reduction, yielding a 10x improvement in an
   industry with 3–5 percent profit margins.
 • The autonomous convoy system unlocks
   previously unavailable capacity, delivering
   2x cargo, at 2x the distance, 2x as fast.

Contribution
 • There are many players in the autonomous
   vehicle sector, but Locomation's model is one
   of the few that balances near-term applicability
   with a balanced mix of human action and
   automation.

Risk
 • Locomation's technology may serve as a
   catalyst for the broader adoption of autonomous
   vehicles, and the societal and environmental
   outcomes that are made possible.
 • Without the advancement of technologies like
   Locomation's, the transportation industry will be
   unable to achieve the fuel and time savings that
   are required to improve efficiencies in one of the
   world's largest and most polluting industries.
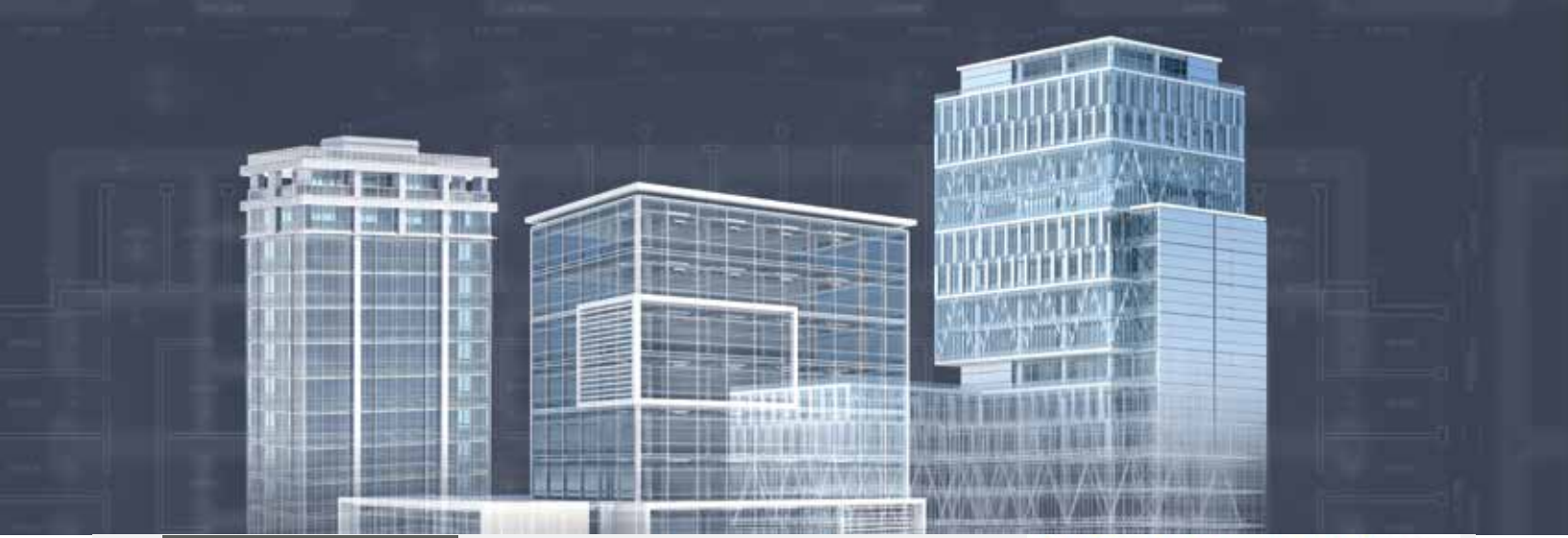
Modulous

REDEFINING THE DESIGN & DELIVERY OF AFFORDABLE, SUSTAINABLE, AND SMART HOMES BY LEVERAGING DISRUPTIVE DIGITAL TECHNOLOGIES.

