AGCPARTNERS

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INSIGHTS

Genomics Data Management

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Introduction

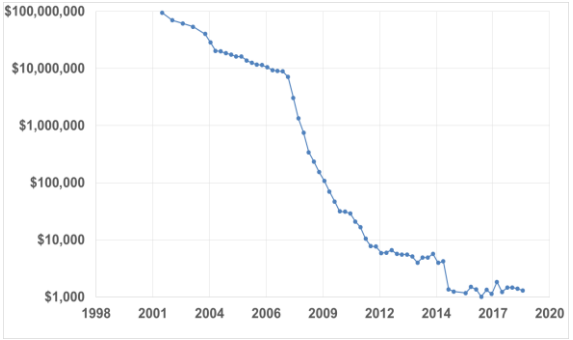
Genomics "Stack"

- **The process of extracting, processing and analyzing genomic data can be represented in 3 steps. Genomics companies can usually be categorized into one (or sometimes two) of these categories**
  - Sample Collection: Companies that collect and store biological samples (blood, saliva etc.) from consumers, patients or test subjects (e.g. 23andMe)
  - Sequencing: Hardware companies that develop equipment to analyze an organism's biological samples, and thereby determine its genomic structure/sequence (e.g. Illumina, and service providers e.g. CRO's who process the samples)
  - Software: Digital solutions used to store, organize, manipulate and analyze the genomic data extracted from sequencing (e.g. Genoox)

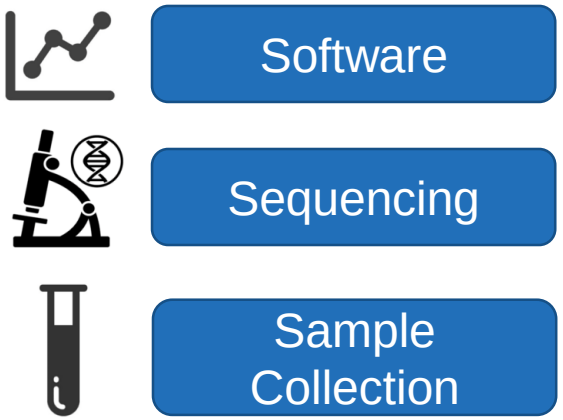
Genomic Data Management Software

- Genomic data describes the genetic composition of the organism
- Terabytes of genomic data is compiled from DNA/RNA sequencing
- With next-generation sequencing (NGS) technology becoming ubiquitous and exponentially cheaper (see chart), many challenges arise in keeping vast datasets of genetic information up to date and easily accessible
- The analysis, integration, and interpretation of the data presents a significant challenge to researchers
- Sophisticated software tools and platforms are needed to automate complex integration and analytics and present them back to the user in such a manner that is immediately interpretable by biologists and bioinformaticians
- This growing need has created a market opportunity for "Genomic Data Management Software"
- Use Cases: Academic Research, Biopharma Companies, Healthcare Providers, Biobanks

DNA Sequencing Cost per Genome



Genomics "Stack"



Source: CBInsights, National Human Genome Research Institute, Genedata, Hewlett Packard Enterprise

Market Size & Growth Forecasts

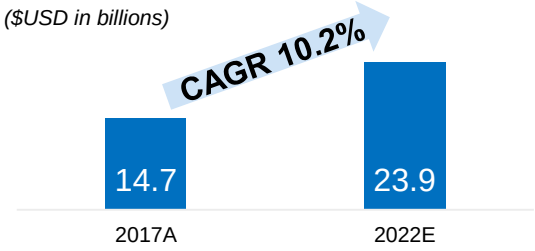
Market Size & Growth Drivers

- The global genomics market is expected to grow from ~$15 billion in 2017 to ~$24 billion by 2022, at a CAGR of 10.2%
- The global clinical genomics market is expected to grow at a CAGR of 17.1%, from ~$400 million in 2018 to ~$880 million in 2023
- The global precision medicine market is expected to grow at a CAGR of 11.2%, from ~$44 billion in 2016 to ~$142 billion in 2026
- The growth of these market is predominantly driven by:
  - Sharp decline in sequencing costs
  - Rise in research activities in the field of genomics
  - Increasing number of start-up companies
  - Increasing awareness of personalized medicine by patients and physicians
  - Medicare reimbursement of genetic testing in the US
  - Growing investments, grants, and funds by the government
  - Increasing application of genomic sequencing in the diagnostics

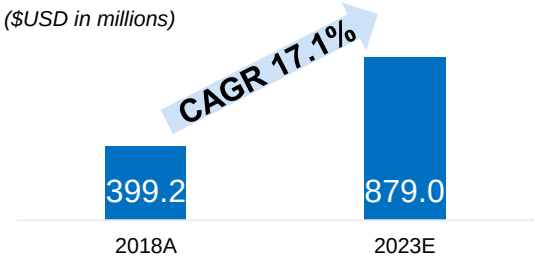
Leveraging New Technologies

- Genomics data management is highly reliant on AI and cloud computing
  - Genomic research involves processing large genomic datasets (~100's of terabytes in size) and storing them in a centralized location that makes scientific collaboration feasible; this makes the availability of fast and reliable cloud computing essential
  - AI/ML algorithms are being implemented in genomics software with growing success, to detect diseases at early stages and design more precise medical treatments based on the patient's unique genetic code

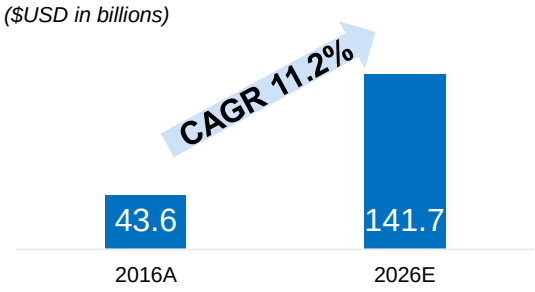
Global Genomics Market



Clinical Genomics Market



Precision Medicine Market



Source: Mckinsey, Research and Markets, Global Market Insights, Meticulous Research

Segments Defined

Sequence Analytics

- Software that enables researchers and scientists to visualize, analyze and even edit genetic sequences
- Leverages big data and AI to aid researchers in genomic analysis and drug discovery
- Genomic simulation/modelling enables researchers to virtually assess the impact of their engineered genomic sequences
- Target Market(s): Academic Research, Biopharma Companies, Governments

Clinical Genomics

- Clinical decision support software (CDSS) that analyzes a patient's genomic data to diagnose cancer and other diseases at an earlier stage than traditional diagnosis; also suggests suitable treatment for either diagnostic support or population health.
- Incorporates AI/ML algorithms to aid physicians in diagnosis and treatment
- Closely associated with Precision & Personal Medicine
- Target Market(s): Healthcare Providers, Biopharma Companies

Storage & Collaboration

- Software that enables researchers and scientists to store, organize and collaborate on terabytes of genetic data
- This segment also includes knowledge base platforms or search engines which collate genomic variants and academic research papers
- Uses cloud technologies for easy collaboration by researchers
- Target Market(s): Biobanks, Academic Research

Buyers & Tech Giants

- Represents buyers in the field with an interest in either consolidation of technology or inorganic growth within the genomics data management industry
- Some high profile buyers are attempting to streamline the wide ranging technological capabilities required in order to provide end-to-end service for genome data management customers
- Other companies are simply interesting in expanding upon the breadth of their data storage capabilities and preemptively entering a market with huge growth potential
- Target Market(s): Sequence Analytics, Clinical Genomics, Storage & Collaboration

Company Landscape

= Indicates operating subsidiary

Sequence Analytics

Clinical Genomics

Storage & Collaboration

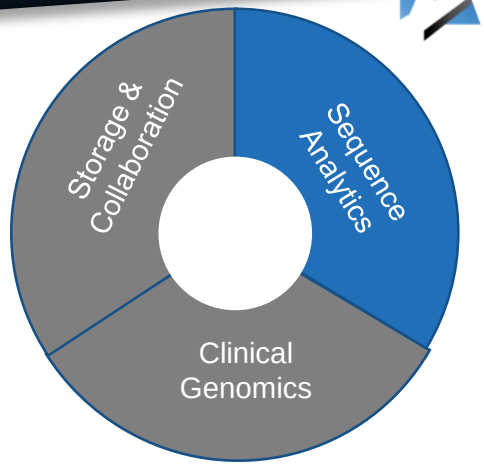
DISCLAIMER: This is a representative list only and may not include all relevant companies. If your company is not listed you would like it to be included in future releases, please email hhoffman@agcpartners.com and we would be happy to consider.

Expanded Focus: Sequence Analytics & RNA Sequencing

- Sequencing costs have fallen significantly, so more genomic data is being produced today than ever before
- The sheer volume of genomic data being produced means that traditional, manual methods of analysis are insufficient to interpret the data in a time-efficient manner
- Thus, sequence analytics software is becoming integral to researcher; sub-sectors of this vertical are:

1. **Sequence Visualization**
   - › Genetic data is read and displayed digitally; components of sequences are color-coded, and can be annotated
2. **Genomic Engineering**
   - › CRISPR is the de-facto method to edit genetic sequences
   - › CRISPR technology allows scientists to edit genetic material to suppress or promote certain biological traits, and has broad applications from material science to energy to agriculture to health.
3. **Simulation/Modeling**
   - › Enables researchers to virtually assess the impact of their engineered genomic sequences
   - › Especially relevant in drug discovery and development, where AI/ML is used to predict the biological outcomes of new compounds
   - › Some companies within this space offer tools that enable governments to conduct population-level genetic disease analytics

- RNA sequencing is a methodology of analyzing the gene expressions of RNA samples. While DNA encodes genetic information and acts as a storage device, RNA functions as the reader that decodes the storage device. RNA sequencing is used to map the transcriptome, which holds the key to understanding the gene expression patterns that are present within every individuals' RNA. Such technology has the ability to greatly advance the existing analytic capabilities by providing quantitative data about the real time operations of a cell.
- Several of the major players in this space (e.g. Illumina, PacBio) also produce sequencing hardware products which interface with their analytics software



CRISPR/Cas9 Gene Editing

SnapGene®

deep genomics

RNA Sequencing Firms

veracyte™

Genomic Health
LIFE, CHANGING.

