

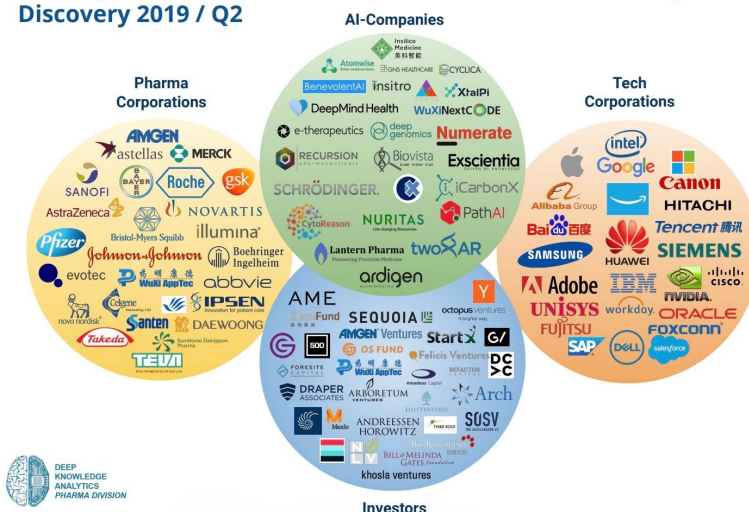


Highlights in AI for Drug Discovery Q2 2019

There's been significant growth in the AI for Drug Discovery sector this year. In the last quarter, the number of new R&D centers increased by 5, companies increased by 20, collaborations increased by 30, and investors increased by 50. There are now 400 investors in the space including Google Ventures, Tencent, WuXi, Andreessen Horowitz, Khosla Ventures, and Sequoia Ventures.

This week, Deep Knowledge Analytics Pharma Division published [Landscape of AI for Drug Discovery and Advanced R&D Q2 2019](#). This report is the most comprehensive analytical report on this the AI for Drug Discovery sector to date. This report provides in-depth comparative and quantitative analysis of the entire landscape including rankings of AI for Drug Discovery companies according to their levels of scientific validation, clinical development, R&D, industry application diversification, and overall prospects for future growth. This report marks the 7th installment in a series of reports that Deep Knowledge Analytics has been producing quarterly since 2017.


Leading Companies - Advanced AI in Healthcare and Drug Discovery 2019 / Q2



Deep Knowledge Analytics quarterly reports are designed to provide an overview of the landscape, reveal trends and correlations, and benchmark the performance of key players. This report provides an analysis of 170 AI companies, 50 corporations, 400 investors, and 35 major R&D centers. The analysis is integrated in interactive mind-maps, which provide the most important information including location, category, and deals.

Influence of AI Implementation

NET INCOME OF TOP-15 corporations USING AI (\$B)								
COMPANY	2013	2014	2015	2016	2017	2018	Chart	Tendency
Amgen	5.08	5.16	6.94	7.72	1.98	8.93		+
Astellas Pharma	0.88	0.88	1.24	1.61	1.95	1.55		+
AstraZeneca	2.56	1.23	2.83	3.50	3.00	2.05		-
Bayer	3.62	3.89	4.66	5.14	8.33			+
Boehringer Ingelheim	1.72	1.36	2.05	2.40	-0.30			-
Bristol-Myers Squibb	2.56	2.00	1.57	4.46	1.01	4.95		+
Evotec	-0.03	0.09	0.02	0.03	0.03	0.07		+
GSK	8.81	4.67	12.88	1.24	1.97	4.84		+
Eli Lilly	4.685	2.391	2.408	2.738	-0.204	3.232		+
Johnson & Johnson	13.83	16.32	15.41	16.54	1.30	15.30		+
Merck	4.40	11.92	4.44	3.92	2.39	6.22		+
Novartis	9.18	10.21	17.78	6.71	7.70	12.61		+
Pfizer	22.00	9.14	6.96	7.22	21.31	11.15		+
Roche	11.30	9.54	9.06	9.73	8.83	10.87		+
Sanofi	4.94	5.84	4.76	5.21	9.53	5.09		-

 - The year the company started to use AI in drug development

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AI Influence

AI is making a tangible impact in Pharma corporations. This table shows the influence that AI implementation has had on net income in the top 15 Pharma corporations. This table shows that almost every company faced a negative trend in net income prior to using AI, and net income increased after implementing AI. The success of all companies using AI for Drug Discovery depends on the presence of highly skilled interdisciplinary leaders. It is crucial for Pharma corporations to have both top interdisciplinary AI experts who innovate, organize, and guide others, as well as [AI friendly CEOs and Board Members](#) who drive the implementation of AI.