The Modulous platform offers a digitized solution that rapidly creates home designs from a kit of parts, enabling third-party local builders to assemble and install high-quality, sustainable, and affordable homes. Its system utilizes generative design alongside its assembler algorithm to efficiently use space for construction. The algorithm also matches assemblers to projects, creating an integrated network that works with the assemblers' supply chain. The data set can help deliver modular homes local to the project at a price and speed that are currently not feasible on the part of large manufacturers. This approach protects local employment and the environment, and it provides the developer and local government with a robust solution for delivering reliable and cost-efficient homes at scale.

SDG IMPACT

Modulous is directly addressing the construction process's efficiency through savings in residential construction costs and improvements in building efficiency metrics. It addresses SDG target 11.1 by providing access to safe, affordable, and sustainable housing. This has a waterfall effect on capital allocation, dispatch processes, and distribution networks. By focusing on the public affordable housing market, Modulus delivers a scalable, industrywide solution that challenges the existing housing and construction sphere and generates positive outcomes for low-income residents. Its model allows public providers of multi-family housing to address currently underserved levels of demand for new housing inventory in a more cost-efficient way, with reduced timelines and project development cycles.

Beneficiaries
- Local planning officers
- Home developers
- Local governments

Target Outcomes
- Providing planning data, market intelligence, and optimized designs to developers and planning officers to establish sustainable homes.

Contribution
- Its platform generates multiple design options that can then be used to build and deliver the most sustainable, robust housing solution.

Risk
- Without the Modulous platform, the traditional construction process produces large amounts of physical waste, causing project overspending and program overruns.

RESPONSIBLE CONSUMPTION AND PRODUCTION

AGORUS

DRAWBOARD

OPPORTUNITY FOR IMPACT:

UN Sustainable Development Goal 12 states that measures should be taken to substantially reduce waste generation through waste prevention, resource reduction and the recycling and reuse of materials by 2030. The goal also encourages companies, especially large, and transnational companies, to adopt sustainable practices and reporting related to sustainability-focused initiatives.

AGORUS'S IMPACT SOLUTION:

Residential housing construction is plagued by delayed completion times and schedule overruns. This is primarily due to a lack of skilled labor, a "slinky effect" caused by the gig economy, whereby skilled workers jump from job site to job site. Typically, for a single in-fill residential housing build, a six-week timeline represents a quick build for the framing process. Oftentimes, this can take up to 10–12 weeks.

Agorus is addressing the lack of sustainable and affordable housing through its approach to software-enabled, offsite, and robotic automation-supported residential construction. Through its panelized approach to construction, which is supported by a digitized design and planning process, Agorus is decreasing excessive waste and time spent on residential housing job sites.

It is currently completing residential housing panels that will be assembled up through the rough trades, including both plumbing and electrical. By moving assembly from a home site into a factory, Agorus reduces the overall consumption of lumber material by approximately 15–20 percent. This equates to an offset of 8,000 pounds of waste that would be generated by a 2,000-sq.-ft home. By shifting this process off-site and constructing a home through panelization, there is a significant reduction in the number of extra lumber cuts and resulting materials waste. Agorus can build and assemble a house frame in approximately two days, with one to two additional days required for on-site tacking.

Agorus

DESIGN, MANUFACTURE, AND ASSEMBLE HOMES THROUGH ONE INTEGRATED SOFTWARE PLATFORM.

The Agorus software solution, Talós, transforms an architect's custom design into a detailed digital design file. The file breaks up the build into panels, which are created on an automated, just-in-time manufacturing line. These panels are transported to the jobsite and assembled by a field assembly and site technology team in days rather than weeks, as is seen through the traditional approach. This value engineering approach has generated a 15–20 percent reduction in overall lumber material usage.

SDG IMPACT

Agorus's digital construction technology allows for speed, customization, and scalability, which are needed to meet currently rising levels of housing demand. Its proprietary platform, Talós, helps it target key inefficiencies in the residential home construction market, promoting SDG 12, responsible consumption and production. Specifically, Agorus is working toward the targets of achieving the sustainable management and efficient use of natural resources as listed in target 12.2 and enable a substantial reduction in waste generation through prevention, reduction, recycling, and reuse, as listed in target 12.5.