COFACTOR genomics

EXACT SCIENCES

Source: Genedata, SnapGene, Syntehgo, Deep Genomics

Sequence Analytics: Opening the Bottleneck

The Problem

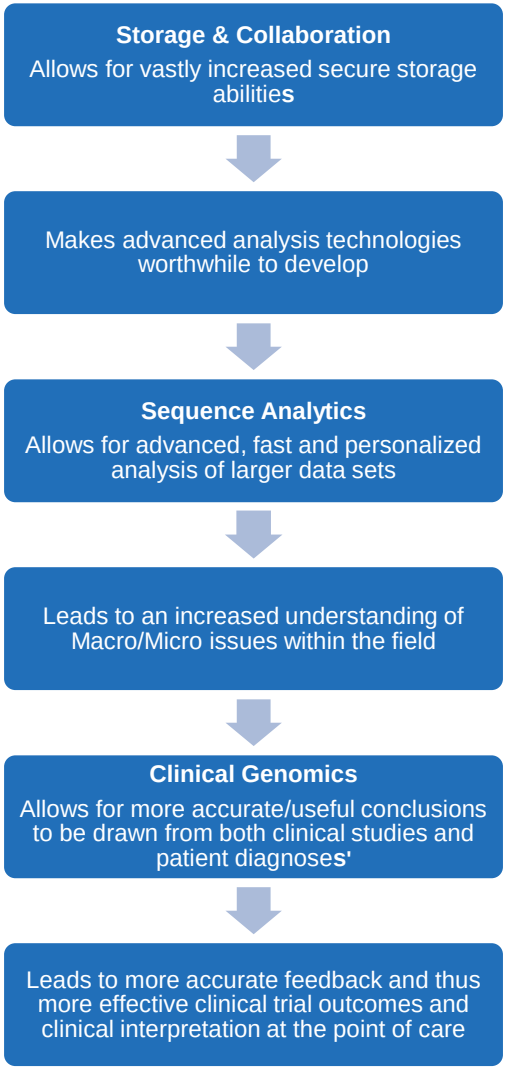
- There is an unprecedented amount of genomic data available for analysis but researchers ability to process and make use of this information remains archaic in comparison. This bottleneck is hampering the potential impact of related genomic technologies. Companies such as 10x Genomics are working to better utilize the information generated by companies within the genomics ecosystem.

The Solution

- Companies in the Sequence Analytics field largely agree that the key to better analysis of genomic data will come from a better understanding of the biological systems the data represents.
  - This problem is being attacked from a variety of angles, whether it be through the use of superior imaging technology, advanced laboratory equipment or high level computer software.
  - The goal of these products is to allow researchers to analyze a wide range of sample sizes in order to respond to the various needs of individual patients.

The Benefits

- Beyond the obvious benefits of being able to process crucial data quickly, progress in the Sequence Analytics field will directly benefit the Clinical usage of genomic data.
  - Better analysis of genomic data stemming from a more comprehensive understanding of relevant biological systems will lead to more accurate diagnosis's within the clinical setting.



Full Stack Genomic Engineering

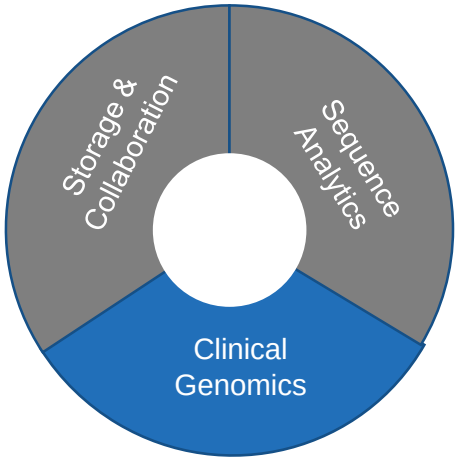
- Synthego (founded in 2012) has pioneered a Full Stack Genome Engineering solution, and remains one of the leading players in the space
- Full Stack Genome Engineering is defined as the entirety of the CRISPR gene editing workflow. It offers complete support for every step of the genome engineering workflow (Design → Edit → Analyze), allowing all scientists to leverage CRISPR and advance their research
- In simple terms, Synthego essentially offers gene-editing as a service, as well as design and analytics software tools relevant to gene editing. The workflow is as follows:
  - **Design:** Synthego provides software that helps scientists plan and visualize a particular genetic edit
  - **Edit:** Ships a kit containing the cells and genetic materials which have been edited according to the scientist's design
  - **Analyze:** Provides software that allows researchers to analyze the stability of the edited gene as well as its response to the new therapies being tested by the scientist
- *"Gene editing technologies like CRISPR have dramatically improved how researchers make genomic modifications. As with many new biological tools, not everyone has the access, time and ability to learn and use CRISPR efficiently to get the results they want. Due to these barriers, there is significant demand for solutions that make CRISPR accessible to the masses so researchers can focus on experimental outcomes rather than method development" - George Church, Professor of Genetics at Harvard Medical School*
- Full Stack Genomic Engineering has made gene editing accessible to a larger segment of the scientific and research communities, and enables even those with limited knowledge of genomic engineering to use edited genomes for their research

SYNTHEGO

Source: Synthego, TechCrunch

Expanded Focus: Clinical Genomics

- Research shows that many of today's prevalent diseases (e.g. cancer, diabetes etc.) are hereditary, and so can be diagnosed through genomic analysis even before the first symptoms appear
- There is also a trend in the healthcare industry towards Personalized & Precision Medicine, which is highly dependent on genomic data for diagnosis and treatment
- Clinical genomics software leverages AI/ML algorithms to aid physicians in the diagnosis and treatment of diseases
- Several of the platforms in this vertical also offer patient portals, reporting functionality and compatibility with existing electronic medical records (EMRs)
- Although the technology is still nascent, commercialized products in this segment have already entered market
- Highly specialized technical knowledge, high R&D costs and slow adoption rates by healthcare providers makes gives this segment the most difficult to penetrate of all three segments
- Patient privacy and cybersecurity to protect the patient's confidential genomic data are important considerations in this space

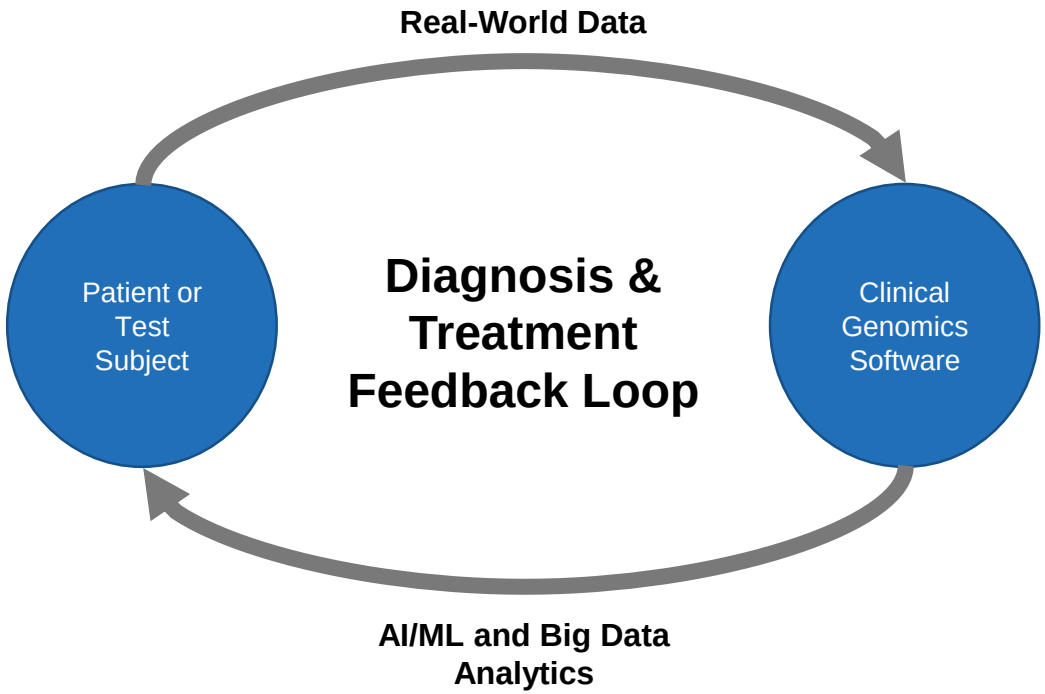


interpreta

Source: McKinsey, BIS Research, Interpreta

Continuous Improvement in Clinical Genomics Software

- One of the reasons more money is flowing into genomics is the emergence of massive training datasets that can now be used to teach AI/ML algorithms
- Building up the amount of genetic data is only the first step, however; understanding how those genes are expressed and interact is still largely unknown, making action on this data difficult
- Thus, the diagnosis or treatment suggested by clinical genomics software is not followed blindly by physicians and researchers
  - For diagnosis: Physicians combine genomic data with other biomedical markers to reach a conclusive diagnosis; if the software's diagnosis is erroneous, this feedback is given to it, allowing it to learn from the mistake
  - For treatment: The patient's response to the treatment proposed by clinical genomics software is assessed, and this real-world data is fed to the AI/ML algorithms in a feedback loop, enabling continuous improvement



TriNetX

Source: TriNetX

The Impact of AI Upon Physician Workflow and Use Cases

Overview

- Current applications of AI in the field of genomics are impacting how genetic research is conducted, and how clinicians are making genomics more accessible to individuals wanting to know how heredity may impact their health. For instance, companies can use AI to help researchers interpret genetic variation. Algorithms are designed based on patterns identified in large genetic data sets which are then translated to computer models to help interpret how genetic variation affects crucial cellular processes. However, in the clinical setting, one of the biggest challenges facing providers who want to deploy genomics or precision medicine at the point of care is managing change to physician workflow.