Significant Deals, Collaborations, and Initiatives in Q2

- Insitro/Gilead strategic collaboration: aims to discover and develop therapies for patients with nonalcoholic steatohepatitis (NASH)

- BenevolentAI/AstraZeneca collaboration: aims to use AI and ML for the discovery and development of new treatments for chronic kidney disease and idiopathic pulmonary fibrosis;
- Iktos/Janssen collaboration: aims to develop new applications, leveraging Iktos' proprietary know-how in deep generative models applied to chemistry and Janssen expertise in AI-enabled prediction of small molecule activities.
- Concerto HealthAI/Pfizer collaboration: precision Oncology using Concerto's EurekaHealth platform, AI models, Real World Clinical EMR, and healthcare claims.
- Sanofi/Google collaboration: Sanofi will use Google's AI and cloud-computing tools in a new Innovation Lab. The goal of the partnership is to speed up drug discovery, maximize operational flows, and improve the patient experience.

Top-30 AI for Drug Discovery Investors



- Atomwise/Enamine collaboration: aims to dramatically increase the discovery of safer small molecule drugs to treat pediatric cancers. Atomwise has launched the 10-to-the-10 program, a 10 billion compound AI-powered virtual drug screening initiative.
- Alibaba/AstraZeneca to deliver smart healthcare services through the use of AI and IOT in China to enable more than one million Chinese patients to learn more about disease

prevention and healthcare services by scanning the AliHealth traceability code on drug packages this year.

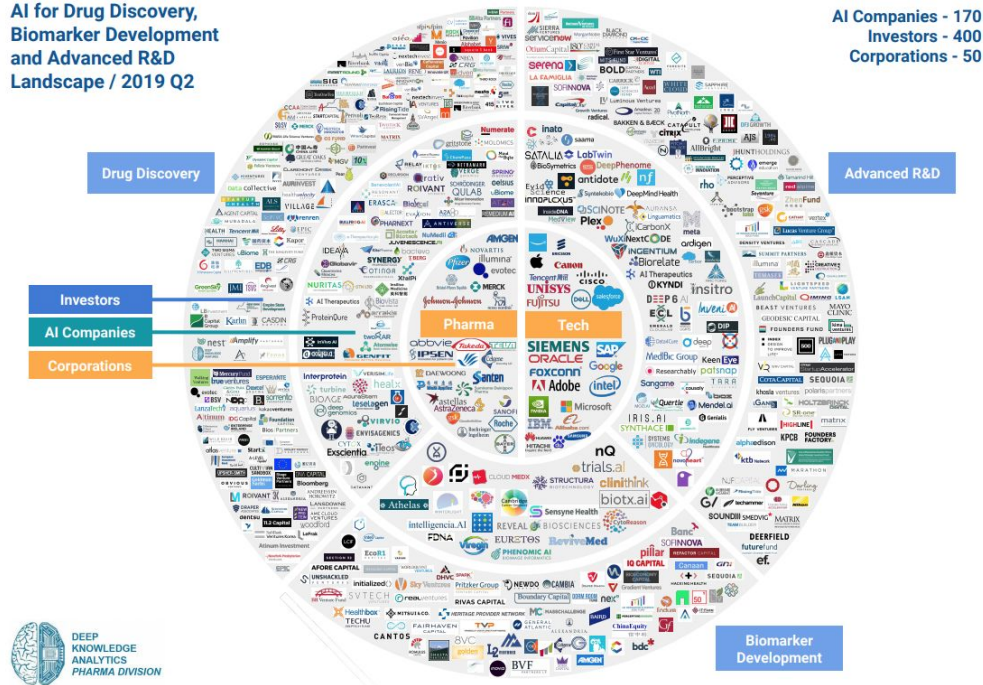
- AstraZeneca/Tencent (MoU). The two companies will harness the power of big data driven technologies to more accurately and effectively crack down on the online sale of counterfeit drugs, and will work together to build a new model for online drug safety management as part of a larger "Smart Healthcare" push.
- Hewlett Packard Enterprise/Biovista to advance Biovista's Project Prodigy Big Data AI healthcare platform applied in the personalized medicine vertical.
- SAP launched Intelligent Enterprise for Healthcare that uses intelligent technologies, such as AI, ML, IoT, and real-time, in-memory analytics to achieve operational and clinical excellence in care delivery.

