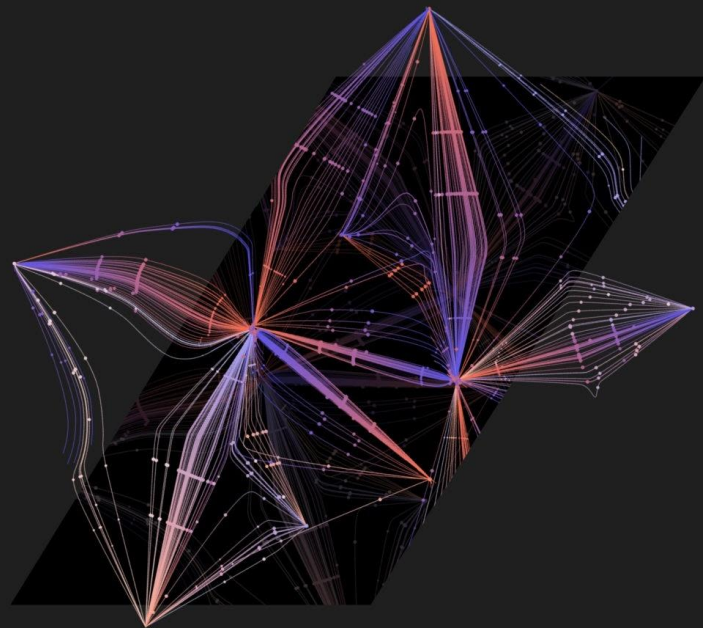


F/PRIME

State of Robotics

Investment trends 2019-2023





State of Robotics – Key Stats & Methodology

1500+
Companies
analyzed

~\$90B
Raised Globally
since 2019

-7%
Investment
CAGR

20
Private
Unicorns

6
Public Cos with
Mkt Cap > \$500M

24
Acquisitions
> \$250M

Methodology

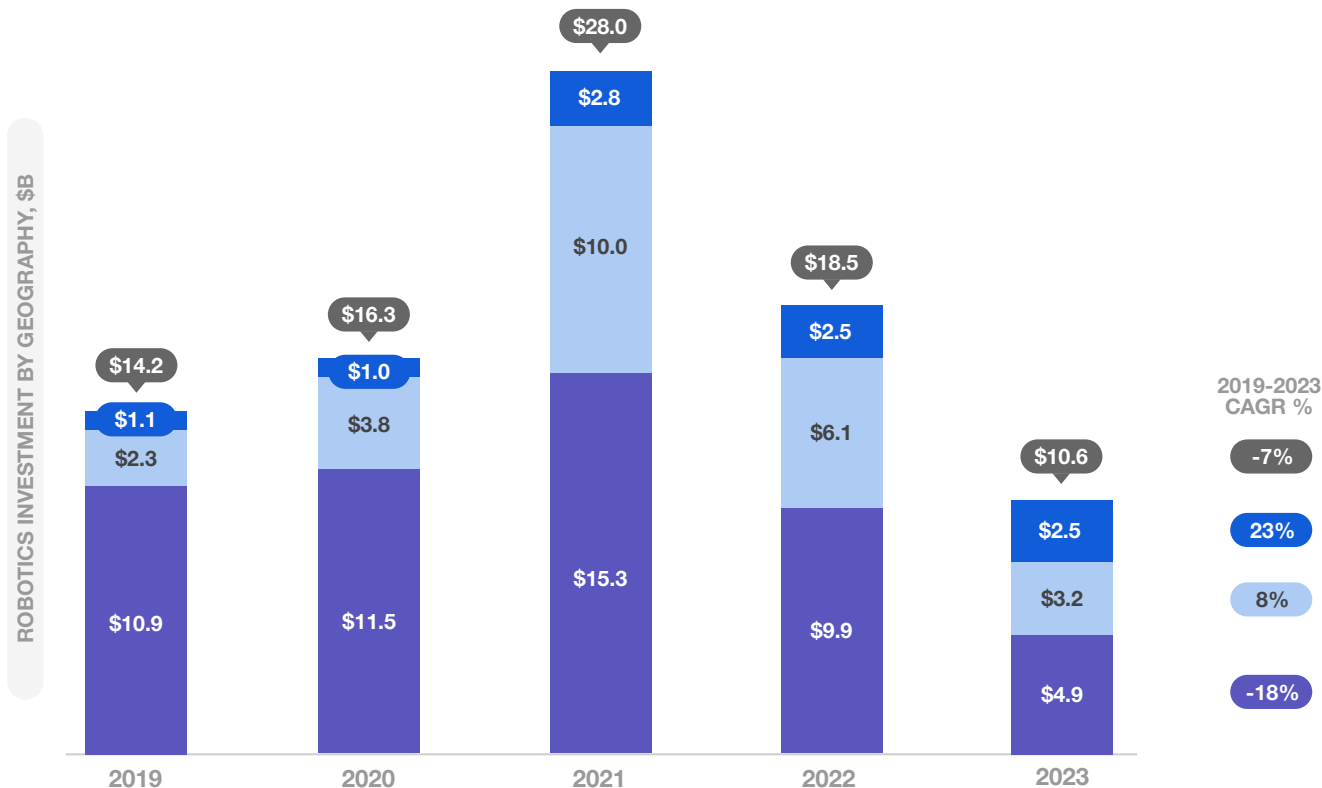
- Analysis consisted of extracting all companies listed in Pitchbook which raised in aggregate of at least \$3M from 2019-2023 and which appeared to be related to AV and robotics; those companies were then individually tagged with the use case, or those that were not relevant to the category were filtered out
- Companies focused exclusively on space, manned flight, electric vehicles, and semiconductors were excluded from the analysis