Deep Genomics and Tempus

- Deep Genomics is a company that utilizes machine learning in order to assist researchers interpret various genetic variations at an accelerated pace and share these findings with physicians to improve patient care. The algorithms they design are based on previously identified patterns in large data sets that have been translated into computer models in order to help clients identify the cellular impact of such variations with an increased degree of accuracy.
- Tempus aims to bring the capabilities of machine learning technology to bear upon genomic issues. Additionally, they plan to utilize AI assisted image recognition software to build an interactive platform that will aid patient diagnosis and treatment.

Intel and Intermountain Healthcare

- Intel has designed an Analytics Toolkit which integrates machine learning capabilities into the clinical workflow process. The Transformation Lab at Intermountain Healthcare collaborated with Intel in an effort to more efficiently integrate genetics in breast cancer treatment and patient care. The partnership resulted in the development of an algorithm to measure factors such as a patient's level of risk for developing multiple cancers.
- A workflow model was developed using machine learning with four major components:
  - A centralized database of genomic data that is linked to clinical and patient data
  - All clinicians and genetic counselors have access to Electronic Health Records (EHRs)
  - All data from genetic tests are integrated into EHRs
  - Clinical Decision Support tools (CDS) are operational and accessible. Examples of clinical decision support include family health histories, screenings and past clinical data.

Potential Industry Impact

- The effective leveraging of genomic AI and solving workflow issues could lead to massive leaps in physicians' ability to provide effective and efficient patient care.
- Through a combination of an increase in archived genetic information to draw upon, improved image recognition software, widespread access to longitudinal patient records and less time required to provide a diagnosis; AI's ability to be incorporated into physician workflow has the potential to radically enhance genomic technologies ability to improve healthcare standards

AI & Workflow

deep genomics

TEMPUS

GNS HEALTHCARE

FOUNDATION MEDICINE

COTA

syapse

GENOSPACE
Precision Medicine by Sarah Cannon

pieriandx

prognos

Use Cases in Genomic Data Clinical Interpretation

SOPHiA provides AI-based technology platforms that separately address genomics-based diagnosis and treatment:

SOPHiA for Genomics (Diagnosis Platform)

- A clinical decision support solution to support oncology and healthcare professionals in diagnosing patients
- One main difficulty lies in distinguishing relevant genomic alterations with actionable diagnostic value from all the others
- By offering clinical-grade genomic solutions to help accurately detect and characterize genomic variants associated with cancers and hereditary disorders, experts can filter down and report relevant candidates associated with a specific type of cancer

SOPHiA for Clinical Trials (Treatment Platform):

- A data analytics solution that enables clinicians to match the right patients to the right clinical trials based on their genomic profiles
- The power of this solution comes from the AI that has accurately analyzed hundreds of thousands of genomic profiles, and a clinical research community that connects more than 980 leading hospitals in 81 countries
- By leveraging this clinical network, this solution simplifies sample management and facilitates highly accurate genomic testing for clinical trials

Genoox provides a genomic analytics platform that translates complex genetic data into actionable clinical results:

Genoox for Genomics (Diagnosis Platform)

- The company's platform uses machine-learning algorithms to analyze rare genetic mutations and predict the probability that they are responsible for a condition, enabling clinics to handle data from genetic screening in less time and improve patient outcomes via increased accuracy and efficiency resulting in personalized medicine.

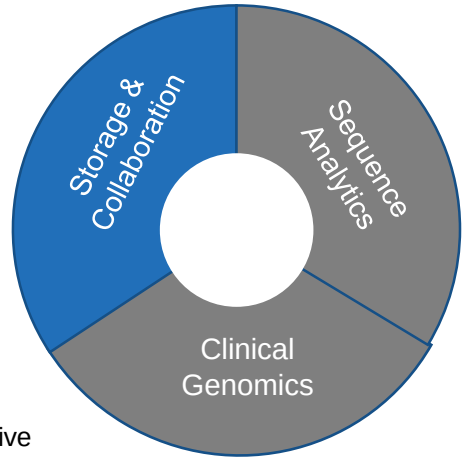
Genoox for Genomics (Treatment Platform)

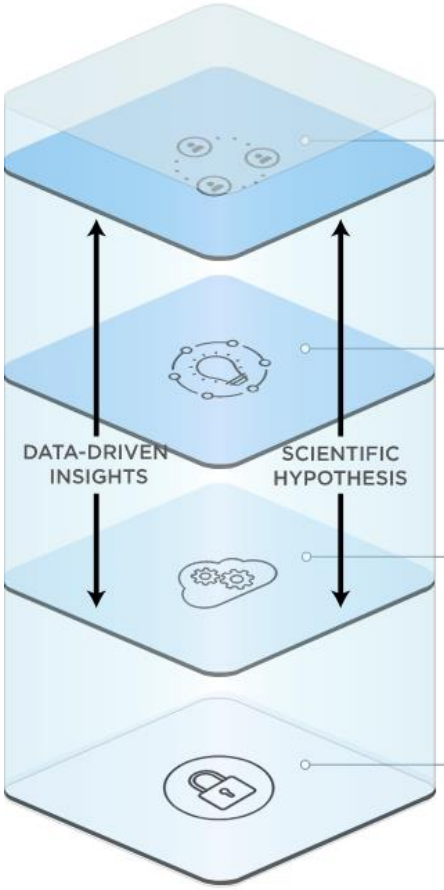
- The Genoox platform employs sensitive statistical modeling algorithms for superior bioinformatics, using a proprietary data structure that allows users to detect variants with better accuracy, while utilizing historical data. The firm’s advanced algorithms allow for extremely high variant detection sensitivity, providing an exceptional level of confidence with variant calls as well as allowing for a significant reduction in sequencing costs.

Source: Sophia Genetics

Expanded Focus: Storage & Collaboration

- Genomic datasets can be 100's of terabytes in size and can be highly interconnected; storing, organizing and processing such data, while making it easy for to collaborate on, requires a reliable cloud-based platform with high compute power
- Companies in this vertical deliver end-to-end bioinformatic solutions — including access to datasets, analytic workflows and algorithms, cloud-computing infrastructure, and scientific support — that speed the path from raw experimental data to new treatments and diagnostics





Collaboration: Connect research teams and data to fuel collaborative research and development in a cloud-based environment

- Since all the tools, data, and compute power live in the cloud, research teams from across the world can collaborate in real-time
- Commenting and annotation tools facilitate discussion and collaboration

Discovery: Bioinformatics workflows and algorithms streamline clinical trial research by effectively organizing large sets of genomics data. This boosts speed and efficiency, thereby reducing time to market

- Seven Bridges' Platform has a Graph Pipeline workflow that enables accurate alignment and variant calling[1] by using a graph-based reference genome

Data & Compute: Immediate access to flexible and reproducible computation, centralized data storage, and diverse public datasets

- Companies in this vertical depend on AWS, HPE, IBM Watson, Microsoft Azure or Google Cloud to handle the storage and computing infrastructure

Security: Keep genomic information safe with comprehensive, integrated security features that meet regulatory requirements

- Security features extend to user permissions, where a particular team member's level of access (including read, write, and execution privileges) can be managed

Seven Bridges

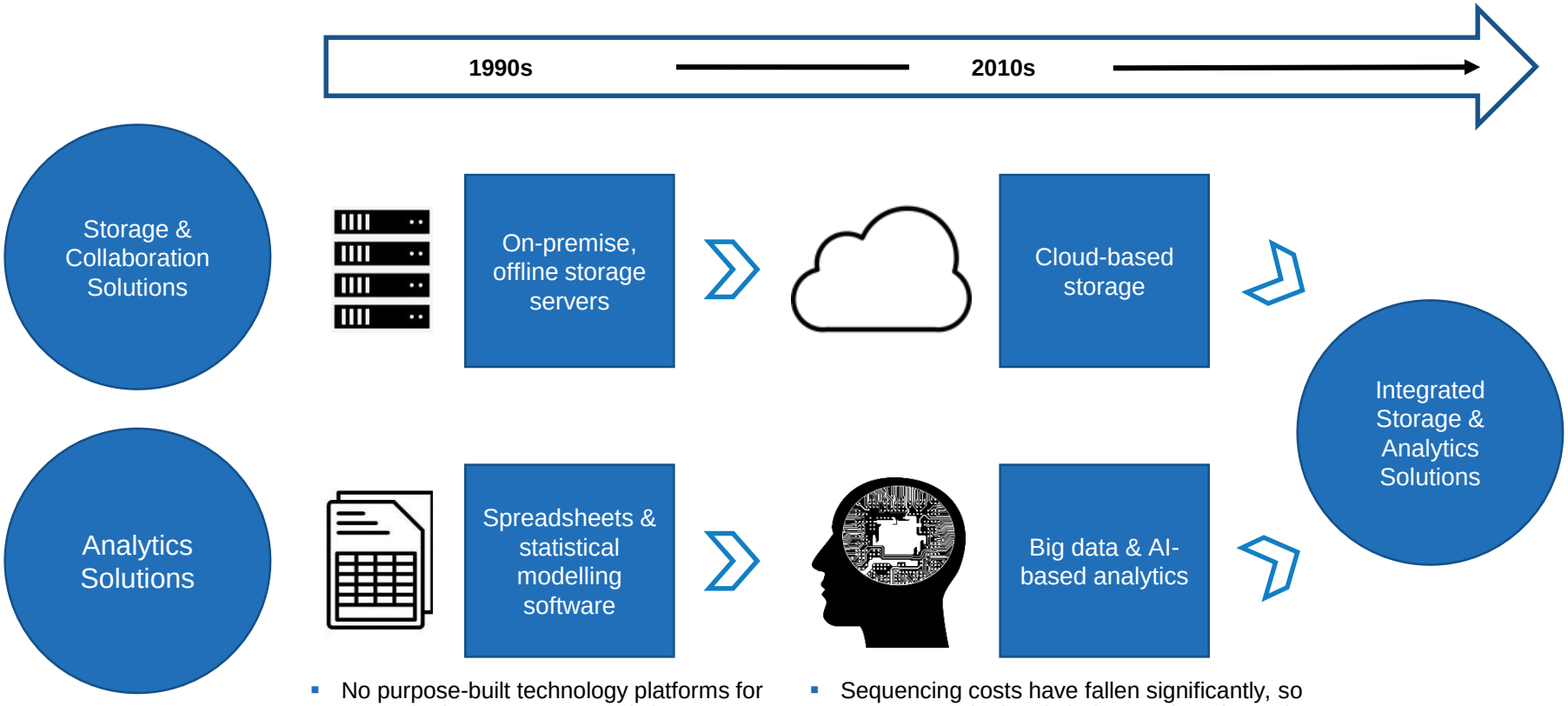
DNAnexus

BC Platforms

Source: Seven Bridges, Veritas Genetics

Integrated Solutions

- Evolution of storage and analytics technologies has made data management more straightforward, allowing researchers to spend more time on research rather than data management
- Storage and analytics of genomic data have hitherto been handled through separate applications; however, we seeing a trend towards integrated storage and analytics solutions, which combine the two functionalities into a single software package