Top-20 Investors in AI Companies

Top AI Companies	Investments overall	INVESTORS	Investments overall	Top AI Companies
Atomwise	9	Y combinator	9	XtalPi
	8	SEQUOIA	8	WuXiNextCODE
	8	SUSV	8	Atomwise
SCHROEDINGER	8	SOSV	8	twoXAR
Atomwise	8	OS Fund	8	Atomwise
RECURSION	8	PC	8	RECURSION
Atomwise	8	AME	7	XtalPi
deep genomics	6	AME Cloud Ventures	6	insitro
	6	khosla ventures	6	twoXAR
	6	Andreessen Horowitz	5	Indico Medicine
PathAI	5	Workday	5	
PathAI	4	General catalyst	4	XtalPi
	4	REFRACTOR	4	RECURSION
	4	Refactor Capital	4	Atomwise
WuXiNextCODE	3	Felicis ventures	3	
	3	AMGEN Ventures	3	

- Oracle's Autonomous Database takes out much of the human effort required in data ingestion and matching, while also ensuring its platforms meet global requirements for security and privacy.
- Cisco's digital technologies, including IoT are helping to accelerate life sciences R&D and manufacturing. Cisco has expressed interest in AI diagnosis-focused algorithms.
- Workday introduced AI Maturity Model that is poised to transform medicine and healthcare.
- Unisys unveiled *AI Center of Excellence* to help clients build advanced data analytics capabilities. They are also using AI solutions to research field engineering services to improve potential new cures.

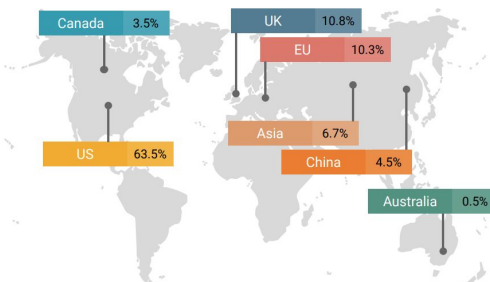
**AI for Drug Discovery,
Biomarker Development
and Advanced R&D
Landscape / 2019 Q2**



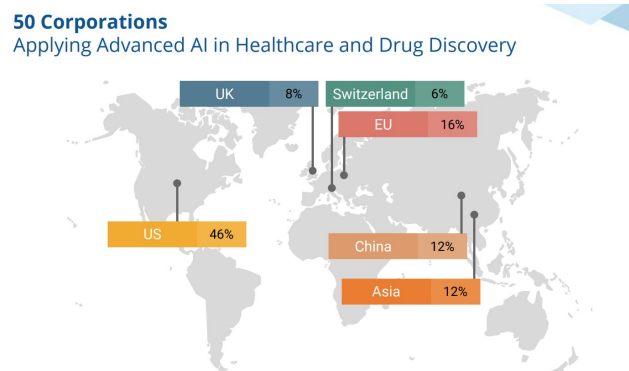
The Landscape: Highlights and Observations

- The US continues to lead the world in both investment in AI for Drug Discovery, and in the number of AI for Drug Discovery companies.
- This year there's been an increased level of activity from the UK and the EU, particularly in government initiatives.
- Although Asia currently has the fifth-lowest proportion of AI for Drug Discovery companies, Asian activity in the space is increasing, especially investment in foreign companies - mostly US-based.