Summary

- The venture capital markets experienced a significant correction in 2023, with investments returning to levels last seen in 2020 and the depths of the pandemic. Robotics was no exception, though the pullback was even more pronounced as funding in the AV sector — which had historically been a driver of robotics investment — continued the rapid decline we’ve seen over the last two years. In 2023, AV investments represented less than 30% of overall activity, compared to around 70% in 2019.
- The primary driver of investment in robotics over the last two years continues to be Vertical Robotics — that is, companies focused on vertical-specific use cases. While investments in Vertical Robotics also declined in 2023, the category has experienced net growth over the last five years, with investments growing from \$2.4B in 2019 to \$4.1B in 2023.
- Despite the overall decline in funding for tech startups, early-stage investing in robotics (Seed and Series A) held up better than late-stage investing over the last three years. This is reflective of investor excitement about the tailwinds creating opportunities in the sector. Advancements in AI, falling hardware costs, and labor shortages are driving more experienced and talented founders to create new robotics businesses. Startup accelerator Y Combinator, a longstanding bellwether of early stage investment activity, included robotics as one of the focus areas of its 2024 cohort.
- Consistent with the broader venture market, 2023 was a challenging year for exits. Deal volume and value in the robotics industry dropped to a five-year low, with deal value falling 90% compared to 2022. Of the 46 companies that went public via IPO or SPAC since 2019, as of the end of 2023 only eight now trade as independent companies with market caps above \$250M. In the public markets, scaled high-growth businesses continue to enjoy premium trading multiples.
- Given the challenging exit market of the last 12+ months, there is still a significant amount of value locked in private robotics companies. There are currently 20 private companies which have raised at valuations north of \$1B, with an aggregate last-round valuation of \$118B. While much of the value is in AV companies, where valuations are likely to reset, there is still an attractive backlog of robotics startups capable of driving significant exit value going forward.

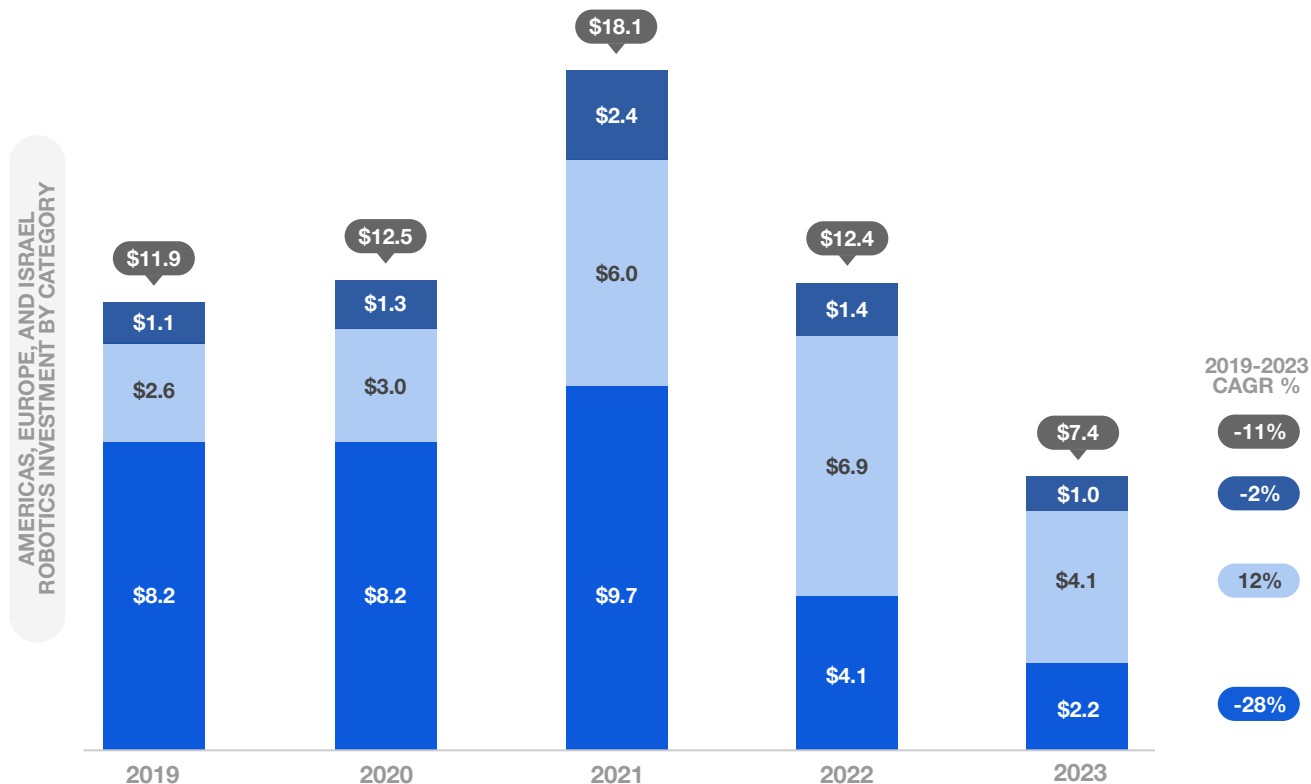
Investment in Robotics fell sharply in 2023 to a 5-year low



70%
of investments
go to companies in
the Americas,
Europe and Israel

- TOTAL
- EUROPE + ISRAEL
- ASIA
- AMERICAS

Vertical Robotics remained the largest investment category, while investments in AV continued their steep decline



ENABLING SYSTEMS

Companies building solutions to enable the development of AV and Robotics, including sensors, LiDar, Drones, and hardware/software components