- No purpose-built technology platforms for genomic data storage & analytics
- Instead, researchers/scientists adapted existing technologies to serve their unique needs
- Sequencing costs have fallen significantly, so more genomic data is being produced; need for more sophisticated technology platforms
- Rise of purpose-built genomic data management software which leverage cloud, AI and big data technologies

Source: Healthcare IT News, Hewlett Packard Enterprise, IBM Watson, BioSymetrics

Integrated Solutions

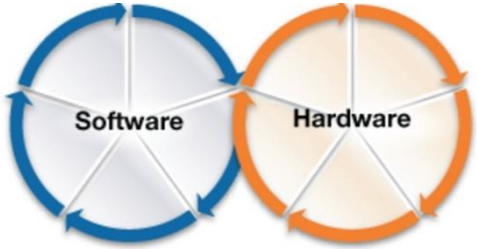
- Illumina's core business is genomic sequencing hardware. However, in recent years, the firm has been developing the BaseSpace Sequence Hub, a suite of genomics data management software, that complements its hardware products
- The BaseSpace Sequence Hub was primarily a storage & collaboration platform with limited sequence analytics capabilities
- In March 2018, Illumina acquired Edico Genome, a company focused on developing genomic analytics software
- After the acquisition, Edico's DRAGEN analytics platform was integrated into Illumina's BaseSpace Sequence Hub, giving the software both, genomic data storage and sequence analytics functionalities
- This acquisition represents a broader trend in the genomics data management space, where companies are moving towards holistic, fully integrated solutions

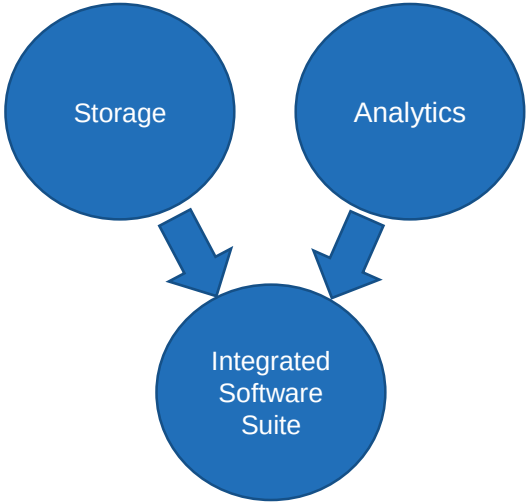
› This integration will result in:

  › Companies developing and integrating hardware and software solutions

  › Companies bundling two or more of the 3 broad features (storage & collaboration, sequence analytics, clinical) into one software suite

  › Thus, looking forward, it is likely that there will be a large number of strategic acquisitions of software-focused genomic data management companies





Source: PRNewswire, Illumina, Edico Genome, Illumnina

Major Challenges

Technological Challenges

- It is often difficult to acquire datasets of sufficient size and quality required for training AI/ML algorithms
- Even if the right quantity and quality of data were readily available, more research needs to be done to refine the current generation of algorithms
- Hiring top talent at the intersection of biology and computer science is also a major challenge, but this is being addressed by an increasing popularity of bioengineering and similar majors at top universities

Ethical & Religious Opposition

- There have been many ethical concerns and much religious opposition to the CRISPR/Cas9 genetic editing process
- The international outcry over He Jiankui's genome-edited baby demonstrates that public sentiment is against editing of the human genome

Data Privacy

- Also, data privacy is a concern in the genomic data management space, especially with the integration of patients' genomic data with EMRs
- Meanwhile, data-privacy laws are becoming stricter. Stakeholders must therefore ensure that their processes collect, retain, and share data in accordance with all applicable privacy laws and regulations.
- These include the Health Insurance Portability and Accountability Act (HIPAA) in the United States and the General Data Protection Regulation (GDPR) in Europe

Source: McKinsey, Nature

Publicly Traded Genomics Companies

($ in millions)

Company	Enterprise Value[a] [b]	Market Data: EV / Revenue LTM	Market Data: EV / Revenue 2019E	Market Data: EV / EBITDA LTM	Market Data: EV / EBITDA 2019E	Operating Data[c]: Revenue LTM	Operating Data[c]: Revenue 2019E	Operating Data[c]: EBITDA LTM	Operating Data[c]: EBITDA 2019E	Operating Data[c]: Revenue Growth 17A/'16A	Operating Data[c]: Revenue Growth 18A/'17A	Operating Data[c]: Revenue Growth 19E/18A	LQ Gross Margin	EBITDA Margin
Illumina	$42,292	12.2x	12.0x	38.2x	34.9x	$3,458	$3,531	$1,107	$1,210	15%	21%	6%	72%	32%
Agilent Technologies	23,557	4.6x	4.5x	19.2x	17.8x	5,090	5,217	1,229	1,327	5%	10%	6%	54%	24%
QIAGEN	7,630	5.0x	5.0x	15.3x	14.3x	1,516	1,525	497	533	6%	6%	2%	71%	33%
Guardant Health	6,098	42.0x	32.7x	NM	NM	145	187	(81)	(104)	97%	82%	106%	69%	(56%)
10x Genomics	5,719	29.1x	24.6x	NM	NM	197	232	12	(34)	38%	106%	59%	73%	6%
Natera	2,792	10.2x	9.5x	NM	NM	273	293	(107)	(130)	(1%)	23%	14%	41%	(39%)
Myriad Genetics	2,581	3.0x	3.0x	25.2x	13.5x	851	855	103	192	(3%)	2%	15%	77%	12%
NeoGenomics	2,369	6.3x	5.8x	50.4x	41.5x	378	405	47	57	4%	15%	46%	49%	12%
Genomic Health	2,238	5.1x	4.9x	34.8x	33.1x	442	454	64	68	4%	16%	15%	84%	15%
Invitae	1,474	8.3x	6.7x	NM	NM	177	220	(125)	(174)	172%	117%	49%	48%	(71%)
Veracyte	926	8.0x	7.7x	NM	NM	116	120	(7)	(7)	11%	28%	31%	71%	(6%)
PAC Biosciences	724	9.2x	7.3x	NM	NM	79	100	(89)	(99)	3%	(16%)	27%	39%	(113%)
Personalis	179	3.3x	2.9x	NM	NM	55	62	(10)	(21)	NM	302%	63%	37%	(19%)
MEDIAN	**$2,581**	**8.0x**	**6.7x**	**30.0x**	**25.4x**	**$273**	**$293**	**$12**	**($7)**	**6%**	**21%**	**27%**	**69%**	**6%**

Notes:

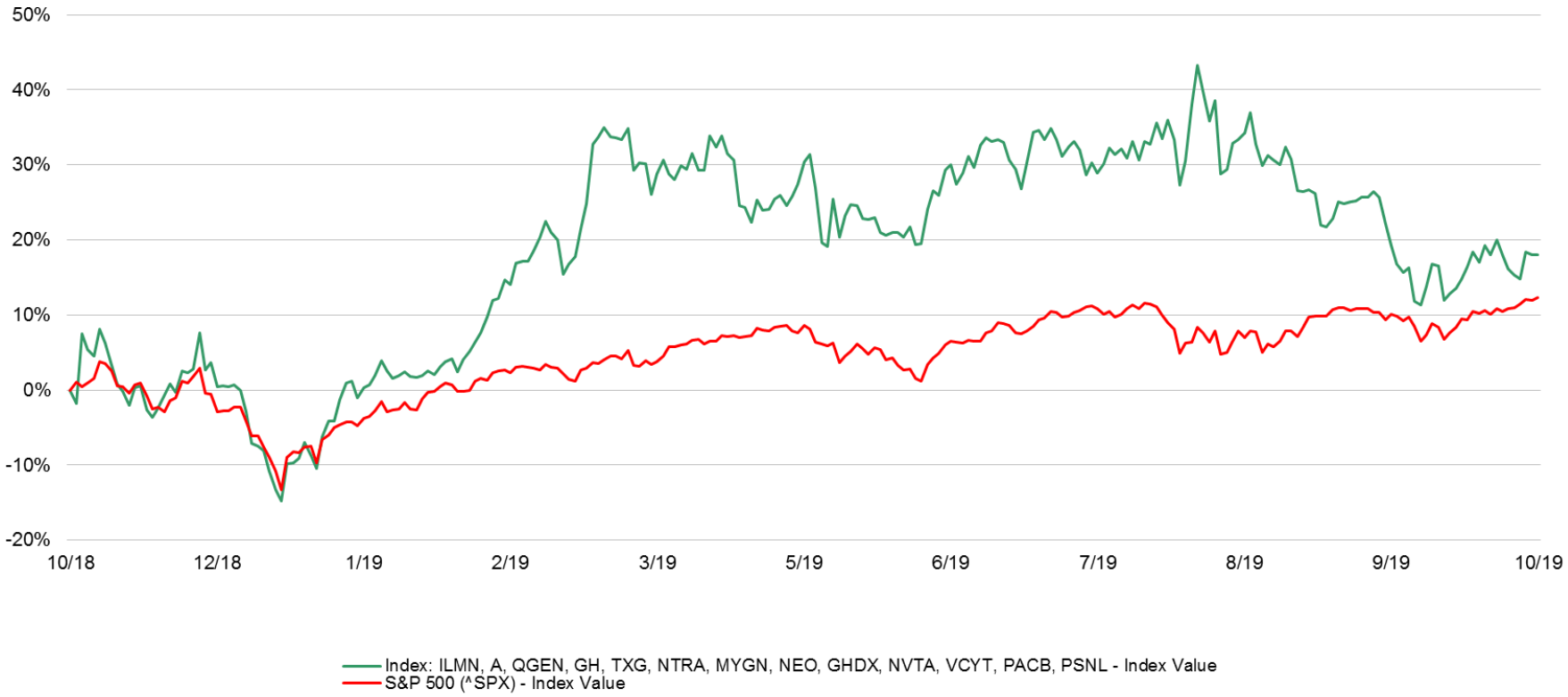
(a) Based on closing stock prices on October 31, 2019