Beneficiaries
- Contractors
- Home buyers

Target Outcomes
- Shifting a 10- to 12-week process to a multiday build while improving labor, environmental, and social outcomes

Contribution
- Agorus uses value engineering to create a 15–20 percent reduction in waste lumber materials.
- A relevant labor productivity metric Agorus tracks is linear feet per hour; at the moment, it stands at approximately 50 and Agorus hopes to reach 150 feet per hour soon.
- This equates to a full 2,500-square-foot home in an eight-hour shift, with installation possible within an additional three days.

Risk
- Rising lack of affordable, sustainable homes due to throughput limitations of existing approaches. This would continue to compound, leading to further unmet demand.

Drawboard

REAL-TIME COLLABORATION AND RESOURCE EFFICIENCY FOR THE INDUSTRIAL SECTOR.

Currently, the design and construction industries rely heavily on paper and available PDF programs for markups. These are expensive and difficult to use, and have antiquated user interfaces that result in slow design review processes. As a result, conventional pen and paper markup experience has been favored, since previous technology-enabled solutions lacked real-time collaboration and could be used only for locally stored files.

Drawboard creates easy and collaborative PDF software for architecture, engineering, construction, and other document-heavy industries. This increases efficiency by enabling a collaborative approach via an online solution. Drawboard's usability, syncing, and digital inking approach can create a future with intuitive, rapid, and paperless workforce collaboration and documentation.

SDG IMPACT

Drawboard enables a massive industrial sector to go paperless, making it more resilient, efficient, and sustainable. Its technology makes the design and construction industry more resource efficient and reduces costly travel needs for design iteration sessions. Drawboard's system integrates complex workflows into its seamless technology, providing users with easy-to-use UX and UI, real-time collaboration, and easy documentation. By allowing for a paperless future and unlocking new opportunities that come along with digitization, Drawboard supports SDG target 12.2 of the sustainable management of resources.

Beneficiaries
- Large design firms
- Teams that need to plan remotely, asynchronously, and simultaneously

Target Outcomes
- In a 100-user pilot, the client experienced significant gains in its processes, and, if annualized, would result in:
    - Internal review cycles increasing in speed by 92 percent
  - 26,280 hours saved on manual tasks
  - $2.5M in net savings
  - 189 tons in CO_2 savings
  - A 97 percent paperless process

Contribution
- Drawboard's superior advantage over other similar market solutions is created by its application's simplicity and ease of use.

Risk
- Presently, remote teams are faced with multiple challenges to asynchronous collaboration because it often requires extensive travel, numerous repeated meetings, and hours of physically working together with paper and pencil to accomplish what is possible through the Drawboard platform.
    - This represents a lack of time efficiency and an immense environmental impact due to travel requirements.
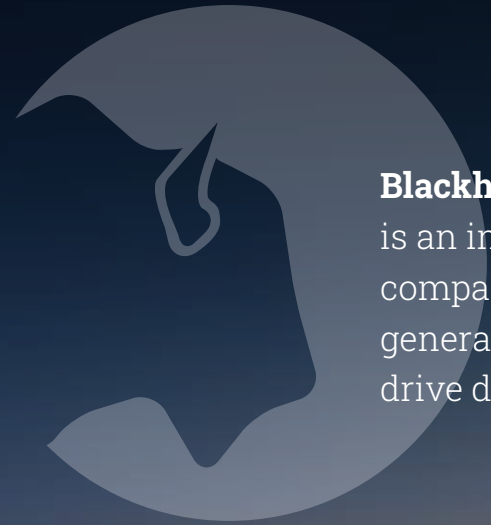
Blackhorn Ventures, founded in 2017, is an investment management firm focused on supporting companies whose business success is fully aligned with generating positive societal outcomes, with the potential to drive deep, collinear social and environmental impact.