PitchBook

EMERGING TECH RESEARCH

Supply Chain Tech

Q2 2020

Contents

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This Emerging Technology Research report is updated on a quarterly basis to reflect changes in venture capital deal activity and other market related updates deemed valuable by the research analyst. The previous quarterly report can be accessed **here**.

Q2 2020 news and updates

VC ACTIVITY

- In Q2 2020, supply chain tech companies based in North America and Europe raised $2.5 billion in VC across 87 deals, marking a 12.3% decline in deal value YoY but 110.7% rise QoQ.
- Last-mile delivery drove supply chain tech VC deal activity as investors made large bets on restaurant, grocery, and convenience item delivery services.
- Acquisitions are increasing as a proportion of exits as management teams eschew traditional IPOs due to turbulent public market conditions.

Q2 2020 DEAL ACTIVITY

- **June 18:** Food delivery service **DoorDash** raised a $400.0 million Series H led by Fidelity and Durable Capital Partners, valuing the company at $16.0 billion.
- **June 11:** Grocery delivery service **Instacart** raised a $325.0 million Series G led by DST Global and General Catalyst, valuing the company at $13.7 billion.
- **May 21:** On-demand warehousing startup **MakeSpace** raised a $55.0 million Series E led by Iron Mountain.

NEWS

- The Consumer Brands Association launched a task force in partnership with 23 consumer packaged goods companies to implement contactless delivery throughout their supply chains.
- Self-driving trucking company **TuSimple** announced that it has launched an autonomous freight network in partnership with UPS, Penske, and others to bring self-driving trucks to market.
- The state of California in the US approved a measure to require automakers to sell more electric trucks beginning in 2024. Under the new measure, all new trucks sold in the state will be zero-emissions by 2045.

KEY TRENDS

- The need to pandemic proof supply chains is leading to more infusions of VC into previously underinvested subsectors such as procurement, risk management, and warehousing technology.
- Last-mile delivery services continue to be a focal point of corporate and VC investment as consumer demand for home delivery has increased significantly, highlighting the need for automated, contactless delivery technology.
- Warehousing tech is seeing a surge in investment as companies seek to diversify supply chains and automate processes.
- Supply chain risk management and visibility startups are gaining traction as the pandemic reveals the need for data analytics and real-time monitoring services.

Executive summary

Today's global supply chain is a highly fragmented industry that includes a sprawling ecosystem of disparate providers, each at different stages of technological maturity. We view this as a compelling backdrop for new entrants seeking to address gaps in the status quo and see areas of growth across the value chain, including procurement, inventory management, freight, warehousing, fulfillment, and last-mile delivery.

The COVID-19 pandemic has strained global supply chains and led to significant mismatches in supply and demand. Assembly and manufacturing plants have faced shutdowns, causing production delays and shortages of global goods. Nonessential goods have been stuck in limbo, with retailers unable to accept deliveries. Grocers have struggled to keep household goods on shelves. These disruptions have highlighted the need for technologies that can help ensure business continuity and mitigate the impacts of economic shocks. Additionally, businesses involved in global trade are demanding better visibility across delivery and supply channels, quicker shipping capabilities, and the ability to source product on-demand to reflect real-time conditions at the consumer level.

Startups are rising to the occasion, developing software and data services to address these pressing needs. Investors, in turn, have put substantial amounts of venture funding to work to both modernize and disrupt this industry. In 2019, VC investors funneled approximately $11.8 billion into supply chain technology startups in North America and Europe across 430 deals. In H1 2020, VC investment into the sector totaled $3.6 billion across 172 deals. This Emerging Tech Research report provides an overview of the supply chain technologies benefiting from these venture infusions, the subsectors emerging in each segment of the industry, and opportunities for growth in each market.

Key takeaways

Investment has cooled in freight tech: Venture investors deployed $185.4 million into the freight tech space in H1 2020, down from $1.7 billion invested in H1 2019. In our view, investor pullback from digital freight brokerage platforms such as **Uber** Freight and **Convoy** contributed to this decline. Although these services serve a large addressable market, these emerging platforms face strong competition from large incumbents in what is fundamentally a low-margin industry. Meanwhile, self-driving trucking companies are facing roadblocks to adoption. **TuSimple** has reportedly faltered in hitting its revenue targets, and the path to commercialize autonomous trucking seems further off than originally envisioned. Since 2019, VC investor appetite for the space appears to have waned, as evidenced by self-driving trucking company **Starsky Robotics** shuttered its burgeoning truck fleet earlier in 2020 after facing difficulty raising capital.

Last-mile delivery a focal point of corporate and VC investment: Consumer demand for delivery has amplified since the beginning of the COVID-19 pandemic, driving investors and corporates to ramp up investment in last-mile logistics. Retailers such as Rakuten and Home Depot are thrusting billions into the creation of facilities and fulfillment centers that will boost their own delivery capabilities. Mobility tech platforms such as **Uber** and Didi Chuxing are increasing their investments into restaurant, grocery, and convenience item delivery. Companies developing delivery robots and drones, such as **Nuro** and **Flytrex**, are benefiting from regulatory approvals and new partnerships as the need for autonomous delivery becomes more apparent.

Risk management gaining traction: The coronavirus pandemic has divulged the necessity of data analytics and real-time monitoring services that improve visibility and reduce risk exposure. Startups providing these services, such as **Interos** and **Riskmethods**, have seen an uptick in venture financing. We expect investment into supply chain risk management platforms to increase as management teams seek greater visibility into their supply chains' exposure to potential shocks, which range from pandemics, geopolitical disruption, and natural disasters to hyper-local events such as fires and labor strikes. Startups providing effective end-to-end solutions to identify threats, assess impacts, and mitigate risk should be well positioned to succeed.

Warehousing tech relatively underinvested: After hitting record levels of venture investment in 2019, warehousing tech startups continued to attract capital. Investor interest has mounted in warehousing technologies such as micro-fulfillment and automation that can reduce labor costs and improve ecommerce delivery times. The coronavirus pandemic has ushered in significant investment into automation technology to augment human workers, make warehouses safer, and ensure continuity of operations. While activity is robust, we believe that warehousing tech is relatively underinvested compared to other segments within Supply Chain Tech, and we anticipate the segment will see continued growth going forward.

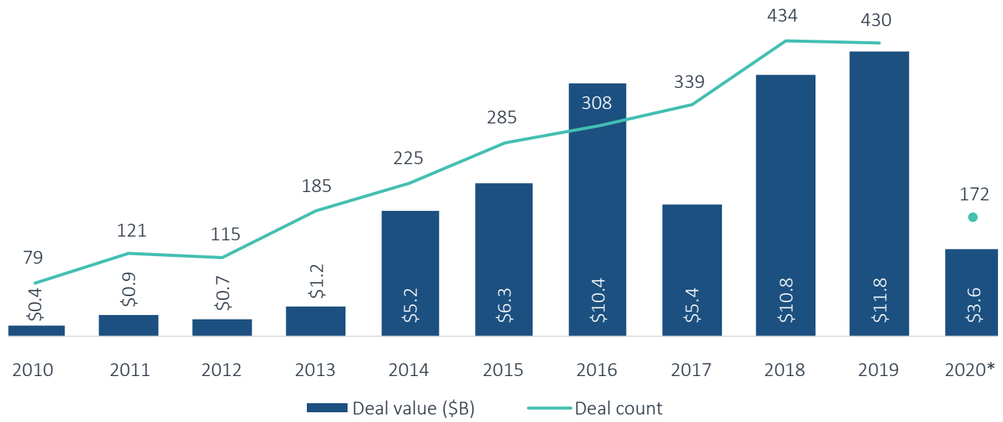
Supply chain as a service is catching on: We continue to see growing enthusiasm for service-based solutions that can help companies turn fixed expenditures into variable costs. Warehouse marketplaces **Flexe** and Stord offer on-demand, subscription-based solutions that can find warehouse space for retailers with excess capacity. Providers of industrial and warehousing autonomous robots such as **Locus Robotics**, **Mobile Industrial Robots**, and **RightHand Robotics** offer subscription-based, full-service solutions as opposed to individual unit sales. Similar to modern SaaS software, these services help customers minimize capital expenditure and focus on their core business while still enabling access to the latest technology. As economic conditions continue to challenge businesses, we expect subscription services to play a more prominent role in serving the needs of capital-constrained customers.

VC activity

VC investment into North American and European supply chain tech companies has generally trended upward over the past 10 years. Aggregate deal value peaked in 2019 at $11.8 billion, spread across 430 deals. Through H1 2020, venture activity has been relatively constrained, with $3.6 billion invested, down 37.0% compared to H1 2019. In Q2 2020 alone, investors deployed $2.5 billion across 87 deals, down 12.3% YoY but up 110.7% QoQ. Last-mile delivery companies received the bulk of the quarter's venture money, particularly those focused on restaurant, grocery, and convenience item delivery services. Major VC deals in the second quarter included **Deliveroo**'s $575.0 million Series G led by Amazon; **DoorDash**'s $400.0 million Series H led by Fidelity and Durable Capital Partners, valuing the company at $16.0 billion; and **Instacart**'s $325.0 million Series G led by DST Global and General Catalyst, valuing the company at $13.8 billion.

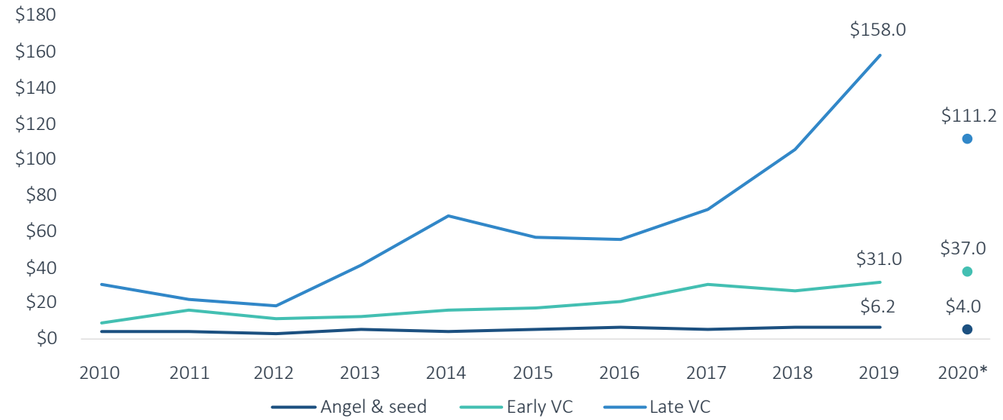
VC exit activity within the supply chain tech industry has been mixed. In H1 2020, VC exit value totaled $557.7 million, positioning the full year to fall short of the $2.6 billion in VC exit value seen in 2019. (This figure excludes **Uber**'s IPO). However, the number of venture exits has been relatively robust. 15 companies exited in H1 2020, 13 of them via acquisitions and two of them via buyouts, reflecting a broader trend in which management teams are shunning the traditional IPO process due to ongoing public market uncertainty.

Figure 1. SUPPLY CHAIN TECH VC DEAL ACTIVITY



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 2. MEDIAN SUPPLY CHAIN TECH VC PRE-MONEY VALUATION ($M) BY STAGE



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Supply chain tech market map

Enterprise supply chain management

Asset tracking

ALIEN, tracelink, mojix, TURVO, exrta, nexxiot

ERP & inventory management

C3.ai, FAIRE, optoro, RELEX, Assent, Aera

Procurement, sourcing & financing

TRADESHIFT, taulia, behalf, qonto, PrimeRevenue, scoutbee

Freight

Trucking logistics

flexport., CONVOY, KEEP TRUCKIN, TRANSFIX, NEXT TRUCKING, project44, sennder, FourKites, Peloton, Aperia, FREIGHTWAVES, loadsmart, Flock Freight, Motiv, WRIGHTSPEED, ONTRUCK, shippo, PLATFORM SCIENCE, cargomatic, VIA

Autonomous trucks

tusimple, EMBARK, Ike, Kodiak, E/NRIDE, isee, plus.ai

Marine, air & rail freight

FREIGHTOS, forto, KONUX, WINDWARD

Warehousing

Warehousing & fulfillment

Clutter, MakeSpace, Deliverr, ShipBob

Warehouse automation

BERKSHIRE GREY, GreyOrange, vicarious., Fabric, LOCUS, DEXTERITY, fetch robotics, VECNA robotics, KINDRED, READY ROBOTICS, RIGHTHAND ROBOTICS, INVIA ROBOTICS

Warehouse marketplaces

FLEXE, Darkstore, STORD, SpaceFill

Augmented reality

realwear, UPSKILL, ATHEER, UBiMAX

Last-mile delivery

Delivery services

DOORDASH, instacart, deliveroo, goPuff, PICNIC, alto, mobilv, Wolt, BOXED, THRIVE MARKET, Glovo, FRESHLY, RITUAL, SUN BASKET, NURX., good eggs, GrubMarket, Misfits Market, Kolonialno, SLICE, BRINGG, Takeoff, VETSOURCE, flaschenpost.de, DRIZLY, Qwilt, narvar, olo, Shyp, ROADIE

Autonomous delivery

nuro, zipline, AIROBOTICS, STARSHIP, CLEARPATH, MATTERNET, VELAVIS, Flirtey, flytrex, REFRACTION AI, kiwibot, robby

Companies included are VC-backed, segmented by primary use case, and sorted by total capital raised.

SEGMENT DEEP DIVE

Enterprise supply chain management

Overview

Supply chain management (SCM) software helps companies manage all aspects of their supply chain processes, including transactions, vendor relationships, and inventory management. SCM can improve a company's ability to manage complex supply chain relationships by providing real-time insights that can enhance customer service, forecasting, and financial management. Subsegments include:

ERP & inventory management: Software platforms providing enterprise resource planning with integrated SCM services (including providers of inventory management software)

Asset tracking: Providers of hardware and software platforms enabling companies to track assets and improve asset visibility

Procurement, sourcing & financing: Software platforms enabling raw materials procurement, sourcing and payment processing solutions

Traditional supply chains consist of a linear process though which raw materials are procured by suppliers, sold to producers, manufactured into finished goods, and sent to distributors to be packaged and delivered to customers. Enterprise SCM software has traditionally operated in the channels between each linear step, facilitating processes such as planning, ordering, and confirming. Separate systems are often used between adjacent parties on the value chain to exchange information, such as orders and returns. These systems are often not integrated to other processes in the supply chain, making data and information sharing difficult. For example, producers shipping to distributors are likely to have little visibility into deliveries, customer satisfaction, or other useful insights.

Similarly, retailers with real-time consumer insights often have difficulty relaying that information to suppliers and distributors. This friction can increase costs and result in missed opportunities.

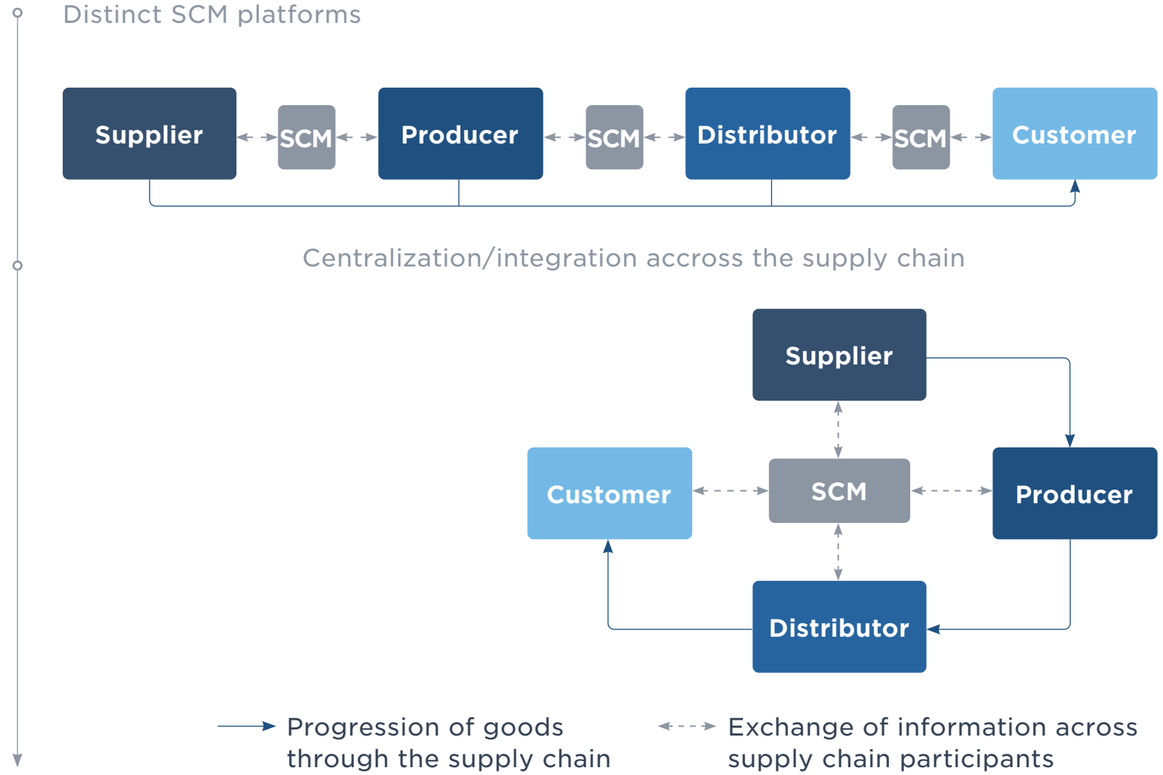
Emerging SCM software consists of connected networks where a central hub helps orchestrate and coordinate data related to supply, demand, inventory, and capacity. By utilizing a connected ecosystem, enterprises at all stages of the value chain can more quickly respond to changes in the production or distribution process, changes in demand, or other external factors affecting the value chain.

Industry drivers

- Increased demand for flexibility and visibility enabling quicker response times to supply chain shocks
- Global demand for cost reduction across the supply chain
- Shift toward digital centralized networks offering increased data visibility and transparency
- Fragmented industry ripe for consolidation and disruption opportunities
- Relatively low-tech incumbent providers, creating room for new technologies

Figure 3.

The SCM shift toward connected networks



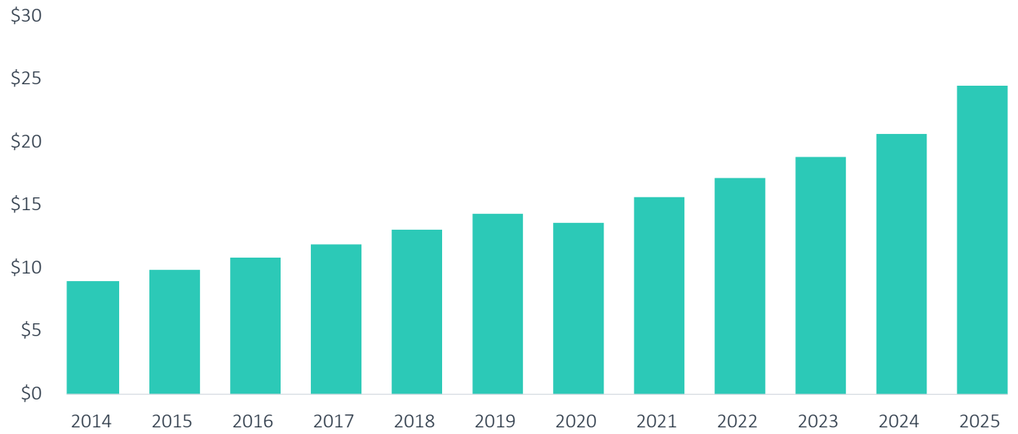
Market size

We forecast global sales of SCM software to grow to $24.5 billion in 2025 from $14.3 billion in 2019, implying a CAGR of approximately 9%. We expect ecommerce-focused and inventory management software to be one of the key drivers of increased growth in the industry. We model a decline in spending in 2020 due to the coronavirus pandemic. With that said, we believe this subsector is relatively insulated and will see a low risk of companies significantly altering or pulling back on SCM spending.

Business model

SCM software helps companies manage multiple interconnected SCM processes, such as procurement, asset tracking, inventory management, and capacity planning. These cloud-based subscription software solutions help enterprises improve and accelerate analysis and decision making, which reduces costs, improves service levels, and supports growth.