(b) Calculated as Equity Value plus total debt, minority interest (at book value unless otherwise noted) and preferred stock, less cash & equivalents

(c) Projections represent Wall Street consensus mean estimates

Source: Capital IQ, Investing News

Publicly Traded Genomic Companies



Source: Capital IQ

Strong Buyer Base

- Strong interest from strategic and financial buyers
- Strategics are buying to offer a more integrated approach to genomic analysis
  - e.g. Illumina's acquisition of Edico Genomics
- Sponsors are increasingly looking for bolt-on acquisitions for rollups of portfolio companies
  - e.g. Insight Partners' roll-up of SnapGene with Graphpad, a portfolio company

Potential Strategic Buyers

Roche, myriad, illumina, PACBIO, Abbott, LabCorp, Celgene, SIEMENS, biolabs, IQVIA, Clarivate Analytics, DANAHER, PHILIPS, illumina, Agilent Technologies, ThermoFisher SCIENTIFIC, GE Healthcare, DASSAULT SYSTEMES, QIAGEN, Google, MERCK, NOVARTIS, GILEAD

VC/Growth and Private Equity Firms

ATLANTICMEDIA, NEA, DEERFIELD CAPITAL MANAGEMENT LLC, SEP SUMERU EQUITY PARTNERS, HGP HEALTHCARE GROWTH PARTNERS, THE CARLYLE GROUP, IEQT, iw INTERWEST PARTNERS, GENSTAR CAPITAL, Lilly Asia Ventures 礼来亚洲基金, KLEINER PERKINS, novo holdings, MARLIN EQUITY PARTNERS, TPG, INSIGHT PARTNERS, ELLIOTT, MPM, PHILIPS Ventures, MERCK, T.RowePrice, WARBURG PINCUS, APOLLO, FP FRANCISCO PARTNERS, polarispartners, SV Life Sciences, NLV, J&J, Arrowroot Capital, abry partners, K1 Enterprise Software Investors, SEQUOIA, Y, KKR, VISTA PRIVATE EQUITY, NEA, Lightspeed, OrbiMed Healthcare Fund Management, TA ASSOCIATES, G/, GALEN PARTNERS, Blackstone, Alta Partners

Strategic Investments by Corporates

- Several corporates in healthcare and technology have been actively making investments in upcoming genomics data companies, usually through a corporate VC division or a startup incubator
- Insurance companies have also begun to forge partnerships with genomics startups
  - MassMutual partnered with Human Longevity, Anthem to provide genomic sequencing to customers and employees
  - Color Genomics has partnered with several insurers including Anthem, CMS and United Healthcare to accept insurance for several tests
- This is a sign that the genomics market is maturing

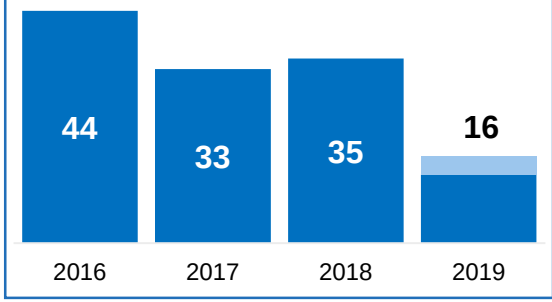
Company	Investments	Company	Investments
illumina	23andMe, Desktop Genomics, Human Longevity, Grail, Kallyope	礼来亚洲基金 Lilly Asia Ventures	Veritas Genetics, Readcodr, Singlera Genomics
GV	Grail, 23andMe, Freenome, DNAnexus, Genomics Medicine Ireland, Cambridge Epigenetix	JLABS Johnson & Johnson INNOVATION	Grail, Inivata, Atlas Genetics
Roche Roche Venture Fund Connecting Innovation to Value	Fabric Genomics, Horizon Genomics, Stratos Genomics	GE VENTURES	Human Longevity, Veracyte, Raindance Technologies

Source: CBInsights

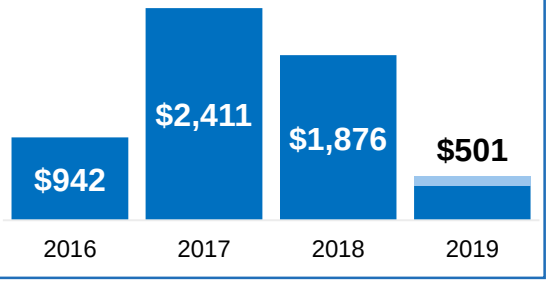
Transaction Activity Summary

Private Placements*

Total Number of Transactions

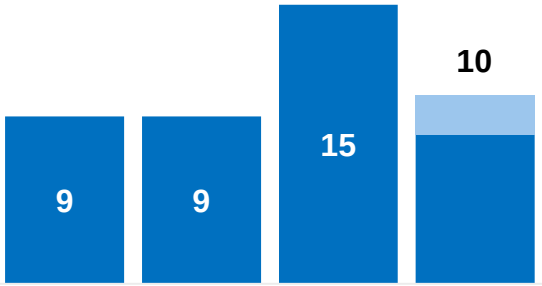


Total Capital Raised ($MM)



M&A Transactions*

Total Number of Transactions



Highlights & Takeaways

Financings:

- Excitement around genomics helped pull in a lot of new seed funding for companies in 2015 and 2016
- Since 2017, however, there has been a pullback in seed-stage, and more focus on mid- to late-stage deals
- Currently, the majority of the financing activity in the space is in the form of growth-stage private placements (typically Series A-C)
- As the industry matures, we will continue to see larger deals in smaller numbers; this will result in an increase in total capital raised, but a decrease in total deal count

M&A:

- Relatively fewer M&A deals in this space as the industry is still nascent and the companies are still early stage

* 2019 values represent annualized totals

Source: Capital IQ, 451Research, CBInsights, Crunchbase

Top M&A Deals (2016 – YTD)

Date	Target	Size ($M)	EV/ Rev	Target Business Description	Acquirer
Feb-18	flatiron	$2,183	31x *	Developer of a database platform designed to organize the oncology information and make it useful for patients, physicians, life sciences and researchers.	Roche
Mar-18	IDT INTEGRATED DNA TECHNOLOGIES	2,000	8x	Develops, manufactures, and supplies custom oligonucleotides for the research and diagnostics life science market in the areas of academic research, biotechnology, and pharmaceutical development.	DANAHER
Nov-18	PACBIO	1,281	14x	Designs, develops, and manufactures sequencing systems to resolve genetically complex problems.	illumina
May-18	edico genome	100	13x	Develops bioinformatics processor chip that helps in DNA analysis.	illumina
Mar-18	integenX	65	ND	Develops human DNA identification solutions.	ThermoFisher SCIENTIFIC
Sep-18	NUGEN technologies	55	ND	Provides a portfolio of technologies to address microarray and NGS applications.	TECAN.
Mar-19	BELLWETHER BIO	30	ND	Develops cell free DNA based diagnostic technologies.	GUARDANT
Oct-18	tpgbiologics	29	ND	Provides gene construction and transfection, antibody humanization, cell line generation, scalable process development, and protein production and purification services.	順天醫藥生技 LUMOSA Therapeutics
Jan-15	NANOMR	24	ND	Develops and manufactures the Pathogen Capture System (PCS), a medical diagnostic device for rapid isolation of rare cells from blood samples for the blood culture market.	DNAe

* Estimate

Source: Capital IQ, 451 Research, Crunchbase

Top Financings (2016 – YTD)

Date	Company	Size ($M)	Sector	Investors	Series	Description
Feb-17	GRAIL	$1,212	Clinical Genomics	Amazon; Arch; Bristol-Myers Squibb; Celgene; Merck & Co.; Varian Medical; Tencent; McKesson; Johnson & Johnson	Series B	Conducts medical research for developing a blood screening test for early detection of cancer.
May-17	GUARDANT	360	Sequence Analytics	Sequoia; Temasek; OrbiMed; Lightspeed; T. Rowe Price; Khosla; Eight Partners; SoftBank	Series E	Provides blood tests, data sets, and analytics in the United States and internationally.
Jul-18	23andMe	300	Sequence Analytics	GlaxoSmithKline	Series F	Operates as a personal genetics company that provides DNA analysis services.
May-18	GRAIL	300	Clinical Genomics	Hillhouse; Sequoia; Blue Pool; Industrial and Commercial Bank of China; CRF Investment; Ally Bridge; WuXi Nextcode; 6 Dimensions; China Merchants; Huangpu River	Series C	Conducts medical research for developing a blood screening test for early detection of cancer.
Aug-17	23andMe	250	Sequence Analytics	Sequoia; Fidelity; The Knut and Alice Wallenberg Foundation; Altimeter; Casdin Capital; Euclidean	Series F	Operates as a personal genetics company that provides DNA analysis services.
May-17	WuXiNextCODE	240	Clinical Genomics	Temasek; Ireland; Sequoia; Yunfeng, Polaris, Arch	Series B	Operates a gene sequencing platform.
Apr-16	HUMAN LONGEVITY, INC.	220	Clinical Genomics	Illumina; Celgene; GE Ventures	Series B	Operates as a genomics-powered health intelligence company.
Nov-18	WuXiNextCODE	200	Clinical Genomics	Temasek; Ireland; Sequoia; Yunfeng, Polaris, Arch	Series C	Operates a gene sequencing platform.
Mar-18	Helix	200	Clinical Genomics	Draper Fisher Jurvetson; Warburg Pincus; Kleiner Perkins Caufield & Byers; Sutter Hill; Illumina; Temasek; Mayo Clinic	Series B	Owns and operates an online marketplace for deoxyribonucleic acid (DNA) powered products.
Jun-19	freenome	160	Clinical Genomics	Polaris; Kaiser Permanente; Perceptive; Roche; T. Rowe Price; RA Capital; GV; Andreessen Horowitz; Data Collective; Verily; Section 32; American Cancer Society	Series B	Provides a medical artificial intelligence platform that detects cancer at its earliest stages and helps clinicians optimize the next generation of precision therapies.