VERTICAL ROBOTICS

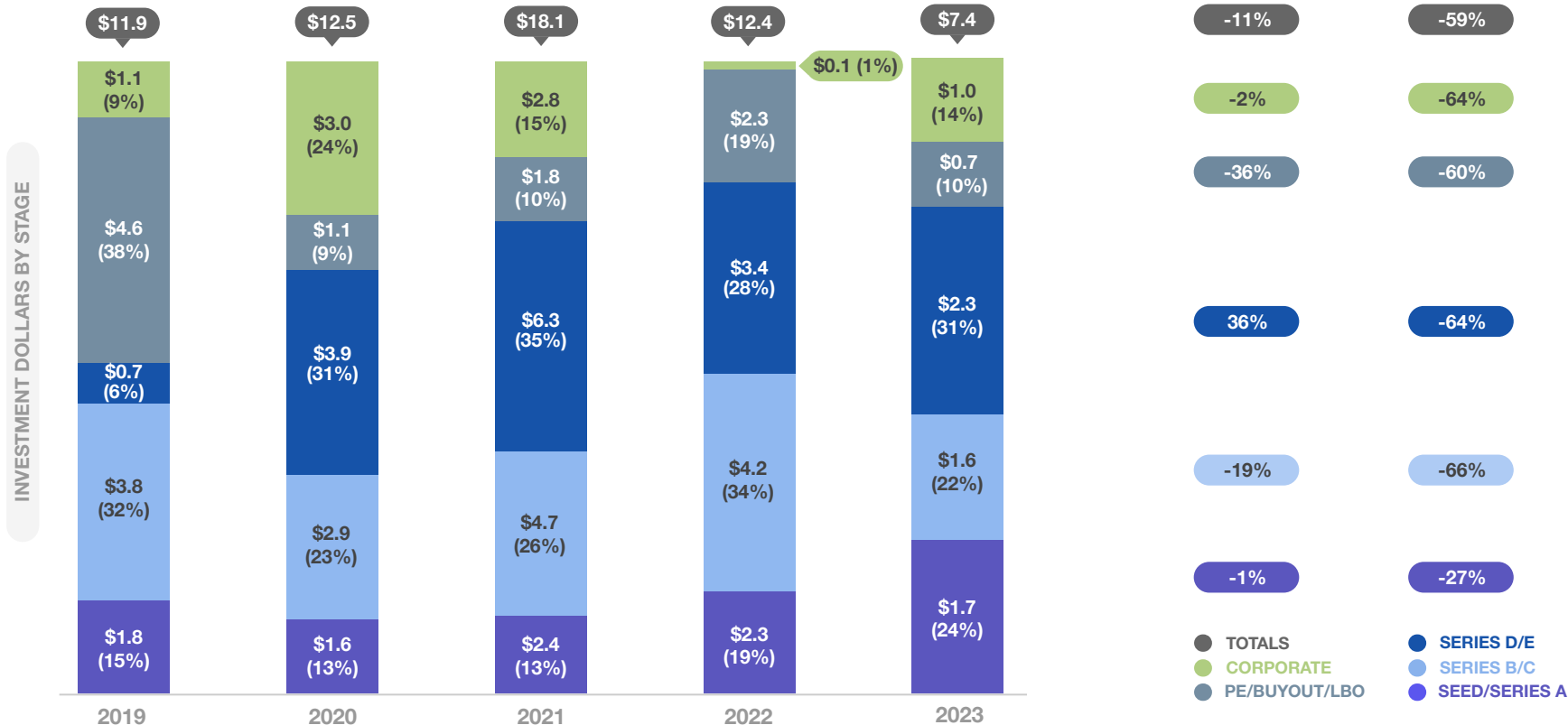
Companies building vertical-specific robotics across industries including logistics, medical, defense and security, manufacturing, agriculture, construction, and mining

AUTONOMOUS VEHICLES (AV)

Companies building solutions for public road deployments across passenger vehicles, trucking, and delivery

- TOTAL
- ENABLING SYSTEMS
- VERTICAL ROBOTICS
- AUTONOMOUS VEHICLES (AV)

Across stages, Seed and Series A investments have been the most insulated from the funding downturn

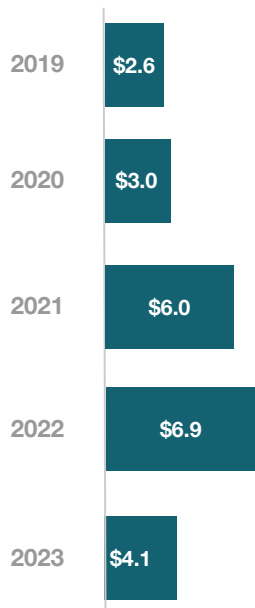


Source: PitchBook, F-Prime team analysis

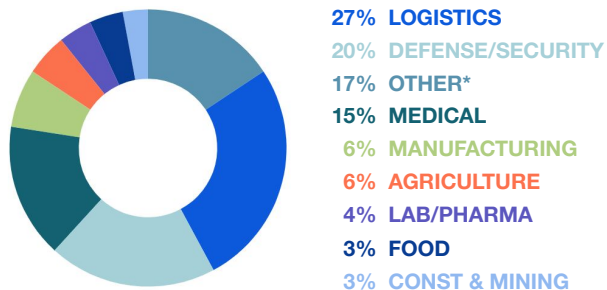
Defense and Logistics have been the major driver of investment in Vertical Robotics