Figure 4. ENTERPRISE SUPPLY CHAIN MANAGEMENT MARKET SIZE ($B)



Source: Internal PitchBook estimates

COMMON INDUSTRY KPIS

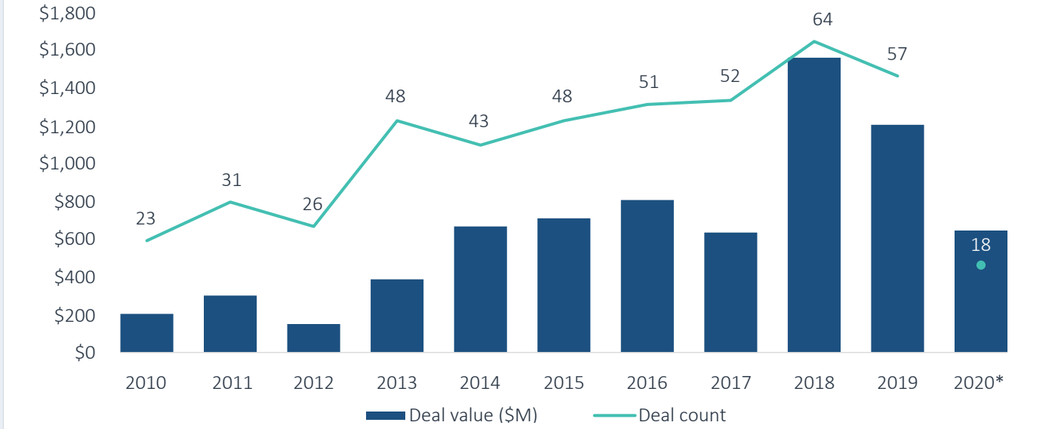
- Users under license
- Average order value
- Return percentage
- Refund/warranty rate
- Inventory turns
- Reject ratio
- Quality assurance (QA)

VC activity

Venture investment in enterprise SCM technology totaled $119.5 million in Q2 2020, down 56.4% YoY and 77.3% QoQ. VC investment in the segment in H1 2020 declined 16.0% relative to H1 2019. Although we note an anecdotal increase in investor interest in this segment, investment has thus far not materialized.

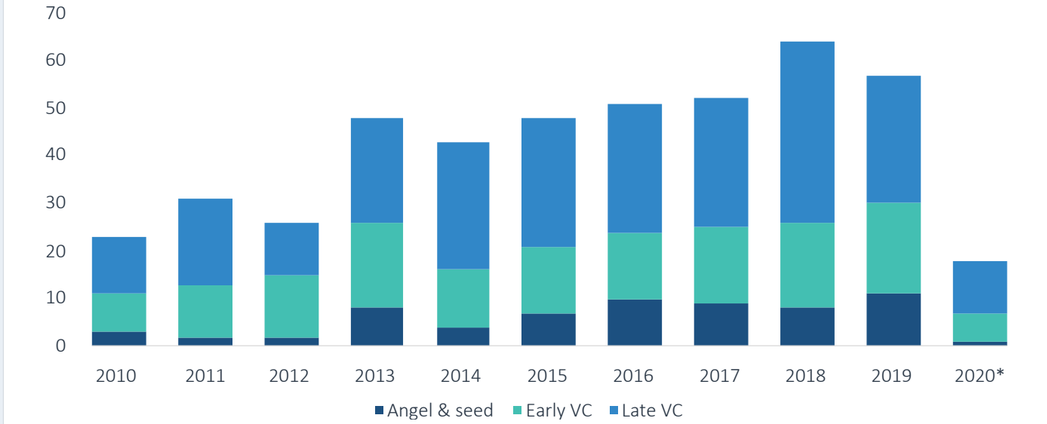
Top deals in Q2 include barcode scanning platform **Scandit**'s $70.0 million Series C round led by G2VP and trade transparency platform **Beacon**'s $15.0 million Series A from 8VC and Jeff Bezos, valuing the company at $60.0 million. Standout deals in Q1 include **Tradeshift**'s $240.0 million Series F and **Qonto**'s $116.0 million Series C. Investors appear to be paying more attention to supply chain risk management platforms a result of the pandemic; **Interos** and **Riskmethods** raised $18.0 million and $9.0 million, respectively, in Q1, and **Mercado Labs** raised $2.5 million in a deal led by Ironspring Ventures in July 2020, suggesting this interest could be sustained into the back half of the year.

Figure 5. ENTERPRISE SUPPLY CHAIN MANAGEMENT VC DEAL ACTIVITY



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 6. ENTERPRISE SUPPLY CHAIN MANAGEMENT VC DEALS (#) BY STAGE

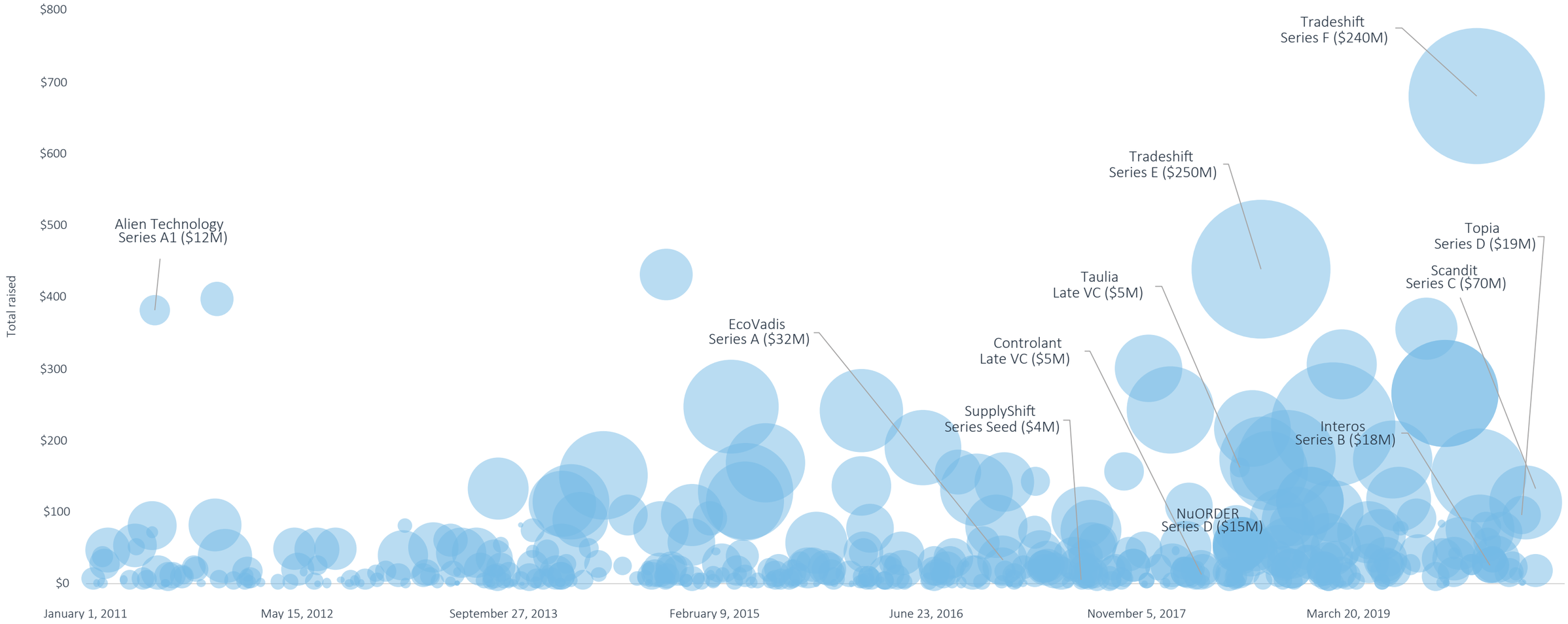


Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

ENTERPRISE SUPPLY CHAIN MANAGEMENT

Figure 7.

Enterprise supply chain management VC landscape ($M)



Source: PitchBook

Note: The left axis indicates total VC raised as of deal date. Bubbles indicate amount raised.

ENTERPRISE SUPPLY CHAIN MANAGEMENT

Figure 8.

Notable enterprise supply chain management VC deals

COMPANY	CLOSE DATE	SUBSEGMENT	STAGE	DEAL SIZE ($M)	LEAD INVESTOR(S)	VALUATION STEP-UP
SCANDIT	May 8, 2020	ERP & inventory management	Series C	$70.0	G2VP	N/A
Beacon	May 31, 2020	Procurement, sourcing & financing	Series A	$15.0	N/A	N/A
SourceDay	April 7, 2020	Procurement, sourcing & financing	Series B	$12.5	Baird Capital	N/A
FUTUREDIAL	April 13, 2020	ERP & inventory management	Late-stage VC	$2.2	N/A	N/A

Source: PitchBook

Figure 9.

Notable enterprise supply chain management VC exits

COMPANY	CLOSE DATE	SUBSEGMENT	EXIT TYPE	EXIT SIZE ($M)	ACQUIRER OR INDEX	VALUATION METRIC
Anaplan	October 12, 2018	ERP & inventory management	IPO	$1,804.4	NYSE	1.28x revenue
zuora	April 12, 2018	Procurement, sourcing & financing	IPO	$1,295.1	Eastlink Capital	N/A
scout	December 9, 2019	Procurement, sourcing & financing	M&A	$513.0	Workday	2.78x revenue
3Gtms Powering Transportation Innovation	April 17, 2019	ERP & inventory management	Buyout/LBO	$87.0	Sumeru Equity Partners	N/A
Pointy Find it locally	January 14, 2020	ERP & inventory management	M&A	$163.0	Alphabet	N/A

Source: PitchBook

Figure 10.

Key VC-backed enterprise supply chain management companies

COMPANY	TOTAL VC RAISED ($M)*	SUBSEGMENT	KEY PRODUCTS	PRODUCT DIFFERENTIATION
ALIEN	$431.6	Asset tracking	RFID chips, tags, and readers	Low-cost provider
C3.ai	$355.7	ERP & inventory management	C3 AI Suite	Best-in-class analytics
FAIRE	$265.4	ERP & inventory management	Online wholesale marketplace	Local retailer focus
RELEX	$222.3	ERP & inventory management	Living retail platform	AI-driven forecasting, inventory planning
optoro	$216.5	ERP & inventory management	Returns optimization platform	ML & predictive analytics
tracelink NETWORK FOR GREATER GOOD	$173.7	Asset tracking	SaaS platform for track-and-trace	Digitized network for life sciences
Aera	$172.9	ERP & inventory management	Cognitive operating system	Data-driven supply chain forecasting
taulia	$161.7	Procurement, sourcing & financing	Supplier financing, process automation tools	Digitized, AI-driven forecasting

Source: PitchBook | *As of June 30, 2020

Figure 11.

Key enterprise supply chain management incumbents

COMPANY	EV/TTM REVENUE*	EV/TTM EBITDA*
SAP	5.7x	21.0x
ORACLE	5.1x	12.0x
infor	N/A	N/A
BlueYonder Fulfill your potential	N/A	N/A
Manhattan Associates	9.5x	48.6x

Source: PitchBook | *As of June 30, 2020

Opportunities

First-mile solutions: Although the bulk of venture dollars has historically gone toward middle-mile and last-mile applications, we see significant opportunity in the first mile of supply chain, which we regard as being relatively underinvested. We define the first mile as encompassing ordering & purchasing, procurement, and import & export customs processes. We see a strong opportunity for startups to digitize and streamline workflows in this space. Most startups in this space focus on solutions for specific workflows, such as supply chain financing and increased tracking and visibility. First-mile platforms **Mercado Labs** and GTNexus, the latter of which was acquired by Infor for $675.0 million in 2015, digitize the entire ordering process for both suppliers and buyers.

Supply chain orchestration: Supply chain orchestration involves the integration of multiple systems into a centralized platform accessible to multiple parties, such as suppliers and distributors. Current management teams are more data-driven than in the past, relying on data to make more informed decisions. However, in many cases, the lack of end-to-end supply chain visibility complicates a management team's ability to accurately forecast inventory and stocking levels. In addition, third parties outside of an organization often cannot gain access to siloed data. Supply chain orchestration platforms help combine disparate systems, enabling management teams to more efficiently coordinate product launches across the supply chain and respond to demand shifts. For example, a chipmaker selling to two different computer manufacturers might use a supply chain orchestration platform to share select data between all three parties in order to boost delivery speed and minimize costs. Key providers include **Elementum**, Infor Business Solutions, **Kinaxis**, JDA Software Group, **Anaplan**, **Oracle** (SCP Cloud), and **SAP** (IBP). They compete with smaller companies offering human capital-intensive services such as outsourced spreadsheet aggregation.

Inventory management software: Inventory management software helps companies optimize inventory levels to improve demand forecasting and planning. We view this as a fundamental challenge for many businesses, as 43% of small businesses either use a manual process to track their inventory or do not track it at all.[1] Similarly, 55% of small businesses either do not track assets or use manual processes. Inventory management software providers such as **Stitch Labs** and **TradeGecko** equip small and medium-sized businesses with web- and mobile-based inventory management platforms.

Wholesale marketplaces: Online wholesale marketplaces such as **Faire** and **Tundra** mitigate inventory risk for retailers. These marketplaces facilitate online transactions and leverage predictive analytics to forecast demand, enabling retailers to reduce the time and money spent on identifying and sourcing goods. Wholesale marketplaces have seen increased interest from investors. In October 2019, **Faire** raised a $150.0 million Series D led by Lightspeed and Founders Fund, valuing the company at $1.0 billion.

IoT technologies, including radio frequency identification (RFID) for asset tracking: We believe secure asset tracking represents a significant potential growth opportunity for investors. "Retail shrinkage," or loss of inventory due to shoplifting, theft, or administrative errors, has had a significant impact on profits across the retail industry. According to the Sensormatic Global Shrink Index, inventory shrinkage cost retailers almost $100 billion annually,[2] a significant portion of which was due to inventory

1: State of Small Business Report, Wasp Barcode Technologies, 2017
2: "2018 Sensormatic Global Shrink Index," Tyco Retail Solutions & PlanetRetail RNG, February 2018

mismanagement. RFID-based systems that can be actively or passively read by proximity sensors enable large amounts of inventory to be more efficiently and reliably tracked. Key VC-backed providers include **Alien Technology**, **Eximia**, and **Mojix**.

Blockchain technology: Several startups are focused on using blockchain technology to trace the origin and status of assets throughout a supply chain. Providers in this segment combine hardware components such as RFID chips or IoT-enabled sensors with blockchain software to connect physical goods to decentralized tracking systems. Products and services include dispute resolution systems for trade financing, triggering smart contracts at product checkpoints, certifying sustainability/fair sourcing of products, monitoring temperatures of sensitive assets (such as medications) and tracking food-born illnesses. These services can increase trust and transparency while cuttingcosts. Key companies in this space include **Filament**, Everledger, and **Chronicled**. Other blockchain solutions such as Eka and **Hyperchain** focus on automating manual and paper processes while distributing data across network participants. IBM has launched a blockchain network dubbed Trust Your Supplier, which aims to diminish procurement and supplier onboarding costs by shifting manual processes such as identity verification and document tracking to the network. Amazon has patented a distributed ledger-based system for authentication of consumer goods. With demand for essential products rising, we anticipate investment into blockchain-based supply chain tracking technologies to rise going forward.

Supply chain finance: Supply chain finance providers such as **PrimeRevenue**, Artis Trade Systems, and Linklogis provide tools and processes designed to optimize the cash flow needs of suppliers and buyers. This enables suppliers to receive payments in advance and allows buyers to alter or extend payment terms. Providers accomplish this by serving as an intermediary between suppliers and buyers or by offering reverse factoring services.

Procurement software: Procurement software companies such as **Taulia**, **Baibu**, and **supplyFORCE** assist in raw materials procurement, sourcing, and payment processing. By providing digital solutions with predictive analysis, procurement software providers enable on-demand procurement, where enterprises can sync with suppliers to increase or decrease production almost instantaneously in response to shifts in demand, minimizing deadweight loss and friction in the system.

Environmental and regulatory compliance: Investors are increasingly focused on evaluating a business' environmental, social and governance criteria (ESG). This is of utmost concern when it comes to procurement, sourcing, and other supply chain activities where environmental impact can be significant and visibility is minimal. Companies such as **EcoVadis** and **Assent Compliance** rank businesses in terms of environmental impact, sustainability, ethics, and human rights, while also helping them comply with regulatory requirements. Modern supply chain technology enables ESG review by providing more transparency into procurement and sourcing practices.

Considerations

Incumbent competition and exit opportunities: VC-backed providers of SCM compete with large enterprise software incumbents, including **SAP** and **Oracle**. These companies typically offer large bundled product suites often deeply entrenched within large organizations and Fortune 500 companies, leaving little room for startups to gain share

in the market. Regardless, incumbents can also provide exit opportunities for late-stage startups. For example, **IQMS** was acquired by Dassault Systems in early 2019 for $425.0 million as part of a strategy to obtain cloud-based enterprise management technology.

Reluctance to adopt new technologies: Large established companies that have made material investments in legacy technologies may be reluctant to replace them, while small regional players may lack the resources to adopt new systems. These companies may rely on low-tech processes that use standard office applications such as Word and Excel, and they may lack sophisticated transportation management systems or supply chain-focused technology. The reputation-based nature of the supply chain industry poses another complicating factor; longstanding relationships are more likely to guide vendor selection than cutting-edge technology. This can make it difficult for new entrants to penetrate the market.

Technology fatigue: Potential customers in the space are subject to heavy marketed, and separating the noise from what is useful can be difficult. In our view, successful providers must demonstrate that they can help companies generate a real ROI. We believe providers that can leverage Big Data techniques to improve visibility and predictive analysis are more likely to succeed in the space.

Outlook

Risk management startups to see boost from coronavirus crisis: We expect investments into technologies that enhance supply chain visibility will mount as management teams seek to enhance their ability to track the journey of parts, components, and products from manufacturing to delivery. Risk management platforms such as **Resilinc**, **Elementum**, DHL Resiliance360, **Riskmethods**, and **Interos** offer data analytics and real-time monitoring services that enable companies to identify and react quickly to anomalies. In January 2020, **Interos** and **Riskmethods** raised $18.0 million and $9.0 million, respectively, reflecting heightened investor interest in this subsector. In July, **Mercado Labs** raised $2.5 million in a deal led by Ironspring Ventures, suggesting interest could be sustained into the back half of the year.

Biggest opportunity in orchestration and inventory management software: We see a substantial growth opportunity in SCM software that can help management teams make more informed, data-driven decisions and orchestrate corporate strategies across supply chain vendors. We also view inventory management technologies that incorporate IoT and blockchain as having significant runways for growth. **Alien Technology** and **Filament** represent attractive acquisition targets for large incumbents seeking to gain access to these disruptive technologies.

SEGMENT DEEP DIVE

Freight

Overview

Freight startups provide technologies and solutions focused on improving the global transport of physical goods. Subsegments include:

Trucking logistics: Platforms and services targeting the commercial trucking industry. Technologies include:

- Digital freight brokerage platforms
- Visibility software
- Freight forwarding tools

Self-driving trucks: Startups enabling self-driving or driver-assistance capabilities for long-haul trucks. The trucking industry comprises 70% of freight tonnage in the US and generates approximately $800 billion in annual revenue.[3] Current freight operations largely consist of established relationships between shippers (companies shipping the product) and carriers (trucking and other freight companies). Traditionally, shippers select carriers based on established relationships—a process that works reasonably well but is beset with limited product-tracking ability, low pricing transparency, and scheduling conflicts that can lead to higher costs in the supply chain.

3: “American Trucking Trends 2019,” American Trucking Associations, 2019

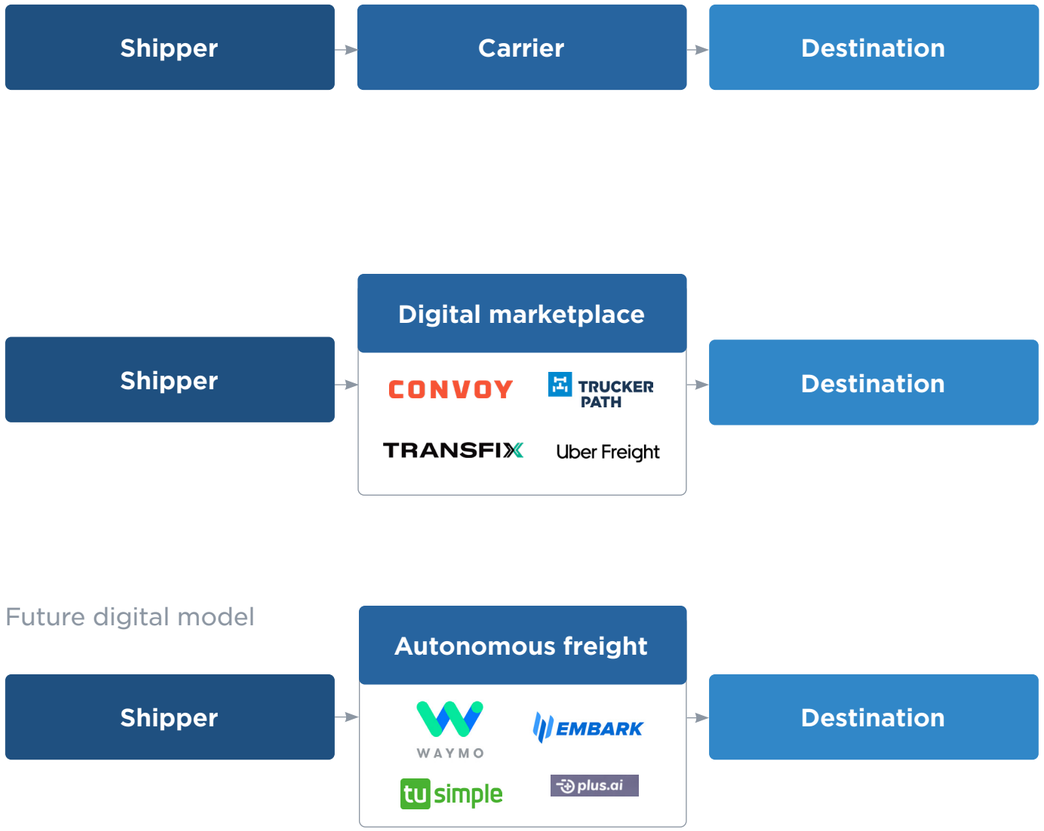
Emerging freight brokerages are using modern supply chain technology to address these inefficiencies. Companies such as **Convoy**, **Uber** Freight, and **Transfix** provide digital marketplaces that improve the ability to match shipping demand with carrier supply. Visibility platforms such as **FourKites** and **project44** provide real-time tracking data and predictive analysis for load arrivals. Lastly, the longer-term adoption of electric and autonomous trucks could dramatically reduce maintenance, service and labor costs for freight companies.