Source: Capital IQ, Crunchbase

Most Active Investors (2016 – YTD)

Investor	Number of Investments	Investments
Illumina	11	23andMe, Celldom, Desktop Genetics, GRAIL, Helix OpCo, Human Longevity, Trace Genomics, Vitagene, Kallyope, Encoded Therapeutics, Biome Makers
GV	7	23andMe, Benson Hill Biosystems, DNAnexus, Freenome, Genomics Medicine Ireland, GRAIL, Cambridge Epigenetix
polarispartners	5	Freenome, Genomics Medicine Ireland, AgBiome, Arivale, WuXi NextCODE
ARCH Venture Partners	4	AgBiome, Arivale, Genomics Medicine Ireland, GRAIL
ALEXANDRIA	4	Benson Hill Biosystems, Epic Sciences, GenePeeks, Synthego
DCVC Data Collective	3	Cofactor Genomics, Freenome, Karius
Fidelity Investments	3	10x Genomics, AgBiome, 23andMe
Foresite Capital	3	10x Genomics, DNAnexus, Genomics PLC
Johnson & Johnson	3	GRAIL, Inivata, Binx
GE Ventures	3	Human Longevity, Veracyte, Raindance Technologies

Source: Capital IQ, Crunchbase

Top Funded Companies

Company	Total Funding ($M)	Sector	Lead / Majority Investors	Business Description
ancestry.com	$4,233	Sequence Analytics	EPIC, GIC; Spectrum; Amerindo; Silver Lake; AOL; Compaq; Pivotal Group	Provides online family history and personal DNA testing services for subscribers worldwide.
GRAIL	1,600	Clinical Genomics	ARCH; Hillhouse; 6 Dimensions; Ally Bridge; Illunina; HuangPu River	Conducts medical research for developing a blood screening test for early detection of cancer.
23andMe	791	Sequence Analytics	Sequioa; National Institues of Health; Johnson & Johnson; Google; GlaxoSmithKline	Offers information and tools for individuals to learn about and explore their DNA.
GUARDANT	778	Sequence Analytics	Lightspeed, Khosla, OrbiMed, Softbank	Provides blood tests, data sets, and analytics in the United States and internationally.
Oxford NANOPORE technologies	771	Sequence Analytics	IP Group; Woodford; Illumina; GT Healthcare; Amgen	Develops and commercializes nanopore-based electronic systems for analysis of single molecules.
WuXiNextCODE	440	Clinical Genomics	Sequoia, Temasek, YF, Ireland Strategic, Arch, Polaris	Operates a gene sequencing platform.
PACBIO®	355	Sequence Analytics	Intel; Maverick; Deerfield	Designs, develops, and manufactures sequencing systems to resolve genetically complex problems.
Helix	300	Clinical Genomics	DFJ Growth	Provides information on personal genomics and connects people with insights into their own DNA.
HUMAN LONGEVITY, INC.	300	Clinical Genomics	Illumina	Operates as a genomics-powered health intelligence company. The company combines its database of genomic and phenotypic data with machine learning to drive discoveries and the practice of medicine.
NantOmics	251	Clinical Genomics	NantHealth	Develops molecular profiling solutions that identify personalized treatment options for cancer patients and their providers at the point of care.

Source: Capital IQ, Crunchbase

Mergers & Acquisitions 2016 – YTD 2019

M&A Transactions

Date	Target	Acquirer	Size ($M)	TTM Rev	EV / Rev	Target Description
Aug-19	GSL Biotech (dba SnapGene)	Insightful Sciences	ND	ND	ND	Provides SnapGene computer-programming services for biotechnology solutions.
Apr-19	HudsonAlpha Institute for Biotechnology (Ploid business)	DC BLOX	ND	ND	ND	Provides storage infrastructure-as-a-service (IaaS) for independent research institutions, life sciences and genomic sequencing organizations.
Apr-19	Biomatters [aka Geneious]	Insightful Sciences	ND	ND	ND	Provides molecular sequence data analysis software for the biopharmaceutical, biotechnology, academic and government industries globally. Software includes features for genomic data analysis, mapping, and visualization.
Apr-19	Custodix	TriNetX	ND	ND	ND	Develops and provides data protection platform and solutions for eHealth.
Mar-19	SimplicityBio	Precision for Medicine	ND	ND	ND	Develops machine-learning-based software designed to analyze biological, clinical, and digital data streams to extract knowledge and insights for use in drug development.
Dec-18	Spatial Transcriptomics	10x Genomics	ND	ND	ND	Develops technology to analyze tissue samples and gene expression data in two dimensions.
Nov-18	Genomics Medicine Ireland	WuXi Nextcode Genomics	ND	ND	ND	Curates and maintains genomics database.
Nov-18	Pacific Biosciences of Californi	Illumina	$1,166	$84	$0	Designs, develops, and manufactures sequencing systems to resolve genetically complex problems.
Oct-18	Intrexon Bioinformatics Germany	Intrexon Corporation	ND	ND	ND	Develops software technologies to analyze and interpret genomic data.
Aug-18	Epinomics	10x Genomics	$22	ND	ND	Decodes the programming of human genome to drive personalized medicine leveraging big data analytics and epigenomics technology.
Aug-18	NuGEN Technologies	Tecan Group	$55	ND	ND	Provides a portfolio of technologies to address microarray and NGS applications.
Jun-18	HumanCode	Helix OpCo	ND	ND	ND	Provides direct-to-consumer genetic analysis via mobile apps. Apps enable users to obtain insights from their DNA sequence, in areas such as appearance, sleep, diet, ancestry, athletics and intellect.
Jun-18	Interactive Biosoftware	SOPHiA GENETICS	ND	ND	ND	Develops software applications for human genetics field to clinical and research scientists worldwide.
Jun-18	TPG Biologics	Lumosa Therapeutics	$29	ND	ND	Provides gene construction and transfection, antibody humanization, cell line generation, scalable process development, and protein production and purification services.

Source: 451 Research, Capital IQ, Crunchbase

M&A Transactions (Cont'd)

Date	Target	Acquirer	Size ($M)	TTM Rev	EV / Rev	Target Description
May-18	Edico Genome	Illumina	$100	$8	$0	Provides next-generation sequencing (NGS) and data analysis SaaS for the life sciences and healthcare industry.
May-18	Genohm SA	Agilent Technologies	ND	ND	ND	Provides laboratory management SaaS for research and clinical-focused markets.
Apr-18	DNAFit	Prenetics Limited	$10	ND	ND	Manufactures and sells tests kits designed to determine a person's suitability to different diets and exercise regimes.
Mar-18	IntegenX	Thermo Fisher Scientific	$65	ND	ND	Develops human DNA identification solutions.
Mar-18	Integrated DNA Technologies	Danaher Corporation	$2,000	$260	$0	Integrated DNA Technologies, Inc. develops, manufactures, and supplies custom oligonucleotides for the research and diagnostics life science market.
Sep-17	Metabolomic Discoveries	Metabolon	ND	ND	ND	Provides mass spectrometry based metabolite profiling and fingerprinting services for biological materials.
Aug-17	Curoverse	Veritas Genetics	ND	ND	ND	Provides open source, AI-based biomedical data analysis software and SaaS for the medical sector.
Jul-17	CAD4Bio	BGene Genetics	ND	ND	ND	Designs and develops genomic design software for molecular biology.
May-17	Cirina	GRAIL	ND	ND	ND	Develops products that detect cancer at its earliest stages and empower clients to take action.
Apr-17	Genos Research	NantOmics	ND	ND	ND	Provides DNA sequencing solutions.
Feb-17	GeneWorks (Manufacturing business)	Integrated DNA Technologies	ND	ND	ND	Provides oligonucleotide manufacturing services.
Jan-17	Spiral Genetics	Fabric Genomics	ND	ND	ND	Develops analysis software for the detection of genomic structural variants from nextNDgeneration sequencing data.
Jan-17	GenoSpace	Sarah Cannon Research Institute	ND	ND	ND	Provides decision support and reporting tools to clinical labs and health care providers.
Jan-17	Omicsoft Corporation	QIAGEN	ND	ND	ND	Provides bioinformatics data management software for pharmaceuticals and biotechnology companies and academic researchers. Software features include data management, analytics and data visualization.

Source: 451 Research, Capital IQ, Crunchbase

M&A Transactions (Cont'd)

Date	Target	Acquirer	Size ($M)	TTM Rev	EV / Rev	Target Description
Oct-16	Tute Genomics	PierianDx	ND	ND	ND	Develops a cloud based application that delivers genomic insights to genetics research, clinicians, and medical practitioners.
Oct-16	GQ Life Sciences	Aptean	ND	ND	ND	Operates a life science information and search company.
Jun-16	ValueGene	Integrated DNA Technologies	ND	ND	ND	Provides gene discovery services.
Jun-16	Mbiotech	Integrated DNA Technologies	ND	ND	ND	Manufactures and markets molecular biology reagents, kits, consumables, and laboratory equipment.
Mar-16	Adorial	C4X Discovery Holdings	2,357	ND	ND	Provides virtual drug discovery and genetic analysis software and related pharmacological and genomics consulting services.
Feb-16	Narus Biotechnologies	Cofactor Genomics	ND	ND	ND	Develops molecular diagnostics solutions to treat neurological diseases.
Feb-16	Lifecode	MedGenome Labs Private	ND	ND	ND	Operates as a nextNDgenerationNDsequencing (NGS) based molecular diagnostics company.
Jan-16	Conexio Genomics	Illumina	ND	ND	ND	Develops genetic sequencing and mutation detection products and services.
	MEDIAN:		**$43**			
	AVERAGE:		**$253**			

Source: 451 Research, Capital IQ, Crunchbase

Private Placements 2016 – YTD 2019

For investments of $5M and above

Private Placement Transactions

Date	Target	Round	Size ($M)	Investors	Target Description
Jun-19	Freenome	Series B	$160	Polaris; RA; Andreessen Horowitz; Section 32	Develops and provides a medical artificial intelligence platform that detects cancer at its earliest stages and helps clinicians optimize the next generation of precision therapies.
May-19	Benson Hill Biosystems	Growth	$33	ND	Designs and develops a community-based crop design platform to tap natural genetic diversity of plants.
Mar-19	TriNetX	Series D	$40	MPM; Mitsui; ITOCHU; Deerfield; F2; ITOCHU; Merck Global	Provides clinical research and enables discoveries by creating real-world evidence.
Feb-19	DNAnexus	Growth	$68	Claremont Creek; GV; TPG Biotech; Foresite; WuXi Nextcode Genomics; Innovatus	Provides cloud-based genome informatics and data management tools for enterprises and organizations that are engaged in the development and delivery of genomic medicine.
Jan-19	SOPHiA GENETICS	Series E	$77	Idinvest; Generation; Balderton; Alychlo	Provides data analytics solutions to support healthcare professionals in diagnosing and treating patients around the world.
Dec-18	TOMA Biosciences	Series C	$7	Keiretsu	Develops reagent kits that enable laboratories and researchers to uncover genomic changes in tumors.
Nov-18	WuXi Nextcode Genomics	Series C	$200	Temasek Holdings; Ireland Strategic Investment Fund; Sequoia; Yunfeng	Operates gene sequencing platform.
Oct-18	Synthego	Series C	$110	Menlo; Founders Fund; Eight	Designs and builds software and hardware solutions for building automated smart research facilities.
Oct-18	Personal Genome Diagnostics	Growth	$42	Innovatus	Engages in the patient-specific analyses of cancer genome using digital characterization and monitoring technologies.
Sep-18	Epic Sciences	Series E	$52	Domain; Varian Medical Systems; Genomic Health; Deerfield; Blue Ox Healthcare; Sabby Management; Alexandria Investments; VI; Altos	Develops highly sensitive tests to identify and molecularly characterize circulating tumor cells through a minimally invasive blood sample.
Aug-18	Inivata	Series B	$52	Johnson & Johnson; IP Group; Woodford; Cambridge Innovation; Woodford; Rohit Thakur	Operates as a clinical cancer genomics company in the United Kingdom.
Aug-18	Genomics	Series B	$41	Vertex Pharmaceuticals; Top Technology; Invesco Perpetual; IP Group; Lansdowne; Foresite ; Woodford; F-Prime; Oxford Sciences Innovation; Tamorer	Develops algorithms and software solutions that focus on cancer, microbes, and rare diseases.
Aug-18	Metabolon	Growth	$7	ND	Develops platforms and informatics that deliver biomarker discoveries, diagnostic tests, breakthroughs in precision medicine, and hips in genomics-based health initiatives.
Aug-18	Benson Hill Biosystems	Series C	$65	Prolog; Mercury Fund; GV; Collaborative Fund; Fall Line; Alexandria Investments; iSelect Fund Management; Activant Group; Prelude; S2G; Tao; Lewis & Clark	Designs and develops a community-based crop design platform to tap natural genetic diversity of plants.

Source: Capital IQ, Crunchbase

Private Placement Transactions (Cont'd)

Date	Target	Round	Size ($M)	Investors	Target Description
Jul-18	23andMe	Series F	$300	GlaxoSmithKline	Operates as a personal genetics company that provides DNA analysis services.
Jul-18	Quantapore	Series C	$16	Northern Light; Shenzhen Sangel; Baidu	Engages in developing a nanopore based nucleic acid sequencing technology.
Jul-18	Phosphorus	ND	$10	ND	Develops a genomic data network that helps providers, researchers, and patients understand the human genome.
Jun-18	Clinical Genomics .	Growth	$26	Quest Diagnostics; Oneventures; Moelis Australia Asset Management	Develops, sells, and markets products for colorectal cancer (CRC) diagnosis.
May-18	Trace Genomics	Series A	$23	Viking Global; Stage 1; AgFunder; S2G	Provides molecular assay for soil-borne pathogens that enables detection of pathogens and beneficial organisms.
May-18	AgBiome	Series C	$65	Arch; Polaris; University of Texas; Fidelity; Bayer Growth; Innotech; Pontifax Agtech	Engages in delivering research and discovery to the agriculture industry.
May-18	Genoox.	ND	$6	Tris; Glilot; Inimiti	Develops and provides a cloud based big data platform for storing and managing genomic data.
May-18	GRAIL	Series C	$300	Hillhouse; Sequoia; Blue Pool; Industrial and Commercial Bank of China; CRF; Ally Bridge; WuXi Nextcode; 6 Dimensions; China Merchants Securities; Huangpu River	Conducts medical research for developing a blood screening test for early detection of cancer.
Apr-18	10x Genomics (NasdaqGS:TXG)	Series D	$85	MeriTech; Paladin; SoftBank; Fidelity; Wells Fargo	Develops and sells instruments, consumables, and software for analyzing biological systems.
Mar-18	Singlera Genomics	Series A	$60	Lilly Asia; Jointown Pharmaceutical; Green Pine; UCF Group; Shanghai Prosperico	Provides genetic testing services for diagnosing genetic diseases and disorders.
Mar-18	Genoox.	ND	$6	Glilot	Develops and provides a cloud based big data platform for storing and managing genomic data.
Mar-18	Oxford Nanopore Technologies	Growth	$140	GIC Special Investments; CCB; Host-Plus Pty	Develops and commercializes nanopore-based electronic systems for analysis of single molecules.
Mar-18	Helix OpCo	Series B	$200	Threshold; Warburg Pincus; Kleiner Perkins Caufield & Byers; Sutter Hill; Illumina; Temasek; Mayo Clinic	Owns and operates an online marketplace for deoxyribonucleic acid (DNA) powered products.
Jan-18	DNAnexus	Growth	$58	Microsoft; Claremont Creek; MidCap; GV; TPG Biotech; Foresite Management; WuXi Nextcode	Provides cloud-based genome informatics and data management tools for enterprises and organizations that are engaged in the development and delivery of genomic medicine.

Source: Capital IQ, Crunchbase

Private Placement Transactions (Cont'd)

Date	Target	Round	Size ($M)	Investors	Target Description
Dec-17	Stratos Genomics	Growth	$20	Fisk	Develops Sequencing By Expansion, a single-molecule detection process that circumvents the limitations of competing technologies and allows whole genome sequencing.
Dec-17	GenapSys	Series C	$33	ND	Develops DNA sequencing technologies, systems for applied genomic testing, and medical sequencing.
Oct-17	Prenetics	Series B	$40	Gobi; eGarden; MFund; Yuantai Investment; Beyond	Specializes in pharmacogenomics.
Oct-17	Personal Genome Diagnostics	Series B	$75	New Enterprise; Bristol-Myers Squibb; Maryland Ventures; Windham; Helsinn; Inova	Engages in the patient-specific analyses of cancer genome using digital characterization and monitoring technologies.
Sep-17	Deep Genomics	Series A	$13	Khosla; True	Develops an artificial intelligence-powered discovery platform that supports geneticists, molecular biologists, chemists, toxicologists, and drug developers in the identification and development of genetic
Sep-17	SOPHiA GENETICS	Series D	$30	360°; Balderton; Alychlo NV; Invoke	Provides data analytics solutions to support healthcare professionals in diagnosing and treating patients around the world.
Aug-17	23andMe	Series F	$250	Sequoia; Fidelity; The Knut and Alice Wallenberg Foundation; Altimeter Management; Casdin; Euclidean	Operates as a personal genetics company that provides DNA analysis services.
Aug-17	MedGenome Labs Private .	Series C	$40	Housing Development Finance Corporation; Sequoia; Sofina Société Anonyme; HDFC; Zodius Advisors	Provides molecular genetic diagnostic tests using Sanger sequencing and next generation sequencing technologies for personalized healthcare.
Aug-17	Karius	Series A	$50	Lightspeed; Khosla; Innovation Endeavors; Tencent; Data Collective; s28	Operates as a life sciences company.
Aug-17	Color Genomics	Series C	$89	Charles River; General Catalyst; Emerson Collective	Offers genetic testing services to help people understand their risk for health conditions and medication responses.
Jul-17	Blueprint Genetics	ND	$16	Creathor, Inventure, MTIP AG	Provides clinical genetics testing followed by blueprint and customized next-generation sequencing services.
Jul-17	Genoox.	Series A	$6	Glilot; Inimiti	Develops and provides a cloud based big data platform for storing and managing genomic data.
Jun-17	BaseHealth	Series C	$9	HBM Healthcare Investments; HBM	Provides a health management platform for physicians and their patients.
Jun-17	Hexagon Bio	Seed	$8	ND	Engages in mining genomic data from fungal genomes to identify novel drugs for diseases with unmet needs.

Source: Capital IQ, Crunchbase

Private Placement Transactions (Cont'd)

Date	Target	Round	Size ($M)	Investors	Target Description
Jun-17	Cofactor Genomics	Series A	$18	Menlo; Wilson Sonsini Goodrich & Rosati; WS; Ascension; Y Combinator; Data Collective; iSelect	Engages in the development of circular RNA enrichment kits and reference profiles.
Jun-17	Centogene AG	Series A	$28	TVM; NRW; DPE Deutsche Private Equity; CIC; OstseeSparkasse Rostock; Cares S.A.	Focuses on genetic and biochemical diagnostic testing services for rare hereditary disorders for the medical community in Germany and internationally.
May-17	Arivale	ND	$14	ND	Provides wellness services to individuals.
May-17	FitnessGenes	Series A	$5	ND	Sells DNA testing services online.
May-19	Gaurdant Health	Series E	$360	Softbank	Provides blood tests, data sets, and analytics in the United States and internationally.
May-17	BC Platforms	Series B	$10	Finnish Industry Investment; Debiopharm	Operates a bioinformatics and genome data management platform.
May-17	Edico Genome	Series B	$22	QUALCOMM; Moore; Dell Technologies	Develops bioinformatics processor chip that helps in DNA analysis.
May-17	WuXi Nextcode Genomics	Series B	$240	Temasek; Amgen; Sequoia; Yunfeng; 3W	Operates gene sequencing platform.
Apr-17	Epic Sciences	Series D	$40	Domain Associates; Genomic Health; Sabby Management; RMI; Hermed; Pagoda; VI; Altos; Reach Tone	Develops highly sensitive tests to identify and molecularly characterize circulating tumor cells through a minimally invasive blood sample.
Mar-17	Benson Hill Biosystems	Series B	$25	Prolog; Mercury; Fall Line; Cultivation; Alexandria; Middleland; Missouri Technology Corporation; iSelect; Prelude; S2G; Lewis & Clark; Technology Acceleration	Designs and develops a community-based crop design platform to tap natural genetic diversity of plants.
Feb-17	GRAIL	Series B	$1,212	Amazon; Arch; Bristol-Myers Squibb; Celgene; Merck; Varian Medical Systems; Tencent; McKesson; Johnson & Johnson	Conducts medical research for developing a blood screening test for early detection of cancer.
Feb-17	Congenica .	Series B	$30	Amadeus; Parkwalk; Cambridge Innovation; BGI Genomics; Future Planet; Healthlink; Digital China Health Technologies	Develops and operates clinical data solutions for genetic diagnosis worldwide.
Feb-17	Freenome	Series A	$72	Charles River; Polaris; Allen & Company; Founders Fund; GV; Andreessen Horowitz; Innovation Endeavors; Data Collective; AME Cloud; Verily; s28; Section 32	Develops and provides a medical artificial intelligence platform that detects cancer at its earliest stages and helps clinicians optimize the next generation of precision therapies.
Dec-16	GenePeeks	Series B	$16	Alta; 5AM; Alexandria Investments; Columbus Nova Technology	Develops a software that provides genetic information to reduce the risk of heritable diseases.

Source: Capital IQ, Crunchbase

Private Placement Transactions (Cont'd)

Date	Target	Round	Size ($M)	Investors	Target Description
Dec-16	Synthego Corp	Series B	$41	Menlo; WI Harper; Founders Fund; ZhenFund; Alexandria Equities; AME Cloud; Eight; Elements; OS Fund; SciFi VC	Designs and builds software and hardware solutions for building automated smart research facilities.
Dec-16	Oxford Nanopore Technologies	Growth	$127	IP Group; Woodford Investment Management; GT Healthcare	Develops and commercializes nanopore-based electronic systems for analysis of single molecules.
Nov-16	uBiome	Series B	$20	StartX; Slow; Eight; Stanford University	Develops sequencing-based clinical microbiome tests.
Sep-16	Genomics Medicine Ireland	Series A	$51	Arch; Maveron; Polaris; Ireland Strategic Investment Fund; GV	Curates and maintains genomics database.
Sep-16	GenePeeks	ND	$10	ND	Develops a software that provides genetic information to reduce the risk of heritable diseases by simulating the genetic reduction and recombination by digitally weaving together the DNA of prospective
Aug-16	Singlera Genomics	Series A	$20	Lilly Asia; Green Pine; CD	Provides genetic testing services for diagnosing genetic diseases and disorders.
Aug-16	Color Genomics	Series B	$45	General Catalyst; Khosla; Formation8; Emerson Collective	Offers genetic testing services to help people understand their risk for health conditions and medication responses.
Aug-16	Metabolon	Growth	$30	EW Healthcare	Develops platforms and informatics that deliver biomarker discoveries, diagnostic tests, breakthroughs in precision medicine, and hips in genomics-based health initiatives.
Jul-16	Phosphorus	Series A	$10	FirstMark	Develops a genomic data network that helps providers, researchers, and patients understand the human genome.
Jun-16	Fabric Genomics	Series B	$23	Roche; Acadia Woods; Ping An; Buchanan; ARTIS; UPMC Enterprises; LDV	Develops scalable and integrated informatics systems to interpret human genome sequences for research and clinical applications.
Jun-16	Chronix Biomedical	Growth	$5	ND	Designs and manufactures laboratory-developed tests, which are blood tests (liquid biopsy tests) for cancer and organ transplants.
Jun-16	AccuraGen	Series B	$40	StartX; Decheng; Junson	Develops sequencing-based cancer-mutation detection systems.
May-16	Freenome	Seed	$6	Founders Fund; Andreessen Horowitz; Data Collective; Third Kind	Develops and provides a medical artificial intelligence platform that detects cancer at its earliest stages and helps clinicians optimize the next generation of precision therapies.
May-16	ACT Genomics Co..	Series B	$13	Hotung Investment Holdings; President International Development; Huanan; UMC; Eminent II; CDIB	Provides a technology to transform cancer genomic information into precision diagnosis and personalized treatments.

Source: Capital IQ, Crunchbase

Private Placement Transactions (Cont'd)

Date	Target	Round	Size ($M)	Investors	Target Description
May-16	uBiome	ND	$17	ND	Develops sequencing-based clinical microbiome tests.
Apr-16	Human Longevity	Series B	$220	Illumina; Celgene Cellular Therapeutics; GE	Operates as a genomics-powered health intelligence company.
Mar-16	Bluebee Holding B.V.	Series A	$11	Capricorn; Korys Investments; Buysse; Biover	Develops cloud-based accelerated genomics analysis platform that enables processing of sequencing data.
Mar-16	Clinical Genomics	Series A	$15	Onevenures Pty Ltd	Develops, sells, and markets products for colorectal cancer (CRC) diagnosis.
Mar-16	10x Genomics	Series C	$55	VR Adviser; Paladin; SoftBank; Fidelity; Foresite; JS	Develops and sells instruments, consumables, and software for analyzing biological systems.
Mar-16	Prenetics	Series A	$10	500 Startups; Union Investments; Ping An; Coent; Venturra	Specializes in pharmacogenomics.
Feb-16	Seven Bridges Genomics	Series A	$45	ND	Operates as a biomedical data company.
Feb-16	Vitagene	Seed	$5	Viking Global; s28	Leverages technology and genomic science to offer physicians a platform for personalized data-driven care.
Jan-16	Inivata	Series A	$45	Johnson & Johnson; Touchstone; Cambridge; Woodford; Woodford	Operates as a clinical cancer genomics company in the United Kingdom.
Jan-16	PierianDx	Series A	$9	ARUP Laboratories; Meyer; Inova Health System; Health Catalyst	Develops a platform to manage, analyze, and interpret complex genomic tests for clinical laboratories across the United States.
Jan-16	Pathway Genomics Corporation	Series E	$40	IBM Watson	Operates a clinical laboratory to provide commercial genetic testing services to physicians and their patients in the United States and internationally.
	MEDIAN:		**$33**		
	AVERAGE:		**$72**		

Source: Capital IQ, Crunchbase

About AGC Partners

AGC's Dedicated Genomics Software Team

Hugh Hoffman
Partner

- Hugh is a partner in the Investment Banking Group at AGC Partners, focusing on Life Sciences Technology and HCIT out of the firm's Minneapolis office
- Hugh is a 25-year technology M&A veteran who ran Piper Jaffray's M&A practice in Software and Services for more than 8 years before joining Craig-Hallum Capital Group in 2006, where he led their M&A practice
- He has completed more than 150 transactions during his career and has worked at Dain Rauscher Corporation, where he started the firm's software practice, and Dillon, Read and Co. Inc. in New York and London
- He received an M.B.A. from Harvard Business School and graduated Summa Cum Laude from the University of Denver

Benjamin Howe
Co-Founder, CEO

- Ben is a co-founder and the CEO of AGC Partners
- In 30+ years as an investment banker, Ben has completed more than 300 transactions
- Prior to AGC, he served as Managing Director, Head of M&A and Executive Committee Member at SG Cowen Securities, and prior to that served as Head of Technology Investment Banking for the East Coast and Europe at Montgomery Securities
- He serves as co-chairman of Excel Academy, which has four charter schools in East Boston, and served on the board of Portsmouth Abbey and the advisory board of Trinity College
- He holds a B.A. in Economics from Trinity College and an M.S. in Accounting from The Stern School of Business at NYU

Bob Renner
Partner

- Bob is a seasoned entrepreneur, initially serving as CTO followed by over 16 years as CEO and President of Liaison Technologies, a company which he founded
- While at Liaison, Bob directed all aspects of corporate financing and operations, overall strategy and acquisitions globally, and completed 11 buyside transactions and 3 capital raises.
- In 2018, he guided the company to its successful $310 million exit to a strategic buyer, Canada's largest software company, OpenText Corporation.
- Bob earned his M.B.A. from Emory University and his B.S. in Electrical Engineering from California State University at Fullerton.

Greg Roth
Partner

- Greg brings over 20 years of experience working as an investment banker and principal investor, and has completed over 100 transactions with an aggregate transaction value exceeding $30 billion
- Greg primarily focuses on Enterprise Software, Infrastructure Software and Digital Media/Internet sectors
- Previously, Greg spent the bulk of his career with Credit Suisse First Boston, ThinkEquity, and Montgomery