400 Investors: Regional Proportion

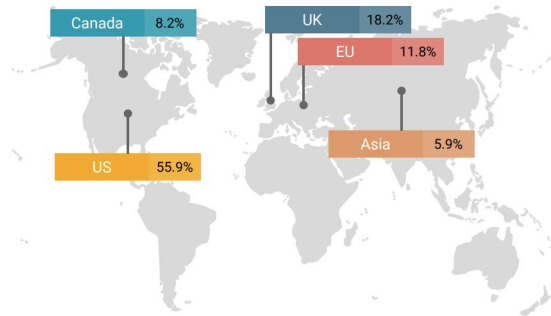


- The US and the EU had the biggest increase in the number of investors, and the UK, US and EU have the most investors in the sector overall.
- Although the US dominates AI for Drug Discovery in number of AI companies, investments, and conferences, this quarter there was an increased level of activity from the UK, Switzerland and China.
- There's an increased number of entities in the sector from China. The entry of Chinese investors in the broader biotech and drug industry landscape mounted significantly in 2019, rising to \$1.4 billion of investments into US-based biotech and drug firms compared to just \$125.5 million during the same period the previous year.



- Chinese IT and Tech corporations, such as Alibaba, Baidu and Tencent, have made significant investments and acquisitions in Pharma and AI for healthcare. Tencent led a \$155 million round for AI-driven healthcare company iCarbonX and also co-invested with Google and Sequoia China in a \$15 million round for XtalPi, a startup applying AI, cloud computing, and quantum physics to drug discovery.
- There's been a substantial increase in the volume of investments and the number of joint ventures in 2019 compared to 2018 and more active participation by the largest Pharma corporations in the AI-related investment and research collaborations. See the [BioPharma Corporations Onboarding AI for Drug Discovery](#) section of the Q2 report.

170 AI Companies: Regional Proportion



- This year the number of deals between tech companies and AI for drug discovery companies decreased compared to the same period in 2018, while Pharma companies were more active in this area this year.
- Deep learning algorithms are becoming a major technology differentiator in the Pharma AI race. DL in general and GANs in particular are increasingly regarded as the gold standard of innovation in the Pharma AI space.

Pharma AI Deals Structure 2019 / Q2

AI Companies				Pharma Corporations		AI Companies	
BenevolentAI	IBERG	Alibaba (阿里)	Tencent 腾讯	AstraZeneca	Biovia	hp	
5	XtalPi	Atomwise		Flare	Janssen	IKTOS	
Insilico Medicine 英矽智能	Exscientia	Cloud		esk	Charles River	C4 Therapeutics	
Researchably	IBERG	Exscientia		SANOFI	NEOS	Atomwise	
WAVE	Insilico Medicine 英矽智能	GeneTech	RECURSION	Incode	SLAY	NURITAS	
	SCHRÖDINGER	CYCUCA		博晖生物	Crystal Genomics	transcriptic	
	5	CYCUCA		Merck	Vertex	Standigm	
	IKTOS	CYCUCA		Roche	KYOWA KIRIN	Exscientia	
	e-therapeutics	5		Roche	GILEAD	Insitro	
	Genialis	Exscientia		Roche	Opobrium	Intelligens	
	SIRENOS	Concerto		Roche	Landbeck	Numerate	
	GeneTech	AMGEN		Roche	Boehringer Ingelheim	NANNA	
	博晖生物	abbvie		Roche	Sanofi	twoXAR	
	APTALIS	NuMedii					
	BASF	NURITAS					

- Although no AI-derived drugs have been approved by the FDA (or even validated in clinical trials yet) we expect that the first milestones will be reached by the end of 2020. We anticipate that the first practical results, stimulated by AI adoption, will cause significant expansion of the total sub-sector capitalization - on the order of 5-10x.

- Tech companies are increasingly entering the healthcare industry. What differentiates them from other newcomers is that many of these companies are already using AI-related solutions for Drug Discovery. A number of tech companies have already announced partnerships with AI companies and institutions in both Drug Discovery and Healthcare.

Download the Q2 Report

The Q2 report is open access. To download the complete report click here:

[Landscape of AI for Drug Discovery and Advanced R&D Q2 2019](#)

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[Deep Knowledge Ventures](#) is a leading investment fund focused on the synergetic convergence of DeepTech, frontier technologies and technological megatrends, renowned for its use of sophisticated analytical system for investment target identification and due-diligence. Major investment sectors include AI, Precision Medicine, Longevity, Blockchain and InvestTech. Deep Knowledge Ventures' Pharma AI - Index Hedge Fund combines the profitability of venture funds with the liquidity of hedge funds significantly de-risking the interests of LP's and simultaneously providing the best and most promising AI companies with a relevant amount of investment.

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