Industry drivers

- Large market provides a stable growth backdrop for service providers despite cyclicality in freight markets
- Fragmented provider landscape provides consolidation and disruption opportunities
- Need among industry participants to integrate legacy information systems
- Relatively low-tech incumbents create opportunity for new technologies

Figure 12.

Evolution of freight



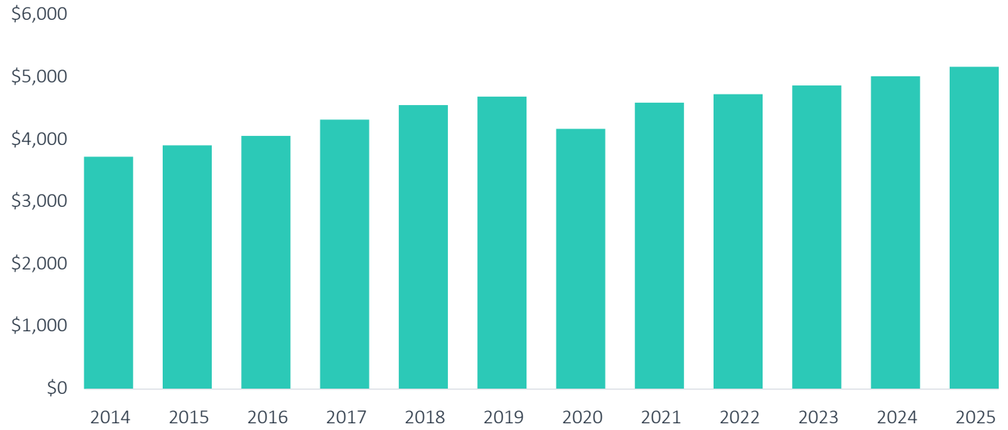
Market size

Startups providing digitized and automated solutions targeting the global freight industry serve a large and underpenetrated addressable market. We estimate the net revenue generated from the global freight industry totaled $4.7 trillion in 2019 and forecast this figure to grow to $5.2 trillion in 2025. 2020 has already seen a major impact from the coronavirus pandemic, with certain shipment volumes such as automotive and imports dropping significantly, while food and other essential supplies have seen surges. Our estimates imply a substantial decline in industry revenue in the second quarter of 2020, with a rebound from pent-up consumer demand in the back half of the year.

Business model

Software platforms in the freight tech space typically monetize by collecting a fee for every transaction. Self-driving companies in this space monetize by selling or licensing technology to fleet managers, OEMs, and technology companies.

Figure 13. FREIGHT MARKET SIZE ($B)



Source: Internal PitchBook estimates

COMMON INDUSTRY KPIS

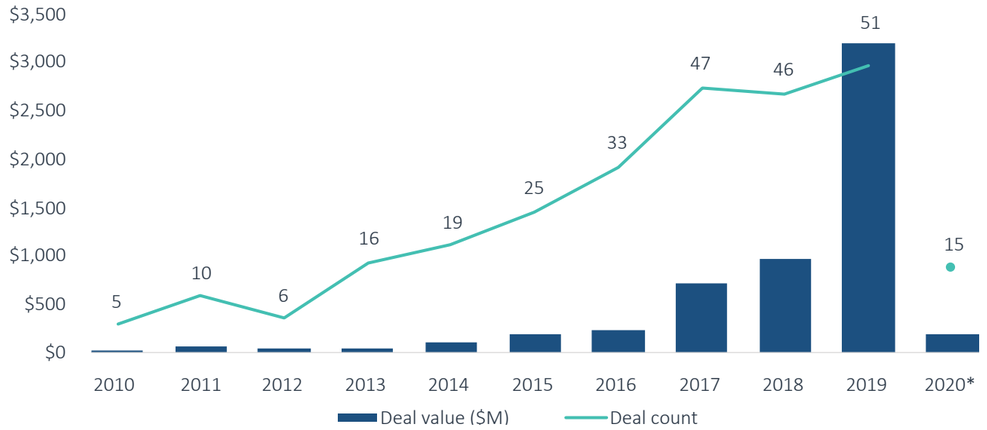
- Shipment cost
- Shipment velocity
- Shipment visibility
- Shipment service
- Gross merchandise volume (GMV)
- Percentage capacity used
- On time pickup %
- Loss and damage claims %
- Custom order cycle time
- Fuel efficiency
- Labor productivity
- Maintenance expenses
- Loading times

VC activity

Venture investment in freight tech startups cooled in H1 2020, with $185.4 million invested across 15 deals in North America and Europe. This is down from the $1.7 billion invested in the space in H1 2019, which was marked by mega-deals such as **Flexport**'s $1.0 billion Series D led by SoftBank. Top freight tech deals in Q2 2020 include multi-carrier shipping software **Shippo**'s $30.0 million Series C round led by D1 Capital Partners, valuing the company at $225.0 million, and freight-focused data and media platform **FreightWaves**' $26.4 million Series B round led by 8VC.

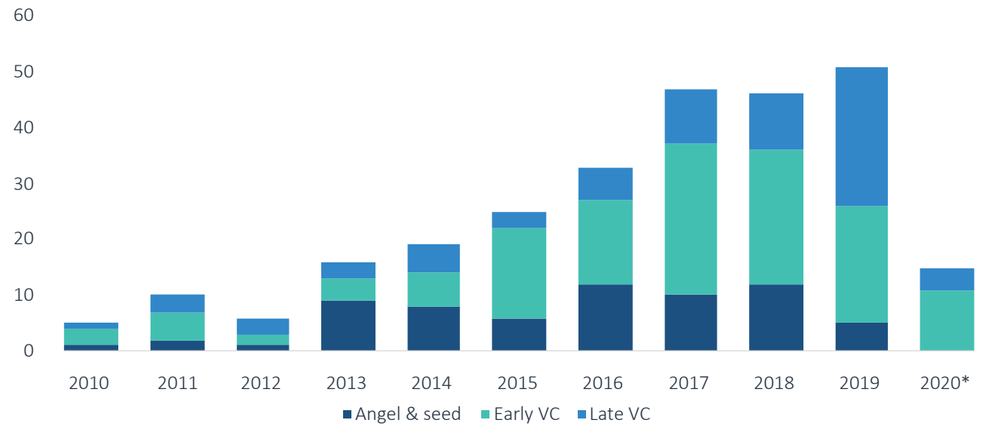
These deals reflect the broader trend of investors opting for asset-light software platforms over asset-heavy, capital-intensive transportation startups. Since 2019, VC investors appear to have less appetite for hardware-focused freight startups, as evidenced by self-driving trucking company **Starsky Robotics** shuttering its burgeoning truck fleet earlier in 2020 after facing difficulty raising capital from investors.

Figure 14. FREIGHT VC DEAL ACTIVITY



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

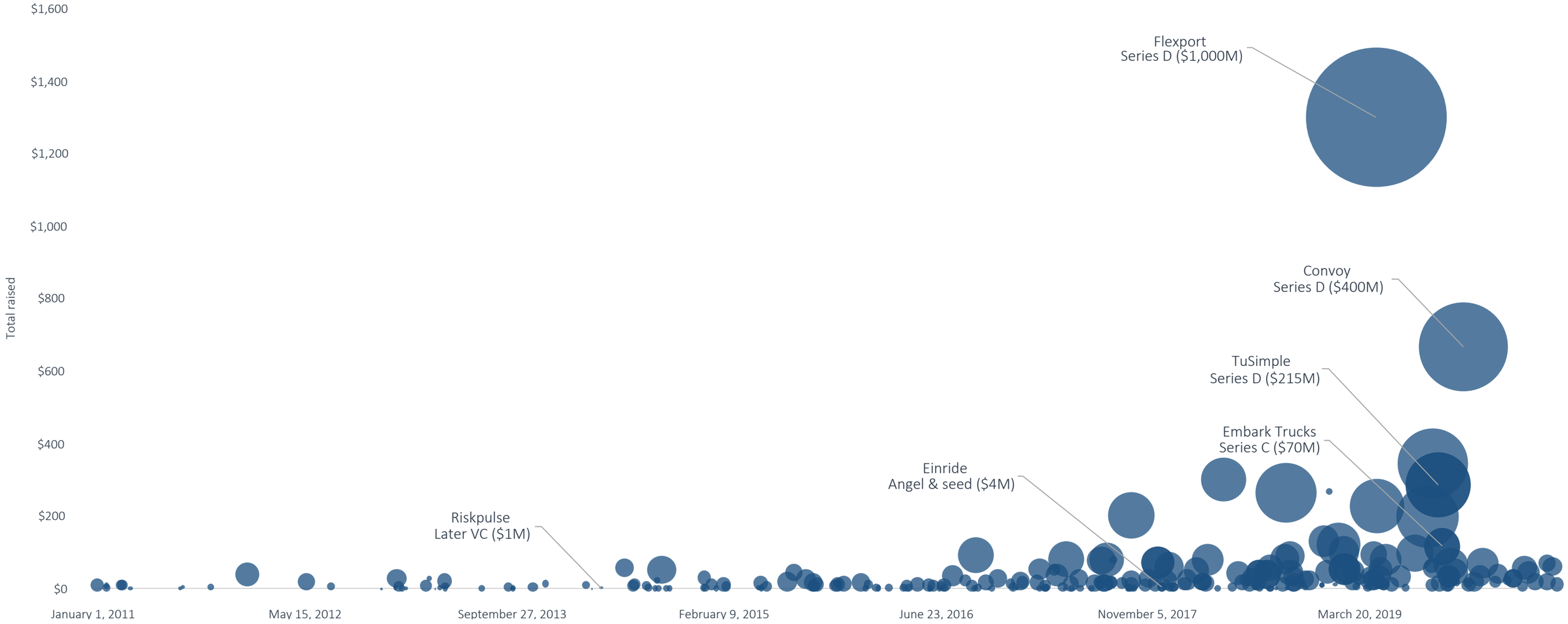
Figure 15. FREIGHT VC DEALS (#) BY STAGE



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 16.

Freight VC landscape ($M)



Source: PitchBook

Note: The left axis indicates total VC raised as of deal date. Bubbles indicate amount raised.

Figure 17.

Notable freight VC deals

COMPANY	CLOSE DATE	SUBSEGMENT	STAGE	DEAL SIZE ($M)	LEAD INVESTOR(S)	VALUATION STEP-UP
shippo	April 7, 2020	Trucking logistics	Series C	$30.0	D1 Capital Partners	2.44x
FREIGHTWAVES	April 15, 2020	Trucking logistics	Series B	$26.4	8VC	N/A
onTRUCK	June 11, 2020	Trucking logistics	Early-stage VC	$18.8	Oil and Gas Climate Initiative	N/A
KLEARNOW	May 1, 2020	Trucking logistics	Series A	$16.0	GreatPoint Ventures	2.31x

Source: PitchBook

Figure 18.

Notable freight VC exits

COMPANY	CLOSE DATE	SUBSEGMENT	EXIT TYPE	EXIT SIZE ($M)	ACQUIRER OR INDEX	VALUATION METRIC
Riskpulse	January 9, 2020	Marine, rail & air	M&A	$22.0	Greenspring Associates, Columbia Capital, Dhl International, **DHL Resilience360**	N/A
KUEBIX	January 9, 2020	Trucking logistics	M&A	$201.1	Trimble	N/A
FLEET	May 26, 2020	Trucking logistics	M&A	N/A	Expeditors International of Washington	N/A

Source: PitchBook

Figure 19.

Key VC-backed freight companies

COMPANY	TOTAL VC RAISED ($M)*	SUBSEGMENT	KEY PRODUCTS	PRODUCT DIFFERENTIATION
flexport.	$1,301.9	Trucking logistics	Freight forwarding platform	Integration with suppliers, carriers, customers
CONVOY	$668.0	Trucking logistics	Digital freight brokerage platform	Scale; 100% automated brokering/pricing of loads to carriers
NIKOLA	$345.0	Electric trucks	Nikola One and Two electric semi-trucks	Efficiency; comparable weight to diesels; lower maintenance costs
tusimple	$287.9	Autonomous trucking	Self-driving platform	Highway applications; focus on retrofits; partnerships with UPS, Mando
KEEP TRUCKIN	$229.3	Trucking logistics	ELDs & smart dashcams/digital freight brokerage platform (Smart Load Board)	ELD data-driven digital marketplace
TRANSFIX	$131.0	Trucking logistics	Digital freight brokerage platform	FTL matching; smartphone-focused
NEXT	$123.0	Trucking logistics	Digital freight brokerage platform	In-app social functions (walkie-talkie, chat)
EMBARK	$117.5	Autonomous trucking	Self-driving platform	Cross country; inclement weather focus

Source: PitchBook | *As of June 30, 2020

Figure 20.

Key freight incumbents

COMPANY	EV/TTM REVENUE*	EV/TTM EBITDA*
XPO	0.9x	9.1x
J.B. HUNT	1.5x	11.3x
amazon.com	4.7x	38.6x
DAIMLER	1.0x	9.0x
Uber Freight	3.7x	N/A

Source: PitchBook | *As of June 30, 2020

Opportunities

Digital freight brokerage: Digital brokerage platforms automate the process of connecting supply chain intermediaries (e.g. connecting shippers to freight companies). These platforms disrupt traditional relationship-based cargo-matching, which often depends on manual processes such as faxing documents to arrange shipments.

Digital freight brokerages can help improve price transparency and reduce shipping costs by promoting more efficient cargo handling. With cost of labor accounting for approximately 65% of the typical freight broker's expenses, digital solutions that automate manual processes can pass savings along to customers (shippers and carriers).[4] Whereas traditional freight brokerages typically charge a take rate in the mid-teens, digital freight brokerage net revenue margins hover in the low single digits.[5]

Key digital freight brokerage providers include **Convoy**, **Uber** Freight, **uShip**, **Transfix**, **Trucker Path**, **Arrive Logistics**, and **Loadsmart**. These companies are pressuring incumbent freight brokers to pour capital into digital technologies to keep pace with emerging startups. J.B. Hunt launched its own digital freight marketplace named Carrier 360 that services more than $500 million in freight. **XPO Logistics** debuted its own offering and expects future transactions to rely on a mix of brokers and automation. Amazon also entered the market in early 2019 with its own digital freight offering in a bid to offset a tight trucking market. According to **FreightWaves**, differentiation from these incumbent providers comes from integration capabilities in drayage and final mile, along with exception management to limit errors in shipment statuses.[6]

4: "Convoy Eliminates Human Intervention in Load-Matching," FreightWaves, Brian Straight, February 5, 2019
5: "Digital Freight Brokerage Growth to Accelerate Sharply Over Next Five Years," FreightWaves, John Paul Hampstead, March 2, 2019
6: "Breaking: Amazon's Digital Freight Brokerage Platform Goes Live," FreightWaves, John Paul Hampstead, April 26, 2019

Freight forwarding: Freight forwarders provide many middle-man functions for importers and exporters, from handling paperwork to identifying shippers and warehouse space. We see a sizable opportunity for more digitization and automation within the global freight forwarding industry, which is estimated at over $140 billion.[7] According to the Boston Consulting Group, automating manual processes could drop industry back-office and operations costs by up to 40%.[8] These manual processes include lengthy offline quotation and booking processes, filling out shipping documents, and antiquated methods of conveying documents such as personal handoffs and faxes. Digital freight forwarders digitize and automate these processes and offer additional services such as maximizing route efficiency for shipping and tracking cargo. Key providers in the space include **Flexport**, **Freightos**, **Forto**, and **ZenCargo**.

Visibility software: Supply chain visibility software provides real-time tracking and data analytics tools for shippers. This can be a crucial value-add for companies shipping high- value goods. Prior to the rise of this technology, shippers would often have minimal visibility into arrival times for loads. Supply chain visibility platforms enable shippers to receive real-time updates and predictions for loads arriving early, on time or late, which helps to streamline operations. Visibility software also helps enterprises better understand critical failure points, enabling them to reduce costly returns, which typically make up 15% of ecommerce volumes. Mobile app integration enables users to view additional delivery data and can capture signatures. Key providers in the visibility space include **project44**, **FourKites**, Clearmetal, MacroPoint (acquired by Descartes), 10-4 Systems, and **Shippeo**.[9]

7: "Global Freight Forwarding 2017," Ti (Transport Intelligence), June 2017
8: "Banks Can Outsmart the Competition With Intelligent Operations," Boston Consulting Group, Derek Hayes, et. al, September 19, 2019
9: "Project44 Bags Amazon and Walmart," Freight Waves, John Paul Hampstead, August 2019

FREIGHT

We see growth opportunities for these companies to serve a relatively untapped carrier market. The next stage of growth includes penetrating the intermodal market (i.e. drayage trucking, rail), which is in the early stages of telematics adoption. Although this category overlaps with SCM software providers, companies highlighted are primarily used by shippers.

Electric trucking: Although the recent decline in fuel prices and current downturn will likely dampen incentives to electrify fleets in the near term, we continue to remain optimistic about electric truck adoption over the long term. Regulation should be a tailwind for this sector; governments in Europe and Asia have maintained emissions targets and are increasing electric vehicle subsidies despite the coronavirus crisis. In late June, the US state of California approved a measure to require automakers to sell more electric trucks beginning in 2024. Under the new measure, all new trucks sold in the state will be zero-emissions by 2045. Additionally, electric fleets have several advantages relative to diesel fleets, including their ability to eliminate fuel costs, reduce maintenance and repair costs, and lengthen vehicle lifespans. Over the past decade, fuel costs have comprised 21%-39% of average marginal costs per mile (depending on fuel prices), making the reduction of a fleet's reliance on fuel compelling for trucking companies. Electric freight mileage is much greater than that of diesel trucks. Typical diesel trucks may have an average lifespan of roughly 10 years; however, electric vehicle battery warranties often cover 12 years, and the vehicles can last up to 20 years. In addition, electric powertrains have fewer moving parts than traditional internal combustion engines and generally have lower associated maintenance costs. Service and maintenance costs for electric fleets can be up to 20% less than diesel fleets, which require specialized equipment and service.[10]

Key companies developing truck electrification technology include Daimler, Tesla, Nikola, **Wrightspeed Powertrains**, **VIA**, Volvo, and XOS (formally Thor Trucks).

Autonomous vehicles for middle mile transport: We believe autonomous solutions targeting B2B middle-mile logistics present a compelling investment opportunity. Middle-mile transport refers to the movement of goods to, from, and among warehouses or shipping facilities in urban and rural locations. Unlike using autonomous vehicles for consumer transport, transporting commercial goods isn't beholden to customer expectations about passenger experience, has lower safety hurdles, and is not as sensitive to delays. Moreover, many of these vehicles operate on fixed routes as opposed to dynamic routes, which decomplicates routing for AI-based systems. Often these routes are in closed-off locations away from the public—such as on shipyards or docks—where collision risks are lower. These environments enable lower success thresholds relative to consumer applications of autonomous vehicles, increasing the likelihood of adoption over a shorter time horizon. Walmart, which pioneered the retail hub-and-spoke distribution model, is now working to automate its last-mile logistics network through a partnership with startup Gatik AI.

Automating long-haul trucking: The automation of long-haul trucking could help combat wage pressure and driver shortages. In 2018, driver wages and benefits comprised 43% of per-mile average marginal costs, up from 35% in 2014.[11] The relative simplicity of automating highway driving compared to urban driving will accelerate deployment of this technology. We are already seeing the first signs of this; in June 2019, a commercial truck operated by **Starsky Robotics** traversed 9.4 miles on a Florida turnpike at highway speeds without a safety driver in the cabin (the vehicle was monitored by remote operator 150

10: Ian Gardner, CEO at Royale EV. Panel at Sustain SoCal Driving Mobility Conference, June 25, 2019

11: "Walmart's Kickstarting a $1 Trillion Driverless Delivery market," Bloomberg, Keith Naughton and Matthew Boyle, June 19, 2019

miles away).[12] Volvo is also targeting this market with its new cab-less, fully autonomous Vera truck, for which it recently announced a partnership with Nvidia. Key VC-backed companies in the long-haul trucking space include **TuSimple**, **Embark Trucks**, and **Kodiak Robotics**. These startups compete with more established technology companies and automakers such as Waymo, Aurora Innovation, Volvo, and Daimler.

Financial market platforms: The high volume of commodity freight shipping and the ability to forecast prices creates an opportunity for derivative products to hedge against price changes. **FreightWaves** is leveraging its role as an industry media and data hub to sell trucking freight futures products for key routes between major cities. In 2019, the company launched a financially settled futures market based on trucking spot rates that trades on commodities-focused Nodal Exchange. This instrument enables hedging in a historically volatile market, giving shippers and trucking companies more control over shipping costs and price risk. **FreightWaves** has built a digital media presence around this platform, providing news and analyst coverage on trends in supply chain and logistics. As the freight industry becomes more connected and digitized, platforms such as **FreightWaves** are well positioned to benefit.

Blockchain for maritime shipping: Blockchain initiatives such as TradeLens and the Global Shipping Business Network (GSBN) could improve transparency and reduce costs for overseas shippers. Five of the world's six largest oceangoing carriers (Maersk, CMA CGM SA, Mediterranean Shipping Co., Hapag-Lloyd AG, and Ocean Network Express) have joined TradeLens, a blockchain platform launched by Maersk and IBM, to provide increased transparency into goods tracking, improve data sharing, and trim the cost of

12: "Starsky Robotics Remotely Drove an Unmanned Truck 9.4 Miles Down a Florida Highway," Venture Beat, Kyle Wiggers, June 26, 2019

Figure 21.

Recent self-driving valuations

SELF-DRIVING CARS		
WAYMO	$30B	March 2, 2020
cruise	$19B	May 7, 2019
MOBILEYE An Intel Company	$14.9B	April 1, 2018
Uber ATG	$7.3B	April 18, 2019
ARGO AI	$7.3B	July 12, 2019

Source: PitchBook

paperwork in the maritime supply chain.[13] Several other large ocean-shipping companies (including PSA International, Shanghai International Port Group, CMA CGM SA, and Yang Ming Marine Transport Corporation) have joined a blockchain consortium from China-owned COSCO. Accenture is also reportedly developing its own blockchain platform for the shipping industry.

Considerations

Substantial investment needed to scale: We believe digital brokerage startups such as **Uber** Freight and **Convoy** have achieved significant success; both companies are generating run-rate annual revenues in the hundreds of millions of dollars. However, we believe that achieving strong network effects and reaching profitability will require each company to grow considerably larger in both geographic scale and breadth of service offerings. Taking meaningful market share from incumbents is likely to require materially more near-term investment.

Unsustainable growth strategies: Amazon's new digital freight brokerage platform has reportedly been undercutting market prices by 26%-33%.[14] VC-backed startups and relatively new entrants such as **Uber** Freight have adopted similar strategies to attract new shippers to their platforms. In our view, this strategy is likely to be unsustainable during periods where access to cheap capital is limited. Given the current downturn, we anticipate the industry will be forced to become more rational with pricing. In this scenario, new entrants risk losing market share to larger competitors and incumbent carriers that are able to sustain these types of discounts.

13: "Shipping Blockchain Initiative Gathers Steam," The Wall Street Journal, Costas Paris, July 2, 2019
14: "Breaking: Amazon's Digital Freight Brokerage Platform Goes Live," FreightWaves, John Paul Hampstead, April 26, 2019

Figure 22.

Recent self-driving valuations

SELF-DRIVING TRUCKS		
tusimple	$1.2B	September 17, 2019
plus.ai	$1B	August 21, 2019
EMBARK	$520M	September 25, 2019
Ike	$250M	February 5, 2019
Kodiak	$210M	August 7, 2018

Source: PitchBook | Geography: Global | *Internal estimates
Note: Waymo is also reportedly testing its technology on long-haul trucks.

Large and established competition: Although startups kickstarted the transition to digital freight brokerage, they risk being outcompeted by incumbent carriers investing heavily in their own capabilities. These companies include legacy providers such as C.H. Robinson, Echo Global Logistics, **XPO Logistics**, and J.B. Hunt, which have the resources to aggressively compete with smaller rivals and develop similar technologies. Many large shippers are making the transition to digital and developing inhouse transportation management software (TMS) capabilities to receive and route freight orders. For example, in early 2019, **XPO Logistics** launched a service called XPO Connect that enables shippers to book and track shipments online.[15] J.B. Hunt has its own freight brokerage service which books over $500 million in freight annually, and Amazon entered the market in early 2019 with its own digital freight offering in a bid to offset tightness in trucking capacity slowing its growth rate.[16]

Unproven model in autonomy: Among all the segments within freight, we believe autonomy may represent the most difficult market for startups. This subsegment requires massive upfront investment to develop complicated and sophisticated technology that may be many years away from working in the real world. Pioneers in the space are also very well funded. Alphabet-owned Waymo is currently piloting autonomous trucks in Atlanta and has an announced partnership with Honda. VC-backed companies **TuSimple** and **Ike Robotics** were last valued at $1.2 billion and $250 million, respectively. Chinese mobile app platform Manbang, which was last valued at $6.5 billion, is reportedly making investments in freight autonomy. **Uber**, which was at one time a competitor through its $700 million acquisition of Otto, has dropped out of the race, likely due to pressure to trim losses. **Starsky Robotics**, a key competitor in the space, has wound down its asset-heavy trucking operations after difficulties raising VC funding. We believe companies developing autonomous technologies that do not rely on fleet operations are better positioned to succeed, especially as investors increasingly favor software-focused, asset-light startups.

Potential customers slow to change and have limited ability to invest: Large enterprises that could benefit the most from automated solutions may be resistant to adopt new technologies or may lack capital to invest. While automated services could slash costs for large shippers, many of these companies lack the infrastructure to integrate with digital platforms. These low-margin companies have limited ability to invest in new technologies, while global trade uncertainty and tariffs are adding additional pressures. We believe the relationship-based culture of this business is another obstacle to adoption as long-standing relationships tend to dictate business decisions.

Outlook

Pandemic highlights need for visibility software: We expect the current downturn to catalyze investment into freight visibility platforms such as **project44**, **FourKites**, MacroPoint, 10-4 Systems, and **Shippeo**, which provide valuable visibility into where high-value goods are in transit, thereby streamlining processes and curtailing friction in the supply chain.

Favor software intermediaries over asset-holding models: We view asset-light software companies with subscription pricing models more favorably than businesses with high variable-cost components. SaaS businesses are likely to have a steadier recurring revenue stream that could prove more resistant to downturns. Startups such as **Haven** serve as

15: “XPO Logistics Joins Push to Digital Freight Booking,” Wall Street Journal, Jennifer Smith, April 11, 2018
16: "Breaking: Amazon’s Digital Freight Brokerage Platform Goes Live,” FreightWaves, John Paul Hampstead, April 26, 2019

software-focused intermediaries that match shippers and cargo without holding inventory. This reduces liability and should limit downside risk.

Potential withdrawal of Uber from industry: We would not be surprised to see **Uber** withdraw from the freight tech space. The company's management team has signaled its intention to refocus on ridesharing and delivery given pressure on its core ridesharing business. As we noted in our discussion of digital freight brokerages, margins are tight in the space, and the company may choose to cut its losses despite the high growth it has seen. Such a move would be positive for startup competitors such as **Convoy**, **uShip**, and **Transfix**.

Increased M&A activity: We expect increased acquisition activity in the freight brokerage space as the industry faces pressure to price more rationally. Large incumbents such as Amazon, J.B. Hunt, and Echo Global Logistics are likely buyers as they gain traction with their in-house solutions. In the long term, we anticipate the tail end of the digital freight brokerage space to consolidate as the current downturn has an impact primarily on smaller, less profitable startups.

Self-driving enablers are attractive acquisition targets: With autonomous trucking companies such as **TuSimple**, **Ike Robotics**, **Embark Trucks**, and **Kodiak Robotics** challenged by the current downturn, we view them as attractive acquisition targets for incumbent freight & logistics providers and other technology companies. In our view, lower valuations for these companies are at odds with the potentially broader and more near-term market opportunity available to automating logistics. As with software-focused startups, we view asset-light technology providers more favorably than startups attempting to operate autonomous fleets, as evidenced by Starsky's failure to find a buyer and subsequent shutdown. We expect investors will remain active in the space given the likelihood that discounted valuations could persist for some time.

SEGMENT DEEP DIVE

Warehousing

Overview

The warehousing industry has experienced strong growth in recent decades. Warehouse employment rose 187% from 1990 to 2019, while total non-farm employment rose 40%.[17] Demand for warehousing space is strong; 183 million square feet of new warehousing space was built in 2017, a sizable increase compared to the 100 million annual average over the past decade, according to CBRE.[18]

While economic growth partially fueled this expansion, it also reflects important technological evolutions that continue to alter the supply chain ecosystem. Walmart's hub-and-spoke approach set the standard for big-box retail in the late 20th century, enabling the company to become one of the largest global retailers ever. This was followed by Amazon's fulfillment center model, which helped facilitate the rise of ecommerce and the ongoing push for same-day delivery. More recently, the rise of dropshipping and the stitching together of third-party warehousing services, such as Shopify's fulfillment network, is empowering small individual retailers to compete on a global scale. Subsegments include:

Warehousing & fulfillment: Startups providing sorting, packaging and shipping services for retailers and enterprises

Automation & micro-fulfillment: Startups providing robotic and automation technologies for warehouses and fulfillment centers

Warehouse marketplaces: Startups helping enterprises with excess inventory find available warehouse space

Augmented reality: Startups developing augmented reality solutions for warehousing applications

17: Employees on Nonfarm Payrolls by Industry, Sector, and Selected Industry Detail." United States Bureau of Labor Statistics, accessed August 7, 2020
18: "Cold Storage Space: One Size Does Not Fit All," CBRE, n.d.

Walmart played a key role in the early stages of warehousing innovation. The company's innovative (at the time) hub-and-spoke distribution system has been critical to its ability to service its global branch network. Under this model, distribution centers operate as hubs that provide inventory for multiple stores. Distribution centers are not designed for long-term storage, but as short-term holding locations where goods are categorized and sorted for distribution to Walmart branches. Some items spend as little as 45 minutes in warehouses before being shipped to a branch where inventory has run out. Key innovations of this system included the use of Walmart's own fleet, which reduces freight and delivery costs relative to using third-party providers; and an integrated inventory tracking system, which enables a real-time view of inventory levels across stores.

While hub-and-spoke models worked well in a physical retail world, ecommerce changed the game entirely. Whereas Walmart's success depended on its ability to make a large selection of goods available in convenient locations, online retail eliminated these constraints, allowing retailers to sell virtually anything. From a supply chain perspective, this has shifted the focus from the complicated logistics of product curation and stocking, to the adjacent—though equally as complicated—logistics of fulfillment and consumer delivery.

Amazon's rise to the forefront of ecommerce has largely reflected the company's ability to provide the best online shopping experience in terms of product search, quick delivery, and easy returns. To accomplish the quick delivery part of this equation, the company turned Walmart's hub-and-spoke model on its head. Instead of a closed internal sourcing and delivery ecosystem, Amazon opened its retail platform up to third-party providers, including sellers, freight, and delivery services, creating a virtual marketplace for these functions. This gave rise to Amazon's fulfillment centers, which act as product hubs that coordinate the delivery of goods directly to consumers by leveraging a network of third-party product suppliers and delivery services.

While Amazon has dominated the ecommerce landscape, it has also provided a model for startups seeking to help traditional and small to medium-size retailers compete. Several companies have emerged that are focused on providing large scale shipping management and fulfillment services for small-scale businesses and other legacy retailers. These include **ShipBob** and **ShipHawk**. Others include **Flexe** and Stord, which are creating marketplaces for outsourced warehousing; **Fetch Robotics** and **Fabric** are creating automated micro-fulfillment centers of the future.

Industry drivers

- Emerging need to manage inventory for real-time changes in demand
- Demand from smaller retailers for tech and services, enabling them to compete with large retailers
- Ongoing efforts to reduce shipping and delivery costs
- New technologies enabling real-time tracking and better mapping of items in transit
- Improving robotics technology
- Increasing demand for quicker delivery times and just-in-time inventory

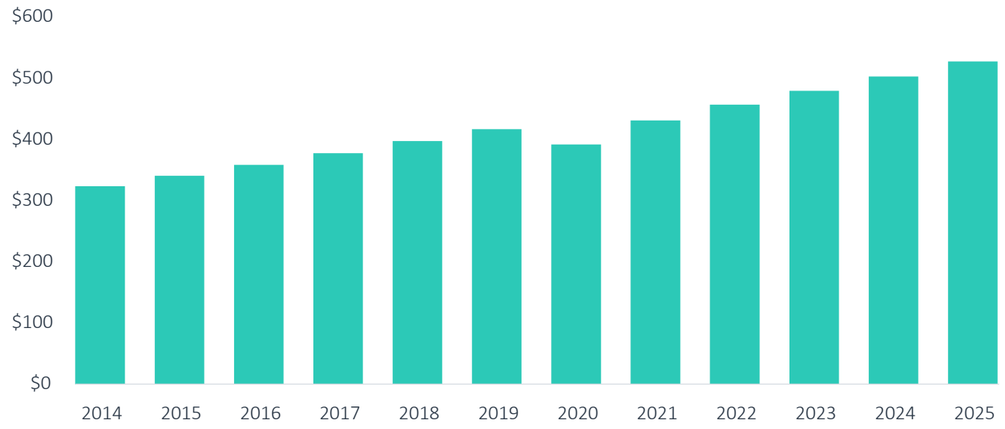
Market size

We estimate the net revenue generated from the global warehousing & fulfillment industry totaled approximately $416.8 billion in 2019 and forecast this figure to grow to $527.3 billion in 2025. Although the current downturn could reduce spending on capital-intensive projects in the near term, we expect increases in ecommerce volumes and heightened demand for automated warehousing robots to be key drivers of market growth in this segment over the long term.

Business model

Companies that provide sorting, packaging, and shipping services typically charge for these services on a per-package basis. Robotics and micro-fulfillment companies typically monetize by selling autonomous robots on a per-unit basis, though an increasing number are transitioning to a full-service subscription-based model.

Figure 23. WAREHOUSING MARKET SIZE ($B)



Source: Internal PitchBook estimates

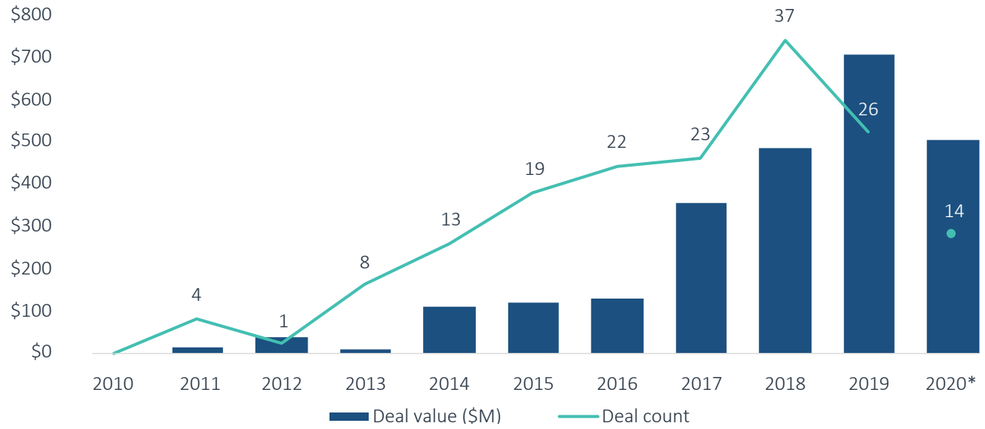
COMMON INDUSTRY KPIS

- On-time shipping
- Order cycle time
- Dock-to-stock time
- Invevntory accuracy (receiving and order fulfillment)
- Recordable incident rate (RIR)

VC activity

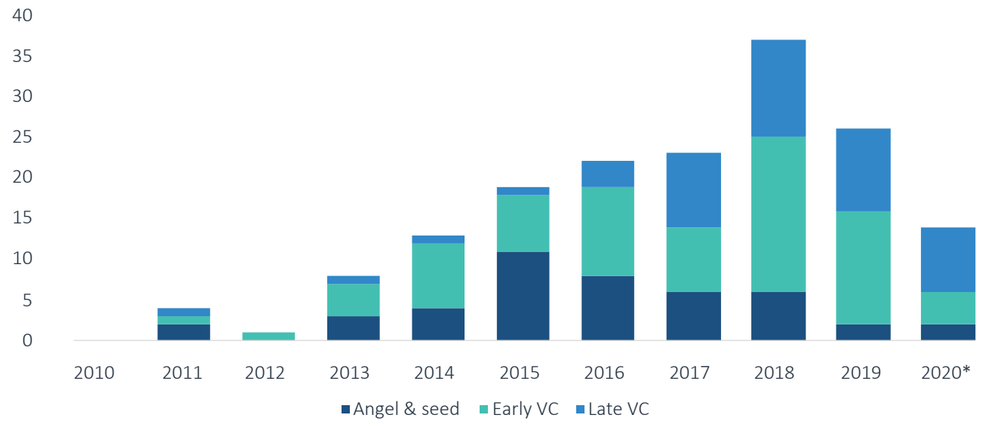
Warehousing tech startups through H1 2020 continued to attract substantial investment after collecting a record amount of venture money in 2019. In the first half of the year, the segment raised $504.2 million, up 9.6% over H1 2019. Outsized deals in the quarter include on-demand storage company **MakeSpace**'s $45.0 million Series E led by Iron Mountain; **Locus Robotics**' $45.9 million Series D led by Zebra Ventures, valuing the company at $361.0 million. Though not reflected yet for this report, in early Q3 2020, warehouse automation company **Dexterity** raised $56.2 million in Series A venture funding. These deals showcase growing investor interest in warehousing technologies such as micro-fulfillment and automation that can reduce labor costs and improve ecommerce delivery times. The coronavirus pandemic is likely driving demand for automation technology that can augment human workers, make warehouses safer and help ensure continuity of operations.

Figure 24. WAREHOUSING VC DEAL ACTIVITY



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

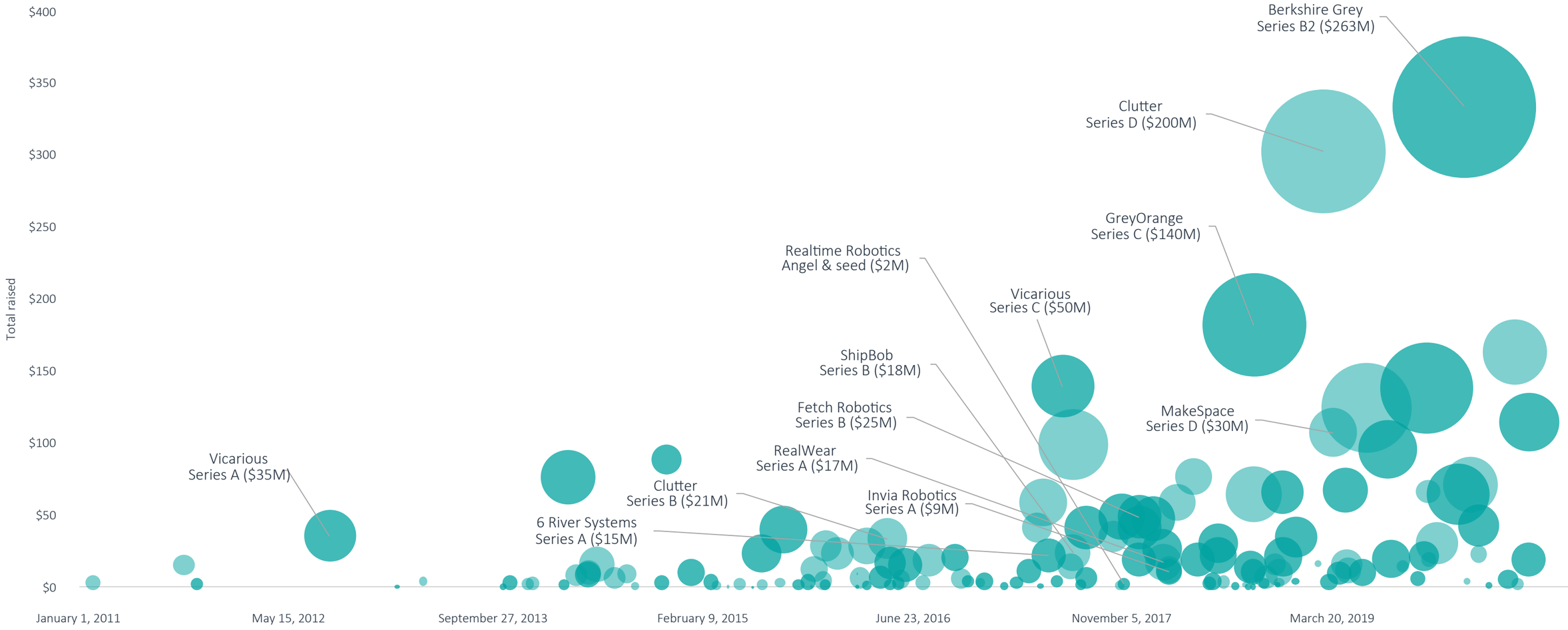
Figure 25. WAREHOUSING VC DEALS (#) BY STAGE



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 26.

Warehousing VC landscape ($M)



Source: PitchBook

Note: The left axis indicates total VC raised as of deal date. Bubbles indicate amount raised.

Figure 27.

Notable warehousing VC deals

COMPANY	CLOSE DATE	SUBSEGMENT	STAGE	DEAL SIZE ($M)	LEAD INVESTOR(S)	VALUATION STEP-UP
MakeSpace	May 21, 2020	Warehousing & fulfillment	Late-stage VC	$45.0	Iron Mountain	N/A
LOCUS	June 24, 2020	Warehouse automation	Late-stage VC	$45.9	Zebra Ventures	1.71x
THIRD WAVE AUTOMATION	June 23, 2020	Warehouse automation	Early-stage VC	$15.0	Innovation Endeavors	N/A
SVT ROBOTICS	May 5, 2020	Warehouse automation	Seed	$5.0	Cowboy Ventures	N/A
WAREHOUSE EXCHANGE	May 28, 2020	Warehousing & fulfillment	Seed	$2.2	N/A	N/A

Source: PitchBook

Figure 28.

Notable warehousing VC exits

COMPANY	CLOSE DATE	SUBSEGMENT	EXIT TYPE	EXIT SIZE ($M)	ACQUIRER OR INDEX	VALUATION METRIC
6 RIVER SYSTEMS	October 17, 2019	Warehouse automation	M&A	$394.0	Shopify	2.63x
CANVAS technology	April 10, 2019	Warehouse automation	M&A	$100.0	Amazon.com	N/A
PEOPLEVOX DESCARTES	February 24, 2020	Warehousing & fulfillment	M&A	$24.6	Descartes Systems Group	1.32x

Source: PitchBook

Figure 29.

Key VC-backed warehousing companies

COMPANY	TOTAL VC RAISED ($M)*	SUBSEGMENT	KEY PRODUCTS	PRODUCT DIFFERENTIATION
BERKSHIRE GREY	$327.6	Automation & micro-fulfillment	Robotic picking, parcel sortation	Flexible, intelligent robotic automation
Clutter	$297.2	Warehousing & fulfillment	On-demand B2C & B2B storage	On-demand consumer storage; expanding to B2B storage
Fabric	$136.0	Automation & micro-fulfillment	Micro-fulfillment platform	Highly automated fulfillment platform tailored for same-day delivery
realwear	$122.1	Augmented reality	HMT head mounted displays	Rugged; hands-free, voice-operated OS
LOCUS	$112.4	Automation & micro-fulfillment	Autonomous mobile robot	Highly flexible platform; RaaS business model
fetch robotics	$94.0	Automation & micro-fulfillment	Autonomous mobile robot	Cloud-based; automated materials handling and data collection for warehouses
Deliverr	$70.1	Warehousing & fulfillment	Ecommerce fulfillment	ML-based item tracking and prediction
ShipBob	$63.1	Warehousing & fulfillment	Ecommerce fulfillment	Data-driven sales channel integration with major platforms and marketplaces

Source: PitchBook | *As of June 30, 2020

Figure 30.

Key warehousing incumbents

COMPANY	EV/TTM REVENUE*	EV/TTM EBITDA*
Deutsche Post DHL Group	N/A	N/A
amazon.com	4.7x	38.6x
XPO	0.9x	9.1x
ups	1.6x	13.8x
Microsoft	10.7x	22.1x

Source: PitchBook | *As of June 30, 2020

Opportunities

Fulfillment technologies: Much of Amazon's ability to provide industry-leading delivery services can be attributed to its investments in warehousing, fulfillment, sorting, and delivery stations. Emerging warehousing technology startups such as such as **ShipBob**, **Delhivery**, and **ShipMonk** are emulating Amazon's model to provide smaller retailers with products and solutions to help them compete with Amazon and Walmart. In addition to typical fulfilment services such as warehousing, packing, and shipping, **ShipBob** offers software that integrates with multiple parties on the supply chain to provide visibility into inventory. Utilizing digital fulfillment software enables enterprises to reduce fulfillment costs and errors, increase transparency, and improve the customer experience. In this way, warehousing and fulfillment technology can provide a competitive edge to help close the gap between smaller retailers and large incumbents.

Digital marketplaces for warehouse space: Warehousing operations account for approximately 20% of all logistics costs,[19] and as enterprises face pressure to streamline their cost structures, many are looking to reduce this spend. While third-party logistics (3PL) providers, such as DHL, **XPO Logistics**, and Ryder Supply Chain Solutions can provide flexible on-demand warehouse space, their operational models are often outdated, involving phone calls, faxing, and traditional relationship-based activities. Emerging digital platforms, such as VC-backed **Flexe**, Stord, and **Darkstore**, create digital marketplaces for external warehouse space. These companies provide a flexible logistics solution for asset-intensive enterprises struggling to place inventory. For example, **Flexe** helps match customers (which include Ace Hardware and Staples) with local warehouse space for excess inventory. These platforms can help add flexibility and scalability for small businesses, enterprises, and other shipping intermediaries so they can maintain steady operational performance during periods of fluctuating inventory demand. Digital marketplaces also increase price transparency and allow for more consumption-based spend.

Automation of micro-fulfillment centers: We see micro-fulfillment as a strong growth opportunity for autonomous technologies that can automate manual warehouse functions. Rising ecommerce volumes and increased demand for faster delivery has led many enterprises to build small warehousing and fulfillment centers close to urban locations. These micro-fulfillment centers enable quicker delivery via the use of last-mile delivery couriers. Yet these centers typically cost more to operate (i.e. higher labor and real estate costs), creating an opportunity for providers of robotic and automation services to help cut costs. According to ABI Research, over 4 million commercial robots will be installed in 50,000 warehouses by 2025, up from around 4,000 robotic warehouses last year.[20] Private companies will be key to this transformation. For example, **RightHand Robotics** has developed a robotic arm to pick and place physical goods at warehouses. **GreyOrange** has developed scalable and modular robot systems that can be used to transport, store, and pick goods in warehouses. **Realtime Robotics** has invented a processor that can effectively react to obstacles intercepting robotic motion plans without being bogged down by wading through a conventional decision tree. We believe the adoption of autonomous mobile robots (AMRs) and additional autonomous warehousing technologies will see growth over the long term as enterprises seek to reduce labor costs. Additionally, we believe autonomation will increasingly provide a source of competitive

19: "Design and Control of Warehouse Order Picking: A Literature Review," European Journal of Operational Research, René De Koster, et.al., 2006

20: "50,000 Warehouses to Use Robots by 2025 as Barriers to Entry Fall and AI Innovation Accelerates," ABI Research, March 26, 2019

advantage for warehouses during pandemic conditions by enabling greater social distancing. More automation should allow warehouses to operate with fewer staffing disruptions during outbreaks and help attract talent drawn to safer working conditions.

Augmented reality: We believe augmented reality technology used in warehousing applications could be a key early-stage investment opportunity. Processes such as picking products from shelves, which currently accounts for 55%-60% of the cost of warehousing operations, could benefit significantly from wearable augmented technology. Warehousing workers of the future could utilize augmented reality glasses to pick and sort automatically labeled goods more quickly and at lower error rates, driving down warehousing costs. Augmented reality glasses could also improve other processes in the warehouse, such as optimizing routes and seamlessly confirming orders. Key startups working on augmented reality specifically for warehousing include **RealWear**, **Upskill**, **Atheer**, **Ubimax**, **Getvu**, and **Oculogx**. These companies compete with AR companies, such as Magic Leap and Unity, as well as the consumer and enterprise AR efforts of incumbent technology companies, such as Facebook, Microsoft, and Apple. Magic Leap, which has reportedly pivoted from consumer to enterprise applications, raised $350.0 million in May 2020, a sign that investor interest in enterprise AR continues to be robust.

Considerations

Automation in early stages: We believe the high cost of deploying autonomous technology in warehousing is a deterrent to adoption. For example, Amazon's CartonWrap machines reportedly cost an average of $1 million each. Additionally, robots can break down, leading to less productivity and unanticipated repair costs. In the medium term, we believe warehouse operators may prefer to invest in alternative technologies such as augmented reality. With that said, in the long term we expect the cost of automating warehouses to continue to decline, which should spur adoption.

Industry-wide inertia: Large established companies with significant sunk costs in legacy technologies and processes may be slow to adopt new technologies and processes. Many of these companies likely use in-house logistics processes for warehousing and fulfillment or rely on established relationships with regional or incumbent outsourced third-party logistics providers. This relationship-based culture could be hard to unseat and may represent a major obstacle to adoption.

Large existing competitors: Well-funded incumbents with established logistics networks are leveraging their market position to outcompete newer entrants. Third-party fulfillment services are dominated by large companies such as **FedEx** (**FedEx** Fulfillment), Amazon (Fulfillment by Amazon), and Rakuten (Rakuten Super Logistics). This makes it more difficult for startups such as **ShipBob** and **ShipMonk** to compete. UPS recently entered the warehouse marketplace space with its Ware2Go product, which competes with startups **Flexe** and Stord. Large technology companies such as Facebook, Microsoft, and Apple are also developing augmented reality solutions to enter the enterprise market, presenting a potential risk to emerging startups in the space such as **Ubimax**. Finally, large technology companies such as Amazon and IBM are developing automated warehouse solutions.

Outlook

Opportunity for both early- and late-stage investment: Within the warehousing and fulfillment space, late-stage deals represent most of the total VC raised since 2008. We believe both early- and late-stage companies in the space are seeing strong interest from investors, as the competitive landscape for disruptive technologies such as outsourced warehousing, micro-fulfillment solutions, and automation is relatively immature. We expect investment in both early-stage and late-stage applications to rise over the next few years as consumer demand for faster delivery services continues to grow, necessitating flexible warehouse and fulfillment solutions.

Tech-enabled warehousing to see long-term growth: During the height of the pandemic, distribution centers prioritized essential freight such as food and medical supplies. Additionally, retailers that were shut down were unable to accept deliveries. This led to nonessential freight items such as furniture and large electronics becoming stuck in trucks and ports. As a result, demand for tech-enabled warehousing services spiked as retailers needed alternative means to store and track nonessential goods. We expect these newly formed relationships could prove sticky as retailers seek to mitigate the risk of future supply chain shocks.

Expect growth in on-demand storage: Consumer-focused on-demand storage providers could expand into the B2B warehousing space. Startups such as **Clutter** and **MakeSpace** currently offer on-demand storage for consumers. In some cases, these startups own and operate warehousing facilities. In early 2019, **Clutter** branched out into B2B storage services, leveraging its consumer expertise for storing items that don't fit well together to serve the needs of businesses with excess, differently sized inventory. On-demand storage is an attractive market given local competitors are often low-tech with limited inventory-tracking capabilities. Additionally, relative to other warehousing business models such as fulfillment, on-demand storage businesses require fewer workers and might not face as much pandemic-related disruption owing to health-related social distancing concerns.

Demand for warehouse robotics as a service to rise: Robots and autonomous technologies can help maintain continuity of warehouse operations during labor shortages and are likely to be areas of continued investment. Startups that have secured partnerships with large retailers include **Kindred AI**, which has partnered with Banana Republic, and **RightHand Robotics**, which has partnered with Walmart. Providers of subscription-based, full-service solutions—such as **Locus Robotics**, Mobile Industrial Robotics, and **Vicarious**—are likely to have more success penetrating smaller enterprises with more limited capex budgets. Recurring subscription models will also likely prove a more attractive model for investors seeking steady cash flows.

SEGMENT DEEP DIVE

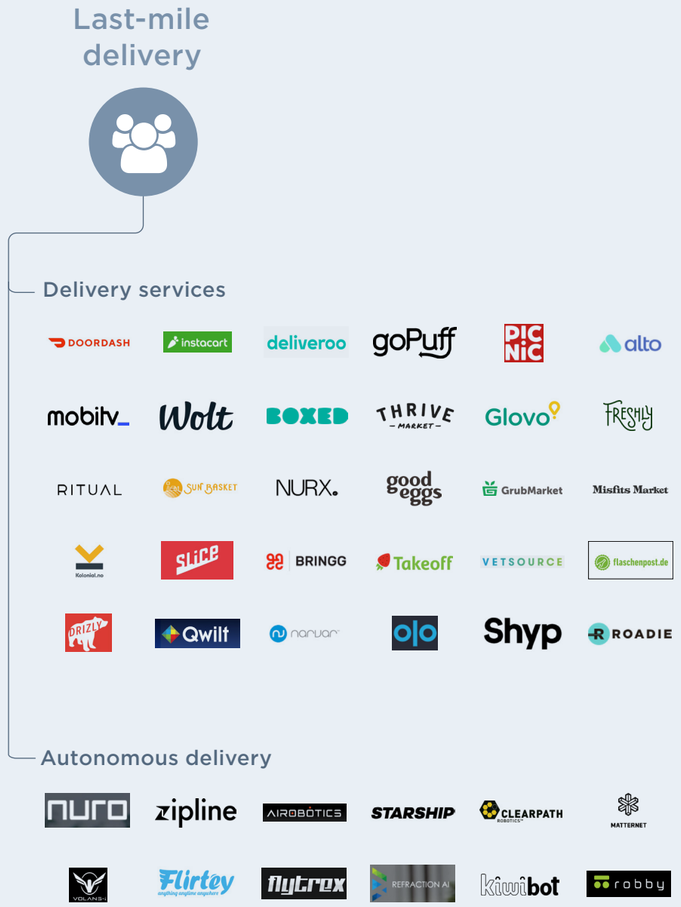
Last-mile delivery

Overview

Last-mile delivery providers focus on hyper-local delivery services that provide retailers with a unique way to deliver products to customers in short time periods. Subsegments include:

Delivery services: This includes delivery platforms such as **Uber Eats**, **DoorDash** and **Postmates**, which contract with couriers to deliver food, groceries and other goods on-demand.

Automated delivery: This includes autonomous delivery companies such as **Nuro** and **Starship** Technologies, which are developing robotic solutions to deliver goods without the need for a courier.



Industry drivers

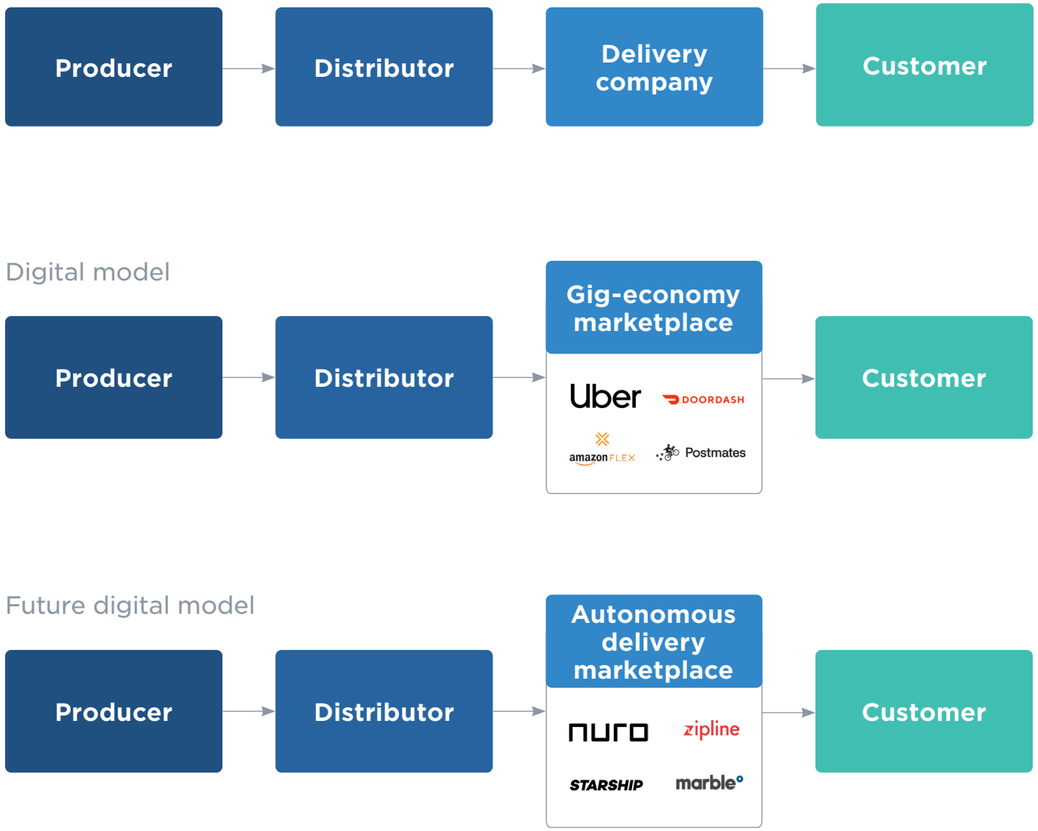
Consumer demand for faster delivery services: Emerging technologies that enable speedier delivery times stand to benefit from growing consumer preference for on-demand, same-day delivery services. In much the same way that ecommerce has taken share from physical retail, we believe on-demand food delivery may be taking share from traditional eat-in restaurants.

The rise of the gig economy: Emerging delivery platforms (e.g., **Grubhub**, **Uber** Eats, **DoorDash**, and Amazon) that connect vendors and consumers allow companies to gain access to an extensive pool of individual drivers ("gig economy" workers) who use their own vehicles to provide local delivery services on a contractual basis. This model can provide local delivery services with higher efficiency and at a lower cost compared to traditional delivery fleets.

Autonomous vehicles: While still several years away, we believe autonomous vehicle technology represents the next stage of delivery's evolution. These technologies include autonomous cars, robots, pods, and drones that have the potential to replace human couriers in serving the need for low-cost, last-mile delivery.

Figure 31.

Evolution of last-mile delivery



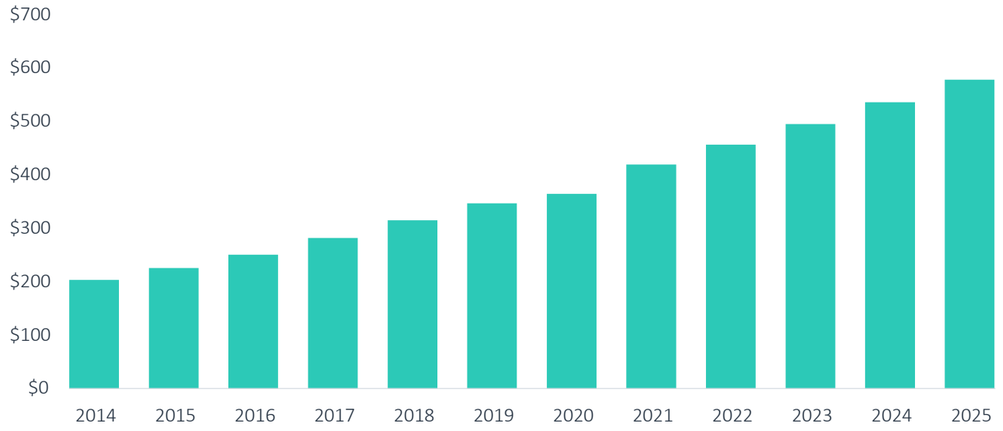
Market size

We estimate global revenue from last-mile delivery services reached $347.3 billion in 2019 and forecast this to grow to $578.8 billion by 2025, implying a CAGR of approximately 7.7%. We expect consumer adoption of online food delivery to be one of the key drivers of increased growth in the industry. Although ecommerce volumes will likely be affected by reduced consumer spending, we anticipate the online food, grocery, and essential goods delivery industries will see a boost. Social distancing could expand adoption and attract more users, meaningfully expanding the market for online food and grocery delivery.

Business model

Last-mile delivery providers focus on hyper-local delivery services that give retailers a unique way to deliver products to customers in short time periods. This includes food delivery platforms such as **Uber** Eats, **DoorDash**, and **Postmates**, which contract with couriers to deliver food and groceries on-demand. These platforms tend to monetize by taking a commission of the gross transaction, in addition to charging an additional delivery fee or service charge to the diner. A percentage of these earnings are then distributed to the couriers. Additionally, some platforms such as Meituan charge fees to restaurants for more favorable app placement.

Figure 32. LAST-MILE DELIVERY MARKET SIZE ($B)



Source: Internal PitchBook estimates

COMMON INDUSTRY KPIS

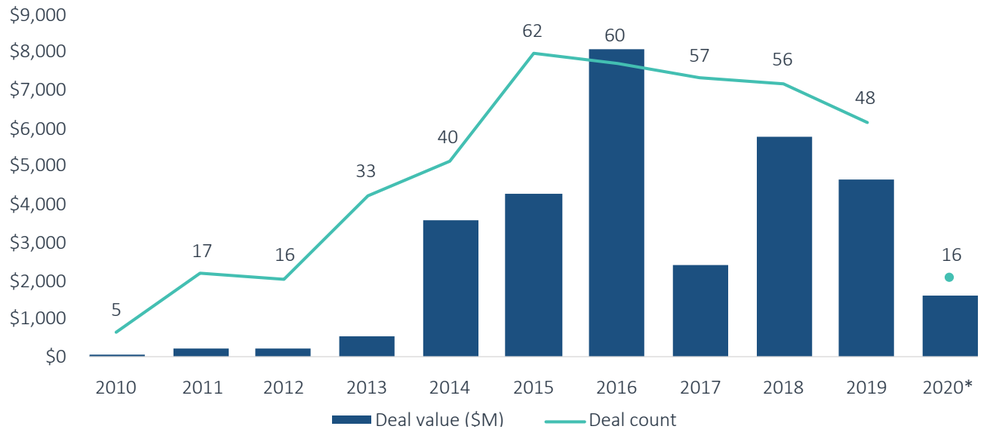
- Gross merchandise volume (GMV)
- Ecommerce conversion rate
- Average order value (AOV)
- Customer lifetime value (LTV)
- Monthly active users (MAU)
- Market penetration %
- On-time delivery %

VC activity

Last-mile delivery VC deal value has trended upward over the past few years as delivery services rapidly expand in an underpenetrated market. Late-stage deals continue to dominant capital deployment, reflecting the relative maturity of VC-backed companies operating in the space. We expect the funding environment for delivery startups to be favorable relative to other supply chain tech segments in the near to medium term.

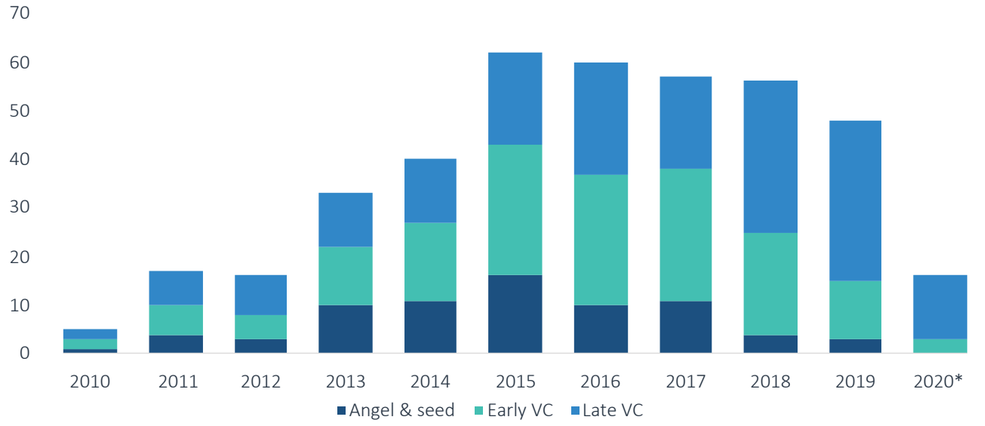
Last-mile delivery companies in North America and Europe raised $1.6 billion in the second quarter, up 143% YoY and up significantly from the $37.9 million invested in Q1 2020. The bulk of venture money in last-mile delivery in Q1 2020 went toward Asia-based delivery companies. Standout deals in the second quarter include **Deliveroo**'s $575.0 million Series G led by Amazon; **DoorDash**'s $400.0 million Series H led by Fidelity and Durable Capital Partners, valuing the company at $16.0 billion; and **Instacart**'s $325.0 million Series G led by DST Global and General Catalyst, valuing the company at $13.8 billion.

Figure 33. LAST-MILE DELIVERY VC DEAL ACTIVITY



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

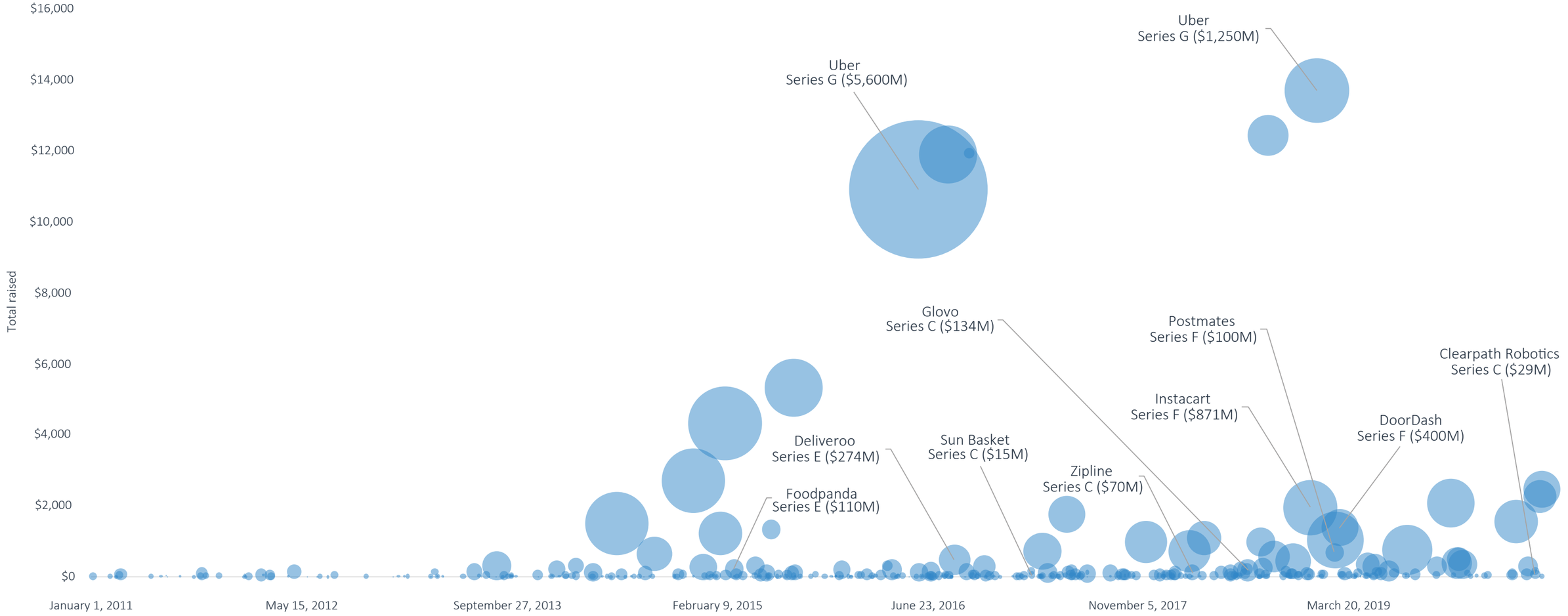
Figure 34. LAST-MILE DELIVERY VC DEALS (#) BY STAGE



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 35.

Last-mile delivery VC landscape ($M)



Source: PitchBook

Note: The left axis indicates total VC raised as of deal date. Bubbles indicate amount raised.

Figure 36.

Notable last-mile delivery VC deals

COMPANY	CLOSE DATE	SUBSEGMENT	STAGE	DEAL SIZE ($M)	LEAD INVESTOR(S)	VALUATION STEP-UP
deliveroo	April 17, 2020	Delivery services	Late-stage VC	$575.0	Amazon.com	N/A
DOORDASH	June 18, 2020	Delivery services	Late-stage VC	$400.0	Durable Capital Partners, Fidelity Investments	1.20x
instacart	June 11, 2020	Delivery services	Late-stage VC	$325.0	General Catalyst, DST Global	1.71x
Wolt	May 15, 2020	Delivery services	Late-stage VC	$108.7	N/A	N/A
slice	May 12, 2020	Delivery services	Series C	$43.0	Kohlberg Kravis Roberts	N/A
instabox	April 8, 2020	Delivery services	Late-stage VC	$40.6	Creades	N/A

Source: PitchBook

Figure 37.

Notable last-mile delivery VC exits

COMPANY	CLOSE DATE	SUBSEGMENT	EXIT TYPE	EXIT SIZE ($M)	ACQUIRER OR INDEX	VALUATION METRIC
Cornershop	July 1, 2020	Delivery services	M&A	$459.0	Uber	N/A
deliv	May 7, 2020	Delivery services	M&A	N/A	Target	N/A

Source: PitchBook

Figure 38.

Key VC-backed last-mile delivery companies

COMPANY	TOTAL VC RAISED ($M)*	SUBSEGMENT	KEY PRODUCTS	PRODUCT DIFFERENTIATION
DOORDASH	$2,471.7	Delivery services	On-demand restaurant ordering & delivery platform	Local suburban market focus; large ticket sizes
instacart	$2,269.8	Delivery services	Same-day grocery and pickup	Grocery focused; seamless UX design
deliveroo	$1,556.2	Delivery services	On-demand restaurant ordering & delivery platform	Investment in ghost kitchens
nuro	$1,032.0	Autonomous delivery	Self-driving vehicle	Cabless; small form-factor; on-road capabilities
goPuff	$758.3	Delivery services	Convenience item delivery platform	Focus on snacks and convenience items
Postmates	$682.2	Delivery services	On-demand restaurant ordering & delivery platform	Provides non-food items; partnerships with apparel retailers
Glovo	$511.5	Delivery services	On-demand delivery application	Provides non-food items; partnerships with pharmacies
zipline	$304.3	Delivery services	Drone delivery service	Focus on medical supply delivery in remote areas

Source: PitchBook | *As of June 30, 2020

Figure 39.

Key last-mile delivery incumbents

COMPANY	EV/TTM REVENUE*	EV/TTM EBITDA*
amazon.com	4.7x	38.6x
FedEx	1.0x	11.5x
ups	1.6x	13.8x
GRUBHUB	4.9x	106.6x
Uber Eats	3.7x	N/A

Source: PitchBook | *As of June 30, 2020

Opportunities

Food delivery: The rapid rise of food delivery platforms (e.g., **Grubhub**, **DoorDash**, and **Uber** Eats) has had a profound impact on the restaurant industry, with incumbent delivery-based companies such as pizza franchises feeling the pressure as more restaurants take share of the food delivery pie. According to **Uber**, the home food delivery market has grown at a CAGR of 77% since 2013, well above the growth rate of the consumer food service market.[21] In much the same way that ecommerce took share from physical retail, we believe food delivery may be taking share from traditional eat-in restaurants. According to the US Department of Agriculture, millennials place a greater preference for convenience when making food-related shopping purchases related to than other generational cohorts, leading to greater usage of delis, carry-out, fast food, and food delivery services.[22] We see food delivery as an attractive, mature market and are more positive on late-stage companies such as **DoorDash**, **Postmates**, **Instacart**, and **Deliveroo** relative to newer entrants, given their scale and capital advantages.

Combined mobility and food delivery platforms: Ridesharing companies are leveraging their platforms to provide food delivery services. While this includes **Uber** with its fast-growing **Uber** Eats service, we see continued opportunity for global ridesharing platforms **Grab**, **Gojek**, and **Ola** to capture market share, and we expect more late-stage investment in these businesses. We see long-term benefits to the mobility-as-a-service strategy, as bundling services has the potential to expand the addressable market and create a source of competitive advantage relative to more pure-play applications. Similar to how Amazon monetized its user base across several services (e.g., video, grocery, AWS, etc.), we believe ridesharing providers could replicate such platforms in the transportation world. This could allow providers to further leverage their existing driver networks and drive synergies by optimizing driver utilization between ridesharing and food delivery.

Delivery robots: Delivery robots have the potential to dramatically reduce costs across the delivery supply chain (e.g., wages for drivers and couriers) while also improving automobile energy efficiency and traffic congestion levels. Startups developing robots to capture this market include **Nuro**, **Postmates**, **Zume**, **Starship** Technologies, **Clearpath Robotics**, **Boxbot**, **Kiwibot**, and Marble. In addition, large incumbents such as Amazon and **FedEx** are developing their own in-house delivery robots.

Delivery drones: The use of drones for air delivery of smaller packages presents another alternative. Companies working on drone-enabled delivery include **Zipline** International, **Matternet**, **Flirtey**, and **Flytrex**. Although we see the largest market for drone delivery as serving ecommerce needs for residential areas, some drone-focused startups have found their niche targeting more underserved communities. Silicon Valley-based **Zipline** International utilizes a fleet of drones to deliver blood, plasma, and medicine to remote clinics in East Africa. While we believe autonomy and drone delivery could have significant potential, both technologies are likely to face significant regulatory hurdles and a long adoption curve as consumers adjust to these new experiences.

Delivery management software: Delivery management software helps inventory-heavy enterprises manage local deliveries and integrate with third-party carriers. Features include real-time dispatching, managing, and tracking of packages, establishing proof of delivery, and collecting signatures.

21: “Form S-1 Registration Statement: **Uber** Technologies, Inc.,” SEC, April 11, 2019
22: "Is the Kitchen Dead?" UBS, Chris Grundberg, June 18, 2018

Some providers also enable enterprises to integrate with third-party delivery services such as UPS and **FedEx**. Delivery management software providers tend to target small and medium-sized businesses that seek to reduce time and cost associated with delivery, increase capacity, and improve the customer experience. Delivery management software providers include **GetSwift**, **MetaPack**, **Bringg**, **FarEye**, **WorkWave**, and **LogiNext**.

Considerations

Food delivery margins structurally low: Food delivery is a structurally low-margin business as services are relatively commoditized and undifferentiated. Customer incentives intended to expand market share further pressure profitability. For example, **Uber** Eats has a take-rate below its corporate average, reflecting the heavy use of incentives. Similarly, prior to its recent acquisition, **Grubhub** has seen margin pressure due to increased marketing spend and competitive pressure from companies such as **DoorDash** and **Uber** Eats. While the market for food delivery is large, consumer price sensitivity and the competitive landscape may permanently impede margin expansion, limiting returns for investors.

Large investment capital needed to grow market share: Food delivery startups need massive infusions of capital to grow and face heightened competition from incumbent ridesharing companies that already have greater scale and capital advantages. With food delivery commissions roughly half that of ridesharing, **Uber** has depended heavily on its higher-margin businesses along with outside funding to finance its aggressive expansion into food delivery. Similar to other companies in the space, **Uber** also relies on heavy subsidies and promotional activity, further pressuring margins. Other ridesharing companies that have moved into food delivery include **Grab**, **Gojek**, and **Ola**.

Labor regulation and minimum wage rules: The last-mile delivery industry is facing increasing pressure from regulators. In late 2019 California signed AB 5 into law, entitling gig-economy workers to receive a minimum wage and greater labor protections. This makes it more difficult for food and grocery delivery services such as **Uber** Eats and **DoorDash** to classify their workers as independent contractors. Despite a potentially lengthy implementation, we expect this legislation to put negative pressure on last-mile delivery company margins as the industry likely will have to pay more to drivers. We believe driver wages are seeing upward pressure across the country and expect to see continued scrutiny surrounding labor practices.

Partner risk: After Amazon acquired Whole Foods, it eventually terminated the grocer's deal with **Instacart** to provide grocery delivery. Presumably, Amazon intends to provide Whole Foods delivery through its own app. This highlights the partner risk inherent to delivery services as the competitive interests of providers and retailers have the potential to become misaligned.Autonomous last-mile delivery stalled by setbacks: Although deep learning has enabled material progress in autonomous driving, the technology still has its shortcomings. While deep learning is excellent at categorizing objects or scenarios it has seen, it struggles to contextualize objects and scenarios it hasn't categorized. For example, placing small stickers on a stop sign can sometimes cause an autonomous vehicle to fail to recognize the sign and consequently not stop.[23] We believe UK autonomous vehicle startup **Wayve** may have a novel approach to machine learning that could give it an edge in the market. Whereas large technology companies train vehicles by using rules, large datasets, and sophisticated sensory equipment, **Wayve** uses limited amounts of data with a greater focus on machine learning. These kinds of novel approaches will be key to solving issues surrounding the limitations of deep learning technology and ultimately enabling commercialization.

23: "Robust Physical-World Attacks on Deep Learning Models," arXiv, Kevin Eykholt, et. al, April 10, 2018

Outlook

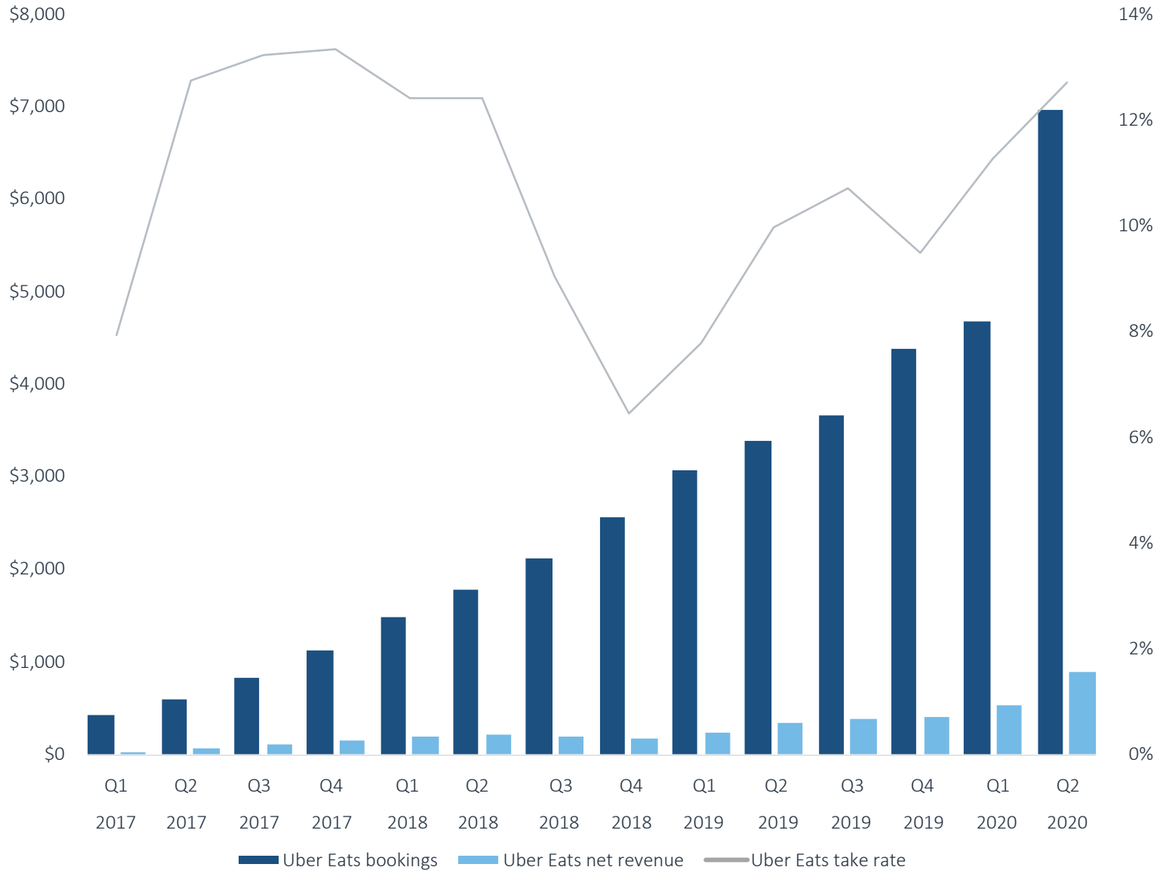
Social distancing to expand market: The coronavirus pandemic and subsequent stay-at-home orders have driven more demand for delivery services. We believe much of this demand is coming from first-time buyers that have not been previously exposed to these services. Chinese online grocery and food delivery apps Dada, Meituan, and **Ele.me** have reported major surges in demand as government-mandated quarantining measures went into effect. US food delivery providers such as **DoorDash**, **Uber** Eats, **Instacart**, and **Postmates** have seen a similar boost to sales, driven by an uptick in pandemic-induced demand.

Large M&A to continue to make industry viable: The North American restaurant delivery market has consolidated to three major players: **DoorDash**, **Uber** Eats-**Postmates**, and Just Eat Takeaway-**Grubhub**. We have long maintained that consolidation is necessary for the online food delivery industry to achieve sustainable margins. In 2019, **Uber** acquired grocery delivery startup **Cornershop**, and **DoorDash** acquired food delivery competitor Caviar. In early 2020, European competitors Just Eat and **Takeaway.com** finalized their merger. In June 2020, Just Eat Takeaway acquired **Grubhub** for $7.3 billion, and in July 2020, **Uber** announced an agreement to acquire **Postmates** for $2.7 billion.

New entrants to keep pressure on margins: While the **Uber** Eats-**Postmates** tie up could lead to more rational pricing, Just Eat Takeaway's entrance into the North American market could be a setback. **Grubhub** had been losing share due to its limited cash

Figure 40.

Uber Eats bookings and revenue ($M)



Source: **Uber**

availability to invest in expansion relative to **Uber** and **DoorDash**. If Just Eat Takeaway, a well-funded, outside competitor, gains a foothold in the North American market, the company could cut into **Uber** and **DoorDash**'s growth plans and potentially put downward pressure on pricing and margins in the space, delaying the industry's path to profitability.

Fees could come under pressure as restaurants struggle: Online food delivery platforms are facing scrutiny over restaurant fees that can range from 10% to 40% of gross transactions. Lawmakers across the US have proposed capping these fees to the 10%-15% range, which would likely put pressure on growth and margins. Several cities in California and New York have already mandated fee caps. Additionally, we expect lawmakers will continue to pass legislation limiting the use of contracted workers, another threat to margins to the extent drivers receive more pay.

Coronavirus could catalyze investment in autonomous delivery vehicles and drones: Prior to this crisis, investors and management teams primarily viewed autonomous delivery as a means to reduce delivery costs. The pandemic has revealed a new use case: increasing safety for consumers and helping providers ensure service continuity when human drivers may not be available. Startups that may benefit from this trend include autonomous robot providers **Nuro**, **Starship**, and **Refraction AI**; automated delivery van providers Gatik.AI and Arrival; and drone companies such as **Zipline**, **Flytrex**, and **Flirtey**. Autonomous delivery pilots that are underway include the partnership between CVS and **Nuro** for prescription deliveries in Houston, Texas in the US. CVS has also partnered with UPS Flight Forward, a drone-focused subsidiary of UPS working with drone startup **Matternet** to deliver medical supplies to retirement communities in Florida in the US. **Zipline** has begun leveraging its drone delivery technology, previously used in Africa, to provide personal protective equipment and essential medical supplies to US hospitals.

Grocery-focused delivery platforms could see uplift: We expect reduced restaurant traffic to provide a long-term uplift to the grocery industry. Key factors driving this shift include lower prices per quantity of food relative to restaurant orders, reduced movement of people into urban areas as more people work from home permanently, and improvement in grocery delivery and curbside pickup services, which hastens market adoption. Beneficiaries of this trend include delivery platforms focused on grocery and convenience items, such as **Instacart** and **GoPuff**. For more detail on the delivery technologies involved in the grocery industry, see our Q2 analyst note Delivery Technologies Are Reshaping the Grocery Industry.

Data will drive differentiation: Critics of ridesharing and food delivery claim consumers will opt for the lowest-priced option, yet we believe delivery and other mobility-oriented platforms can successfully differentiate themselves by leveraging user data to create curated experiences. For example, many companies are identifying demand for specific foods in certain neighborhoods (i.e., the rise of "cloud kitchens"). The ability to store payment, address, contact information, and order history also adds stickiness and can help drive network effects.

Supplemental materials

Select company profiles

FLEXE
The Marketplace for Warehouse Space

Business overview

Developer of an online marketplace designed to provide warehousing space on-demand. The company's marketplace solves inventory overflow and fulfillment needs by connecting retailers and brands requiring warehousing and fulfillment services to warehouse operators who have it. This helps enterprises expand their distribution networks by accessing affordable warehouse space in key markets. **Flexe** turns the process of purchasing warehousing space, which has traditionally been a fixed cost, into a variable cost. This business model better serves the capital needs of retail customers. We see increasing demand for outsourced warehousing and fulfillment services as inventory-heavy enterprises look to reduce costs and streamline operations.

Leadership

Co-founder & CEO: Karl Siebrecht
Co-founder & COO: Edmond Yue
Co-founder & CTO: Francis Duong

Competitors

Stord, **Flowspace**, **Darkstore**, Amazon, UPS (Ware2Go)

Financing history

Raised to date: $64M over four deals
Most recent round: $43M Series B (May 2019)
$193M post-money valuation

Ownership

Activate Capital Partners, Redpoint Ventures, Madrona Venture Group, among others

RIGHTHAND
ROBOTICS

Business overview

Developer of integrated robotic piece-picking solutions designed to be simple to integrate and adaptable to improve the utilization of various customer workflows such as sorting batch-picked items, picking items from an ASRS, inducting items to a belt sorter and order quality assurance, enabling businesses to reduce the cost of order fulfillment in electronics, apparel, grocery, pharmaceuticals and many other industries. We believe **RightHand Robotics**'s subscription-based robotics as a service (RaaS) business model is well positioned to gain share among middle-market customers. This improves affordability for smaller enterprises and enables them to shift large, one-time purchase costs that would normally count as capex to smaller, more easily digestible operating expenses. This also reduces RightHand's dependence on cyclical changes in customer CapEx budgets and improves the resiliency of its revenue stream.

Leadership

Co-founder, president & board Member: Leif Jentoft Ph.D
Co-founders & board members: Lael Odhner & Yaroslav Tenzer Ph.D
Co-founder: Robert Howe

Competitors

Geek+, **Boston Dynamics**, **Fetch Robotics**, **GreyOrange**, CommonSense Robotics, among others

Financing history

Raised to date: $34M over seven deals
Most recent round; $23M Series B (December 2018)
$88M post-money valuation

Ownership

Menlo Ventures, Playground Global, GV, among others

Select company analysis

marble

Business overview

Developer of self-driving delivery robots designed to automate last-mile logistics. Unlike other providers that focus on sparser suburban areas, **Marble** robots traverse busy urban environments such as San Francisco where sidewalks are filled with obstacles and pedestrians. We believe this focus on challenging urban environments could give the company a competitive edge in the development of its technology. We are optimistic about autonomous technology enabling timely last-mile delivery. Moreover, as the online food delivery industry faces increased regulation targeting its use of gig-economy workers, self-driving delivery robots could provide a means to reduce cost across the supply chain.

Leadership

Co-founder & CEO: Matthew Delaney
Co-founder & hardware lead: Jason Calaiaro
Co-founder & software lead: Kevin Peterson

Competitors

Zume, **Starship** Technologies, **Clearpath Robotics**, **Nuro**, Waymo, GM Cruise, Ford (Argo AI) and others within the autonomous delivery space.

Financing history

Raised to date: $14M over two deals
Most recent round: $10M Series A (April 2018)
$38M post-money valuation

Ownership

Gelt Venture Capital, Tencent Holdings, Lemnos, Maven, Promus, Tuesday Capital

DOORDASH

Business overview

Developer of a food delivery application that provides on-demand food-ordering and delivery services from local restaurants. The company has been a clear beneficiary of the pandemic-driven rise in demand for online food delivery. Additionally, we believe **DoorDash** has a more favorable financial operating model than peers such as **Uber Eats**. We view **DoorDash**'s targeted focus on local suburban markets, which yield higher ticket sizes, as a major source of differentiation and cost advantage over competitors focusing on urban areas. According to our analysis, these factors have enabled **DoorDash** to outgrow the market and deliver impressive incremental operating margins.

850+ employees

Leadership

Co-founder & CEO: Tony Xu
Co-founder & CTO: Andy Fang
CFO: Prabir Adarkar

Competitors

Postmates, **Uber Eats**, **Grubhub**, **Deliveroo**, **Instacart** and others

Financing history

Raised-to-date: $2B over nine deals
Most recent round: $700M Series G (November 2019)
$13B post-money valuation
First institutional round: $2M (September 2013)

Ownership

SoftBank Group, Sequoia Capital, Kleiner Perkins, GIC Private, DST Global, Coatue Management, Dragoneer Investment Group, Temasek Holdings

Select company analysis

project44

Business overview

Provider of real-time tracking and data analytics tools. The company provides shippers and carriers with improved visibility into load arrival times, with real-time updates and predictive analysis that gets product to market faster, limits product loss and reduces costs related to late delivery fines and fees. We believe a differentiator for **project44** is real-time API connectivity, whereas much of the competition provides tools that provide intermittent updates not ideal for customer needs. Another key value add for the company is its end-to-end approach to visibility, which goes beyond just transit and provides visibility across workflows which include planning, documentation and invoicing. We see growth opportunities for this company to serve a relatively untapped carrier market. We see the next stage of growth in penetrating the intermodal market (drayage trucking, rail) which is in early stages of telematics adoption.

100+ employees

Leadership

Co-founder & CEO: Jett McCandless

President: Tommy Barnes

COO: Chris Helton

Competitors

FourKites, Descartes MacroPoint, 10-4 Systems, **XPO Logistics**

Financing history

Raised to date: $110.5M over six deals

Most recent round; $20M (estimated) Series C1 (June 2019, in progress)

$280M post-money valuation

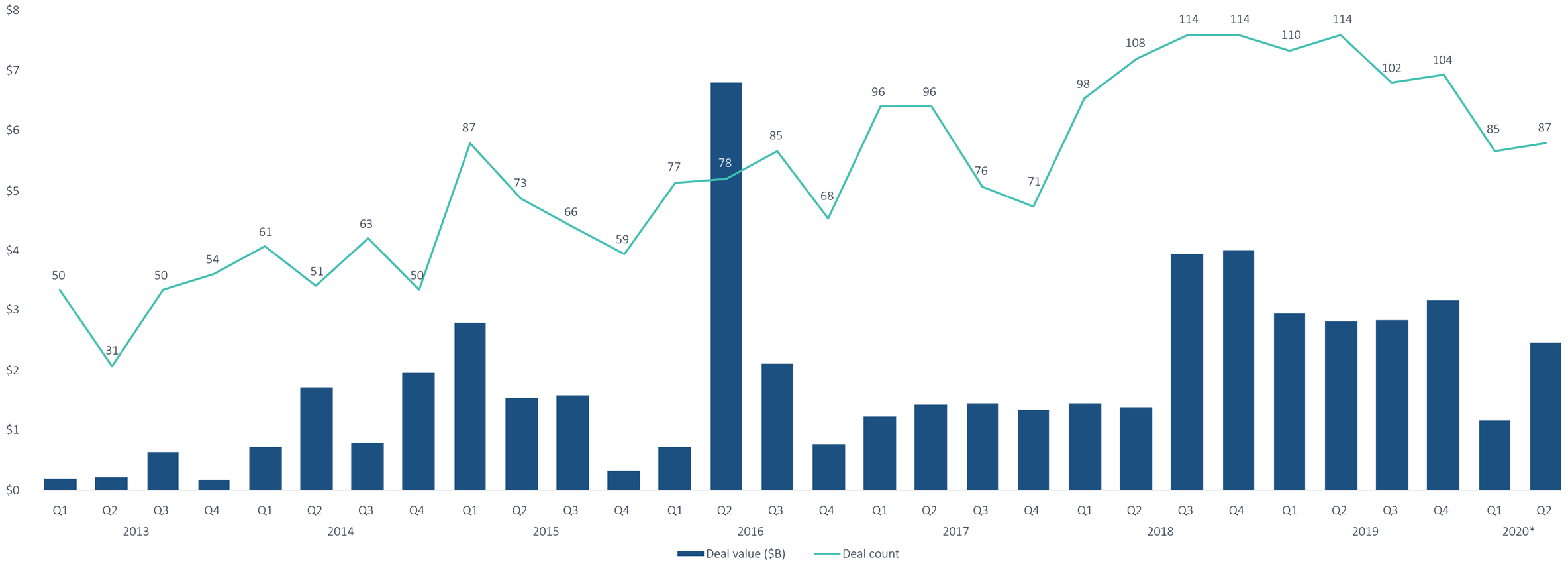
Ownership

OpenView Venture Partners, Sapphire Ventures, Emergence Capital Partners

Additional VC data

Figure 42.

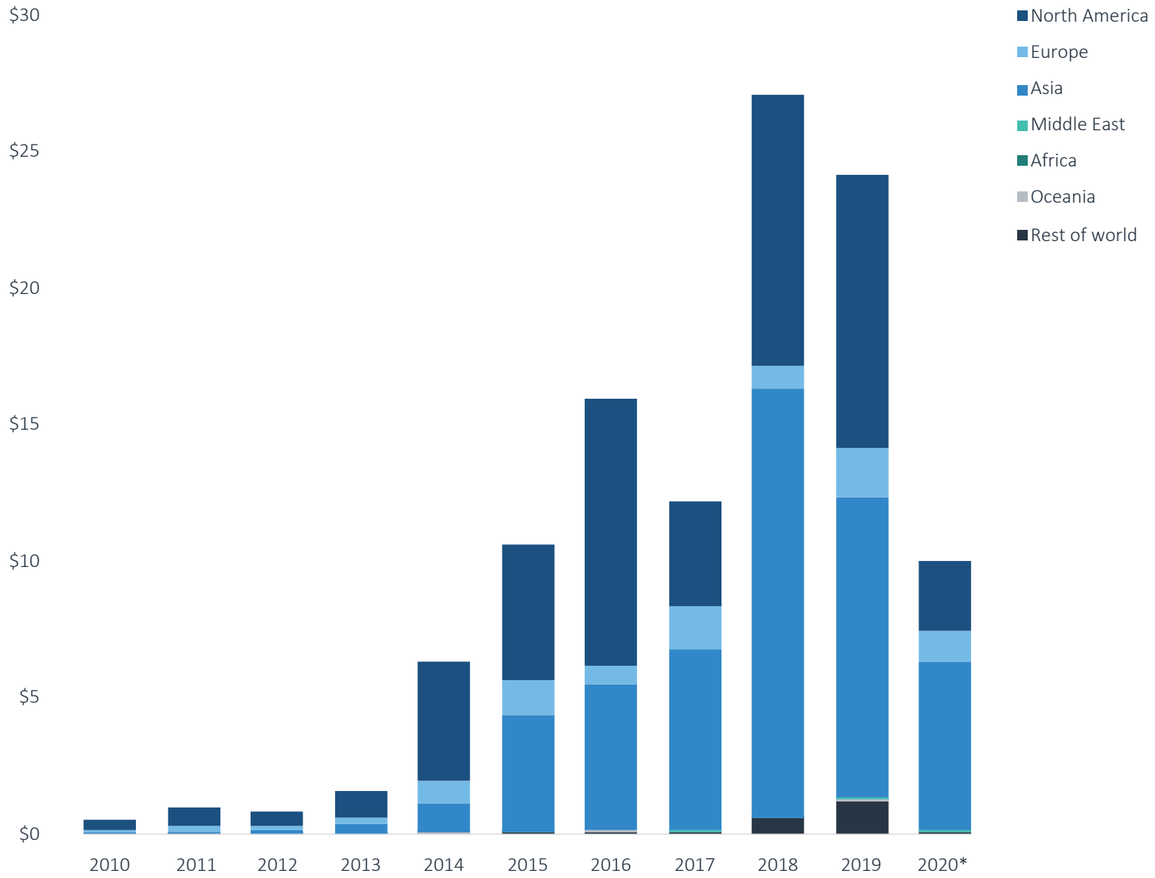
Supply chain tech VC deal activity



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 43.

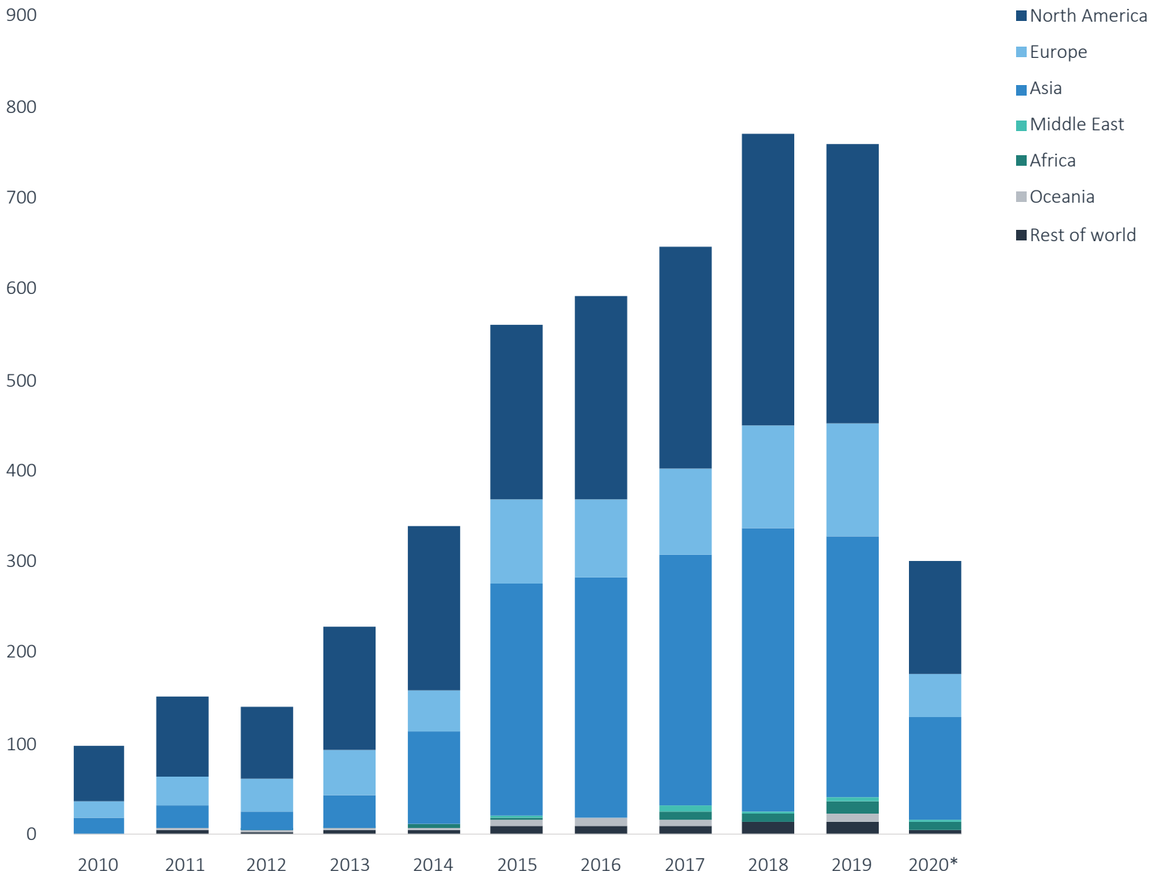
Supply chain tech VC deals ($B) by region



Source: PitchBook | Geography: Global | *As of June 30, 2020

Figure 44.

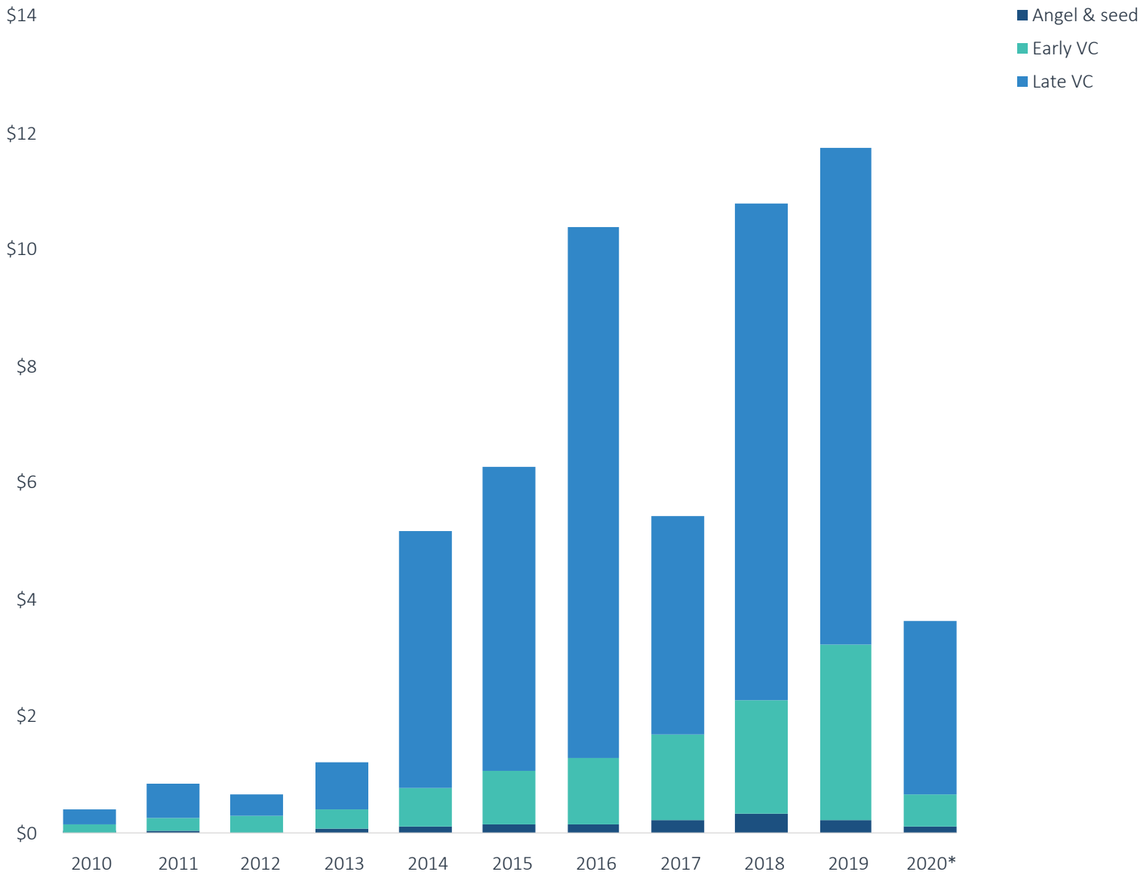
Supply chain tech VC deals (#) by region



Source: PitchBook | Geography: Global | *As of June 30, 2020

Figure 45.

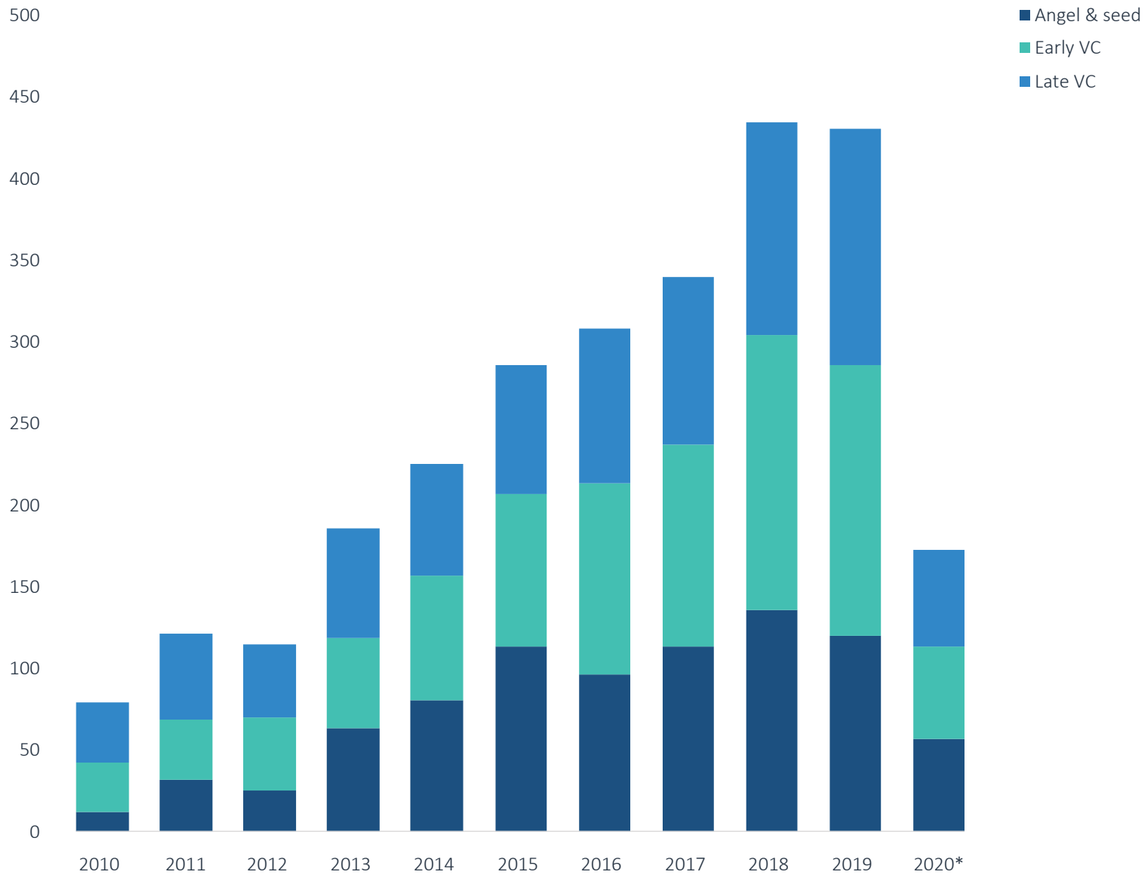
Supply chain tech VC deals ($B) by stage



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 46.

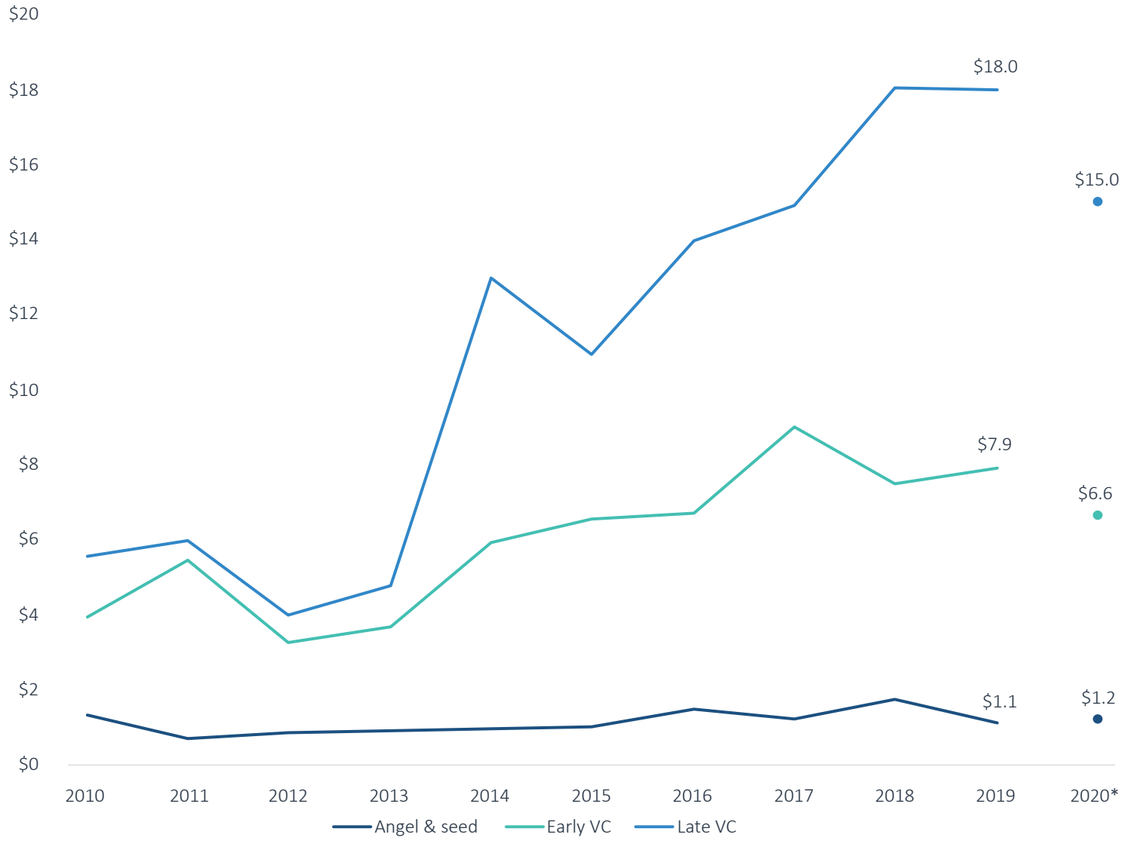
Supply chain tech VC deals (#) by stage



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 47.

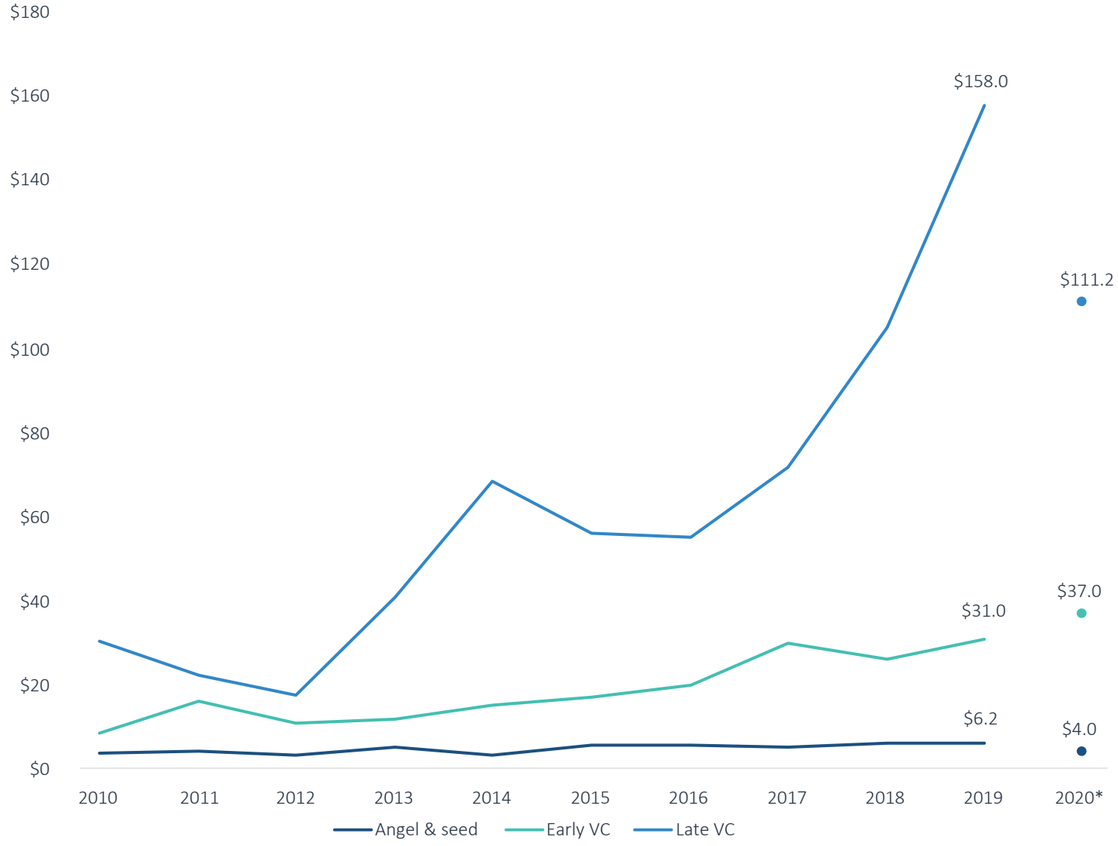
Median supply chain tech VC deal size ($M) by stage



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 48.

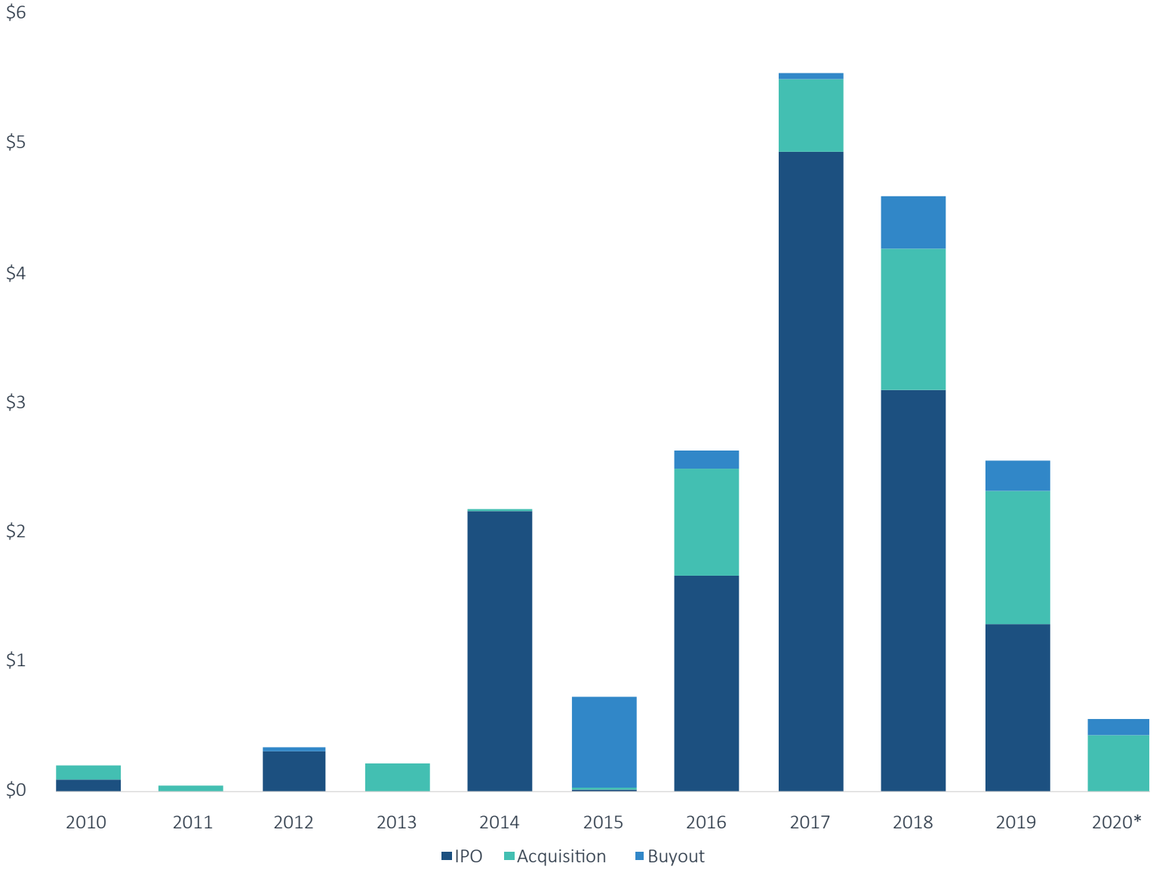
Median supply chain tech VC pre-money valuation ($M) by stage



Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 49.

Supply chain tech VC exits ($B) by type

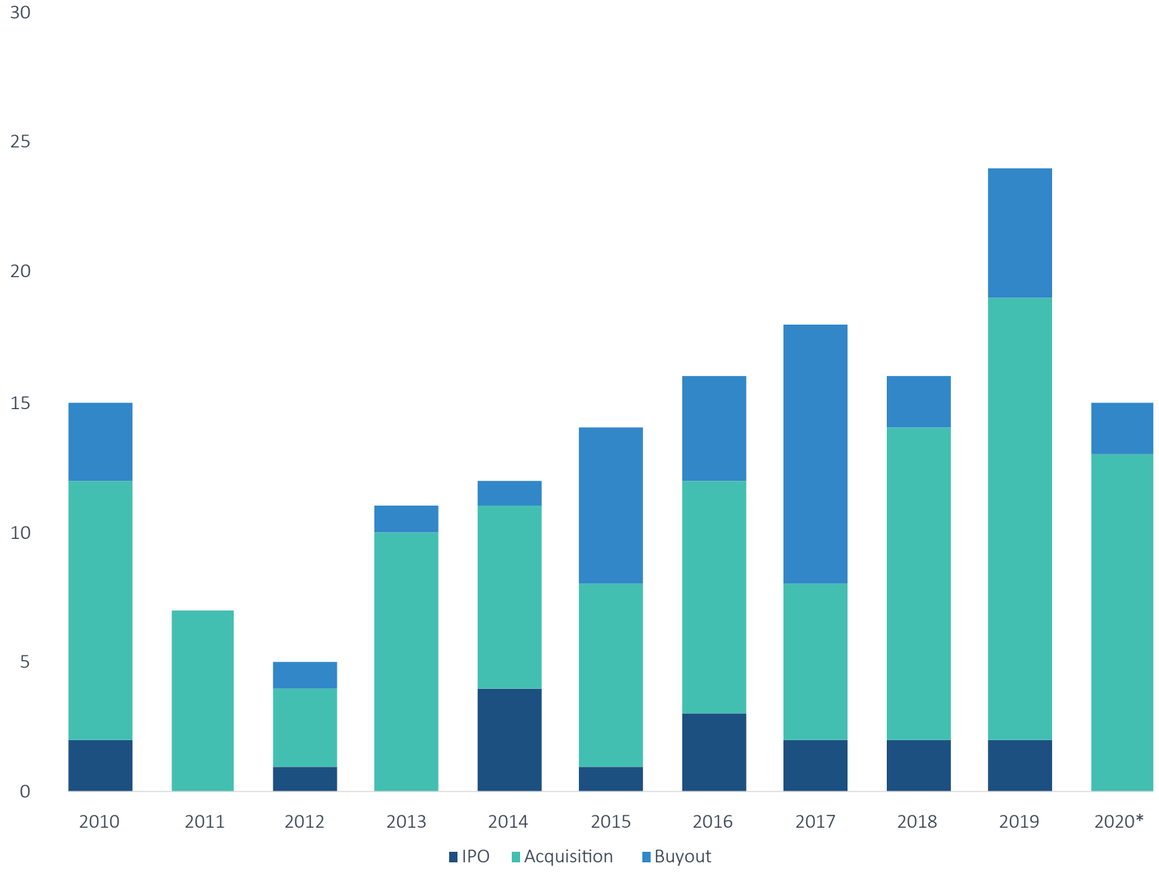


Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Note: This chart excludes **Uber**.

Figure 50.

Supply chain tech VC exits (#) by type



Source: PitchBook | Geography: North America & Europe | *As ofJune 30, 2020

Figure 51.

Top 10 VC investors in supply chain tech by deal count since 2018*

INVESTOR NAME	DEAL COUNT
8VC	14
Schematic Ventures	13
Dynamo Ventures	12
Sequoia Capital	12
Scale Venture Partners	12
Alumni Ventures Group	11
Kleiner Perkins	11
Bain Capital Ventures	10
Forerunner Ventures	10
Lightspeed Venture Partners	10

Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Figure 52.

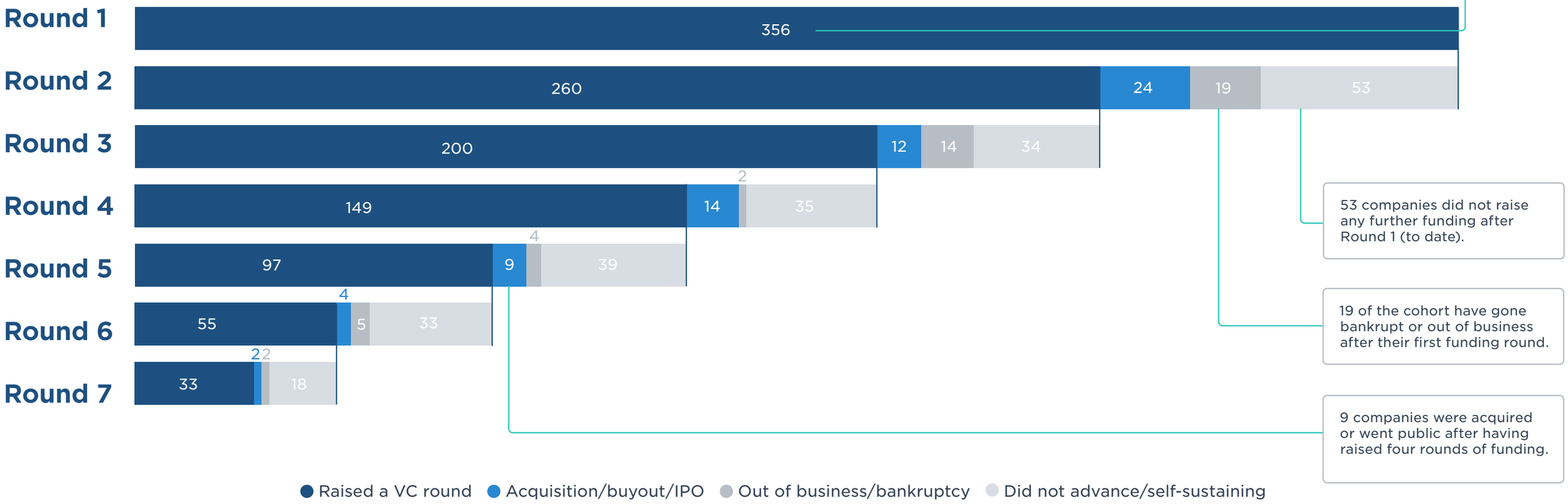
Top 10 VC-backed supply chain tech companies by total VC raised to date ($M)*

COMPANY	VC RAISED TO DATE
DoorDash	$2,472
Instacart	$2,270
Deliveroo	$1,556
Katerra	$1,443
Flexport	$1,302
Nuro	$1,032
GoPuff	$758
Tradeshift	$680
Convoy	$668
Glovo	$512

Source: PitchBook | Geography: North America & Europe | *As of June 30, 2020

Supply chain tech VC funnel

This VC funnel uses PitchBook data to analyze the VC funding life cycle by highlighting, by round, the number of firms that successfully raised a subsequent round, exited (through acquisition or IPO), went out of business or did not have a further liquidity event.



Buyers list

Figure 53.

Strategic buyers (corporations, holding companies & private companies)

Strategic buyers in this space tend to be large incumbent logistics and supply chain incumbents. Rather than developing in-house, they tend to partner or outright acquire key technologists in the space.

INVESTOR NAME
Amazon
Descartes Systems
DSV
E2Open
Echo Global Logistics
Infor Global Solutions
Oracle
XPO Logistics
SAP
UPS
Walmart
XPO Logistics

Source: PitchBook

Figure 54.

Financial buyers (PE groups)

PE investors in the space generally favor end-to-end enterprise solutions that solve pain points for their customers' supply chains. This contrasts with the niche focus of technologists in the venture world. Profitable growth, margin improvement, and capital efficiency are key KPIs for investors in this space.

INVESTOR NAME	DEAL COUNT SINCE 2009*
Accel-KKR	7
Kohlberg Kravis Roberts	6
Golden Gate Capital	6
ABS Capital Partners	5
Klass Capital	5
Thoma Bravo	4
Insight Partners	4
Summit Partners	4
New Mountain Capital	4
Marlin Equity Partners	4

Source: PitchBook | *As of June 30, 2020

About PitchBook Emerging Tech Research

Independent, objective and timely market intel

As the private markets continue to grow in complexity and competition, it's essential for investors to understand the industries, sectors and companies driving the asset class.

Our Emerging Tech Research provides detailed analysis of nascent tech sectors so you can better navigate the changing markets you operate in—and pursue new opportunities with confidence.

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