Vertical Robotics - Americas, Europe, Israel

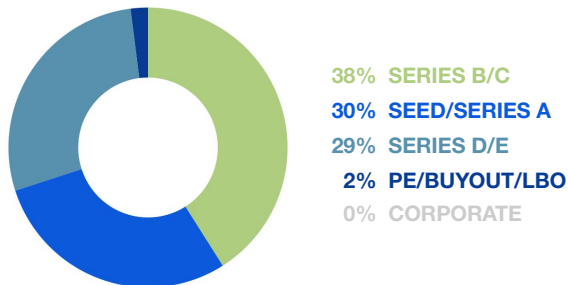
TOTAL INVESTMENT, \$B



INVESTMENT BY SUBCATEGORY



INVESTMENT BY STAGE



TOP FUNDING ROUNDS
2022-2023

COMPANY	SEGMENT	ROUND SIZE
ANDURIL	Defense	\$1.5B
Shield AI	Defense	\$500M
zipline	Logistics	\$330M
EXOTEC	Logistics	\$328
EPIRUS	Defense	\$200

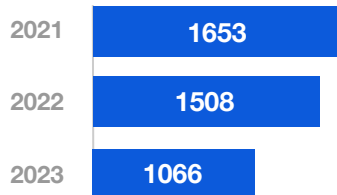
Source: PitchBook, F-Prime team analysis

*Other: Other includes inspection/survey, landscaping, recycling, retail, cleaning/maintenance and marine use cases, amongst others

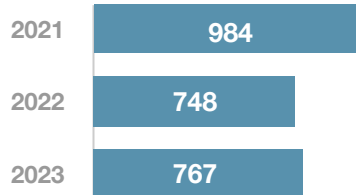
Logistics and Medical Robotics saw the most activity in 2023; several emerging segments also saw sustained activity

ESTABLISHED SEGMENTS: > \$500M INVESTED/YR

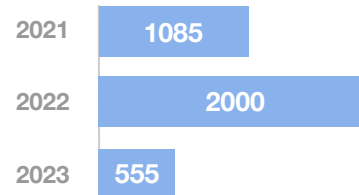
LOGISTICS



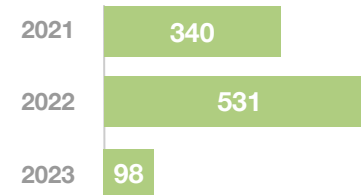
MEDICAL



DEFENSE/SECURITY



MANUFACTURING



HIGHEST FUNDED
PRIVATE
COMPANIES

GreyOrange zipline
EXOTEC

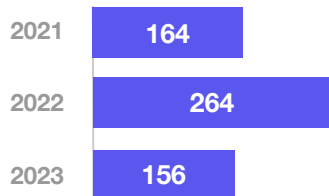
Noah Medical Distalmotion
CMR
SURGICAL

ANDURIL EPIRUS
Shield AI

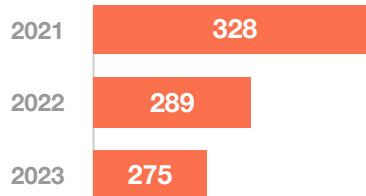
FLEXIV Bright Machines.
path
ROBOTICS

EMERGING SEGMENTS: < \$500M INVESTED/YR

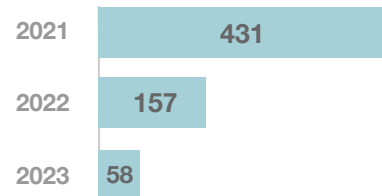
CONSTRUCTION/MINING



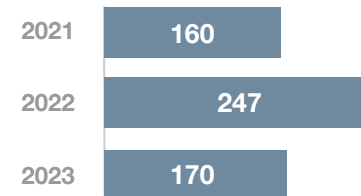
AGRICULTURE



LAB/PHARMA



FOOD



HIGHEST FUNDED
PRIVATE
COMPANIES

DUSTY ROBOTICS BUILT
ROBOTICS
SafeAI

VERDANT ROBOTICS IRON
BOX ecorobotix

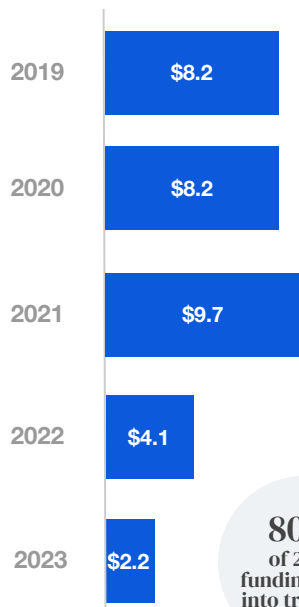
opentrons Emerald Cloud Lab
strateos

SOFT ROBOTICS MISO ROBOTICS
BEARROBOTICS

Much of the recent focus in AV has shifted to trucking-related use cases

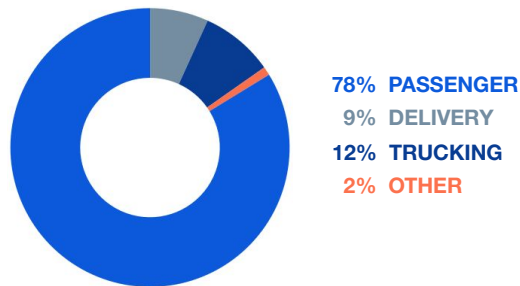
Autonomous Vehicles - Americas, Europe, Israel

TOTAL INVESTMENT, \$B

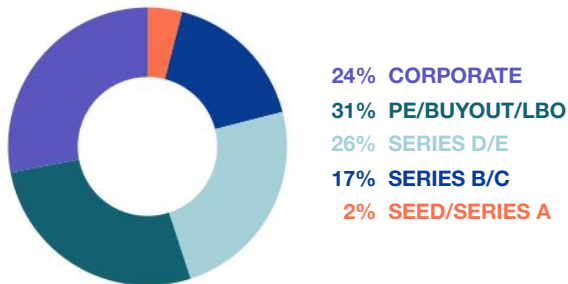


80%
of 2023
funding went
into trucking

INVESTMENT BY SUBCATEGORY



INVESTMENT BY STAGE



TOP FUNDING ROUNDS
2022-2023

COMPANY	SEGMENT	ROUND SIZE
cruise	Passenger	\$2.1B
STACK	Trucking	\$1.0B
CONIGITAL CONNECTED DIGITAL	Trucking	\$632M
nuro	Delivery	\$625M
einride	Trucking	\$500M

News for passenger AV companies has been particularly challenging

Public sentiment lags tech advancements



F Fortune

Cruise says its autonomous vehicles can save thousands of lives. But Americans still don't trust driverless cars

Cruise says its autonomous vehicles can save thousands of lives. But Americans still don't trust driverless cars ... Americans still don't trust driverless...

Apr 21, 2023

Legislative headwinds

Cruise told by regulators to 'immediately' reduce robotaxi fleet 50% following crash

Cruise, the self-driving car subsidiary of GM, has been asked to reduce its robotaxi fleet by 50% in...

By Kirsten Korosec | August 18, 2023

Yet still some optimism remains

Reuters

Zoox headcount grows as Amazon's self-driving unit expands testing in Vegas

Amazon.com Inc's self-driving vehicle unit Zoox has grown its headcount by about 16% at a time when access to capital is tight and other large companies...

Jun 27, 2023



S&P Global

Autonomous Vehicle Reality Check: Widespread Adoption Remains at Least a Decade Away

Automated - rather than autonomous - driving continues to be the focus of industry development. Today's broad deployments of Level 2+ and Level 3 systems by...

Sep 25, 2023



Transportation

Another blow for self-driving trucks as former industry leader abandons the US

Kirsten Korosec @kirstenkorosec / 11:00 AM EST • December 5, 2023

Comment



Zach Williams

Nov 16, 2023, 10:03 AM UTC

New York Takes on Self-Driving Car Rules Amid Labor Opposition

Uber

Waymo and Uber Partner to Bring Waymo's Autonomous Driving Technology to the Uber Platform

Today, Waymo and Uber Technologies Inc. (NYSE: UBER) are excited to announce a new, multi-year strategic partnership to make the Waymo Driver available to...

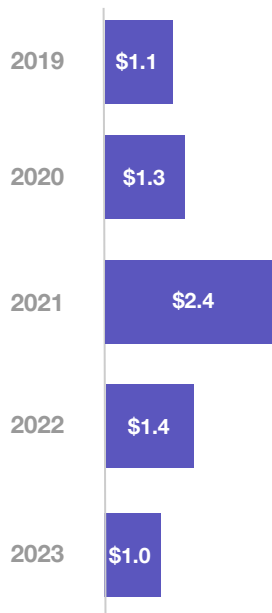
May 23, 2023



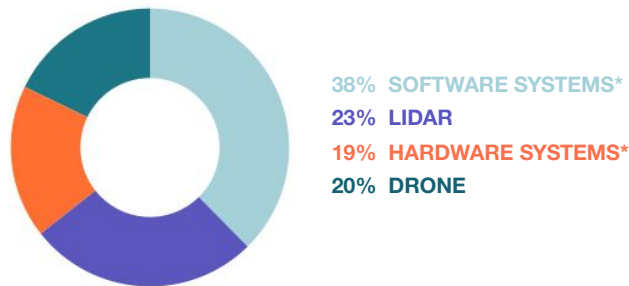
Investments in Enabling Systems are a smaller niche within robotics

Enabling Systems - Americas, Europe, Israel

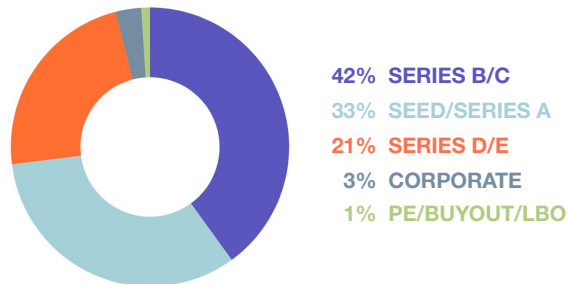
TOTAL INVESTMENT, \$B







INVESTMENT BY SUBCATEGORY



INVESTMENT BY STAGE



TOP FUNDING ROUNDS
2022-2023

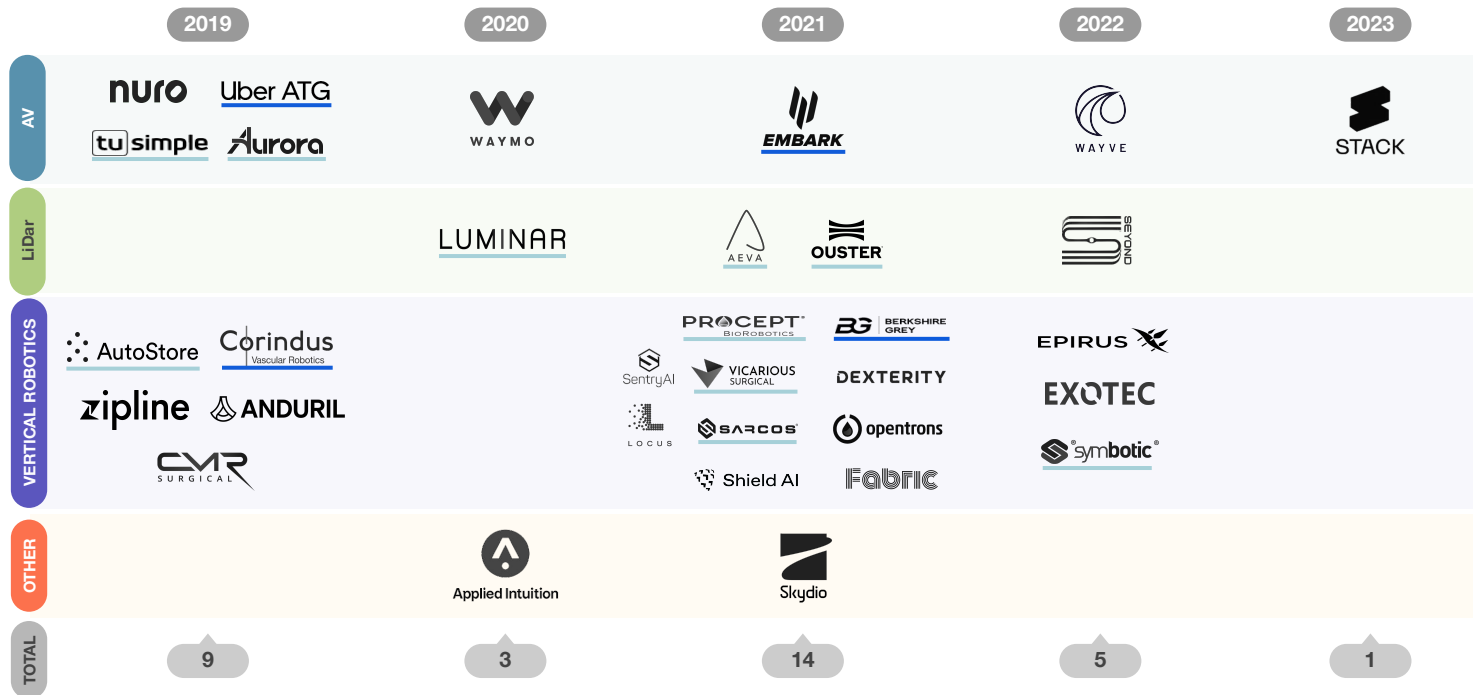
COMPANY	SEGMENT	ROUND SIZE
 Skydio	Drone	\$230M
 ECHODYNE	Sensor	\$135M
 AUTOBRAINS	Perception	\$120M
 BEYOND	LiDar	\$118M
 swift NAVIGATION	Sensor	\$100M

Source: PitchBook, F-Prime team analysis

*Hardware systems include robot arms and other sensors; software systems include perception, location, mapping, security and navigation

Robotics has produced numerous unicorns, with significant value in still-private companies

New Robotics Unicorns in each of the last 5 years



20
unicorns still
private**

representing
\$118B
last round
valuation

Source: PitchBook, F-Prime team analysis

*Public market caps dropped below \$1B in subsequent years

** includes Cruise and Pony.AI

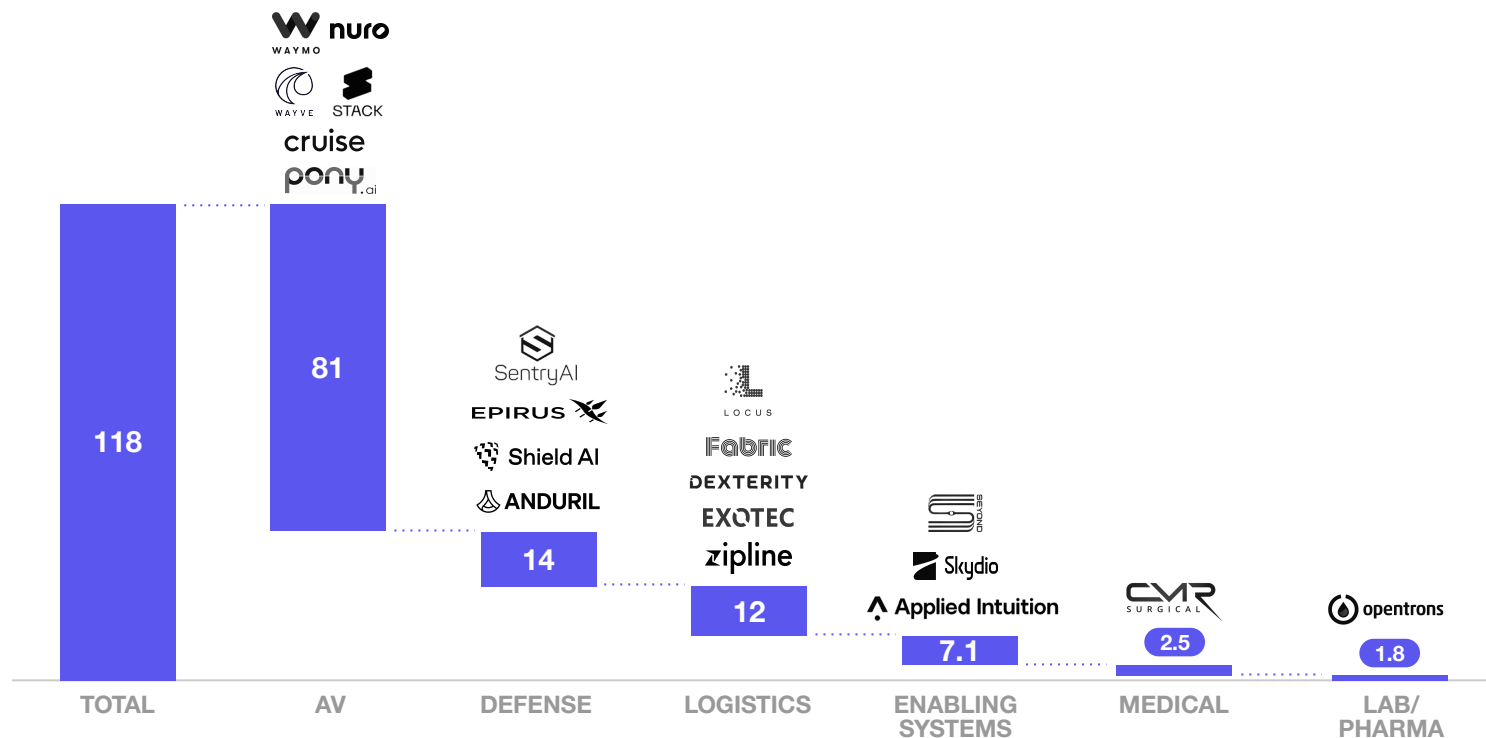
Dropped*: TuSimple, Embark,
Berkshire Grey, Vicarious
Surgical, Sarcos, Aeva, Ouster

M&A **IPO**

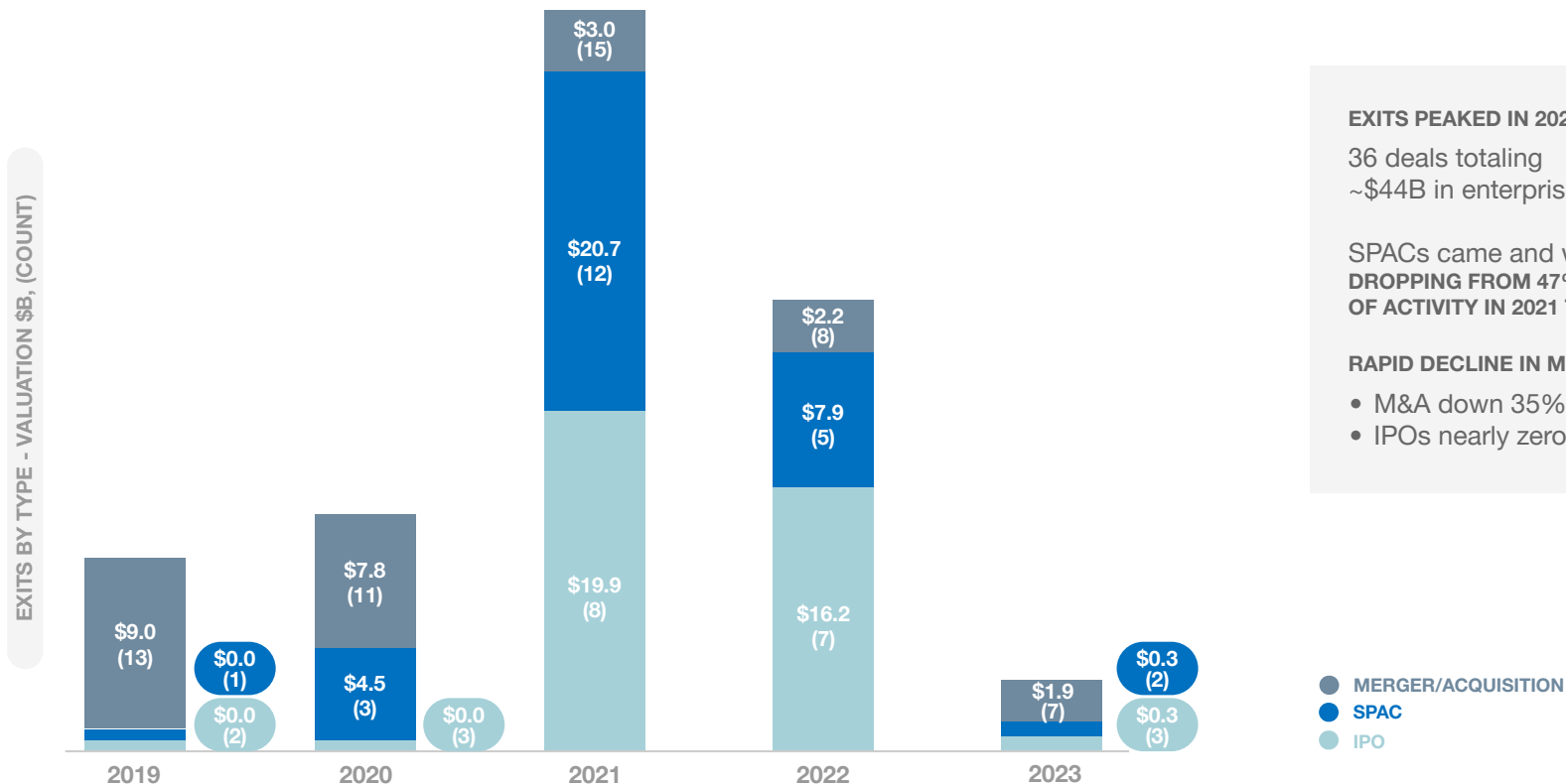


Much of the private market value is in AV companies, where valuations may reset; other sectors should see value expansion as companies continue to scale

Private market value of unicorns split by use case (\$B)



Exit activity has pulled back significantly as IPOs and SPACs disappeared, and M&A significantly slowed



EXITS PEAKED IN 2021:

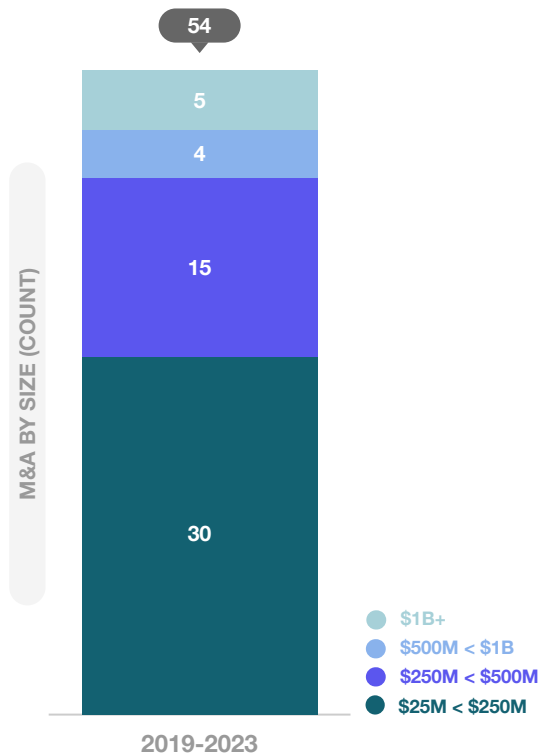
36 deals totaling
~\$44B in enterprise value

SPACs came and went,
**DROPPING FROM 47%
OF ACTIVITY IN 2021 TO 0% TODAY**

RAPID DECLINE IN M&A AND IPOs:

- M&A down 35% from 2021
- IPOs nearly zero in 2023









Most M&A deals have been <\$250M, with a handful of larger exits



M&A exits above \$500M since 2019

COMPANY	ACQUISITION VALUE	DATE	ACQUIRER	SEGMENT
AURIS	\$5.75B	April 2019	Johnson & Johnson	Medical
Uber ATG	\$4.0B	December 2020	Aurora	AV
ZOOX	\$1.3B	June 2020	amazon	AV
ISRA VISION	\$1.1	June 2020	Atlas Copco	Enabling System
Corindus Vascular Robotics	\$1.1B	October 2019	SIEMENS Healthineers	Medical
Boston Dynamics	\$880M	June 2021	HYUNDAI	Logistics/Other
Elmo Motion Control	\$700M	September 2022	BOSCH	Enabling System
Velodyne Lidar	\$600M	February 2023	OUSTER	Sensor
lyft SELF DRIVING UNIT	\$550M	July 2021	woven planet	AV

Recent public listings of robotics companies have seen mixed results, with the market mostly valuing scaled, high-growth businesses

COMPANY	MARKET CAP (12/29/2023)	LTM REVENUE	LTM REVENUE GROWTH	EV/LTM REVENUE	12 MONTH STOCK PERFORMANCE	SEGMENT
 symbotic	\$22.0B	\$1.2B	98%	18.3x	4.3x	Logistics
 Aurora	\$6.6B	\$2M	-98%	N/A	3.5x	AV
 AutoStore	\$6.6B	\$618M	16%	10.9x	1.1x	Logistics
 PROCEPT BIOBOTICS	\$2.1B	\$116M	90%	16.4x	1.0x	Medical
 LUMINAR	\$1.4B	\$59M	40%	28.9x	0.7x	LiDar
 HESAI	\$1.1B	\$236M	59%	3.1x	0.4x*	LiDar
 INNOVIZ TECHNOLOGIES	\$417M	\$8M	23%	37.8x	0.7x	LiDar
 OUSTER	\$312M	\$70M	66%	2.6x	0.9x	LiDar

*Performance since IPO in Feb 2023

Note: Only includes Americas, Europe, Israel with public listing in last 5 years. Excludes companies with market cap <\$250M.



Future Outlook

- The venture-backed robotics industry is still in its early innings, increasingly fueled by the growth of Vertical Robotics and the rapid pace of development of AI. The last few years' robust early stage activity will drive increased later-stage investment as companies mature and achieve commercial milestones.
- The boom and bust of the AV sector has been a simultaneous boon and bane for the robotics industry. Initially, it attracted lots of investor interest and talent, ultimately helping to fuel the rise of Vertical Robotics as experienced AV founders shifted to focus on use cases with a shorter path to commercialization. However, the ongoing correction in the AV sector has caused many investors to become far more cautious about what it takes to build a successful robotics business.
- The significant exit backlog of scaled robotics companies will create a massive tailwind for the industry in the coming years. The IPO window will reopen and established businesses will seek to reinvent their product offerings through the acquisition of Vertical Robotics players, sharpening the opportunity in the eyes of many investors. Over time, the virtuous cycle of company creation and exit will accelerate.
- The past year has been a wake-up call to the entire venture ecosystem — and particularly robotics. Hype-driven investment cycles inevitably come to an end, while those focused on business fundamentals endure. Investors today are looking for differentiated solutions which transform massive addressable markets, but they must also deliver superior financial results. The industry's tailwinds have positioned it to be one of the driving sectors for venture returns in the coming years — though plenty of work remains to deliver on the financial promise of robotics.



About F-Prime

We create and invest in healthcare and technology companies that impact lives all over the world. We have over 200 companies in our portfolio including 23 that we started. Our global portfolio is spread across the US, Europe, and Asia.



State of Robotics Team



Sanjay Aggarwal
Venture Partner



Betsy Mulé
Senior Associate



Learn more about F-Prime:

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Platform Director



Betsy Mulé
Senior Associate



David Jegen
Managing Partner



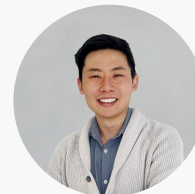
Gaurav Tuli
Partner



Henry Trapnell
Industry Networks Director



Jillian Enos
Financial Sr. Director



John Lin
Principal



Quinten Dol
Marketing Manager



Rachel Feely-Kohl
VP, Community & Platform



Rocio Wu
Principal



Sanjay Aggarwal
Venture Partner



Sarah Lamont
Senior Associate



Shervin Ghaemmaghami
Operating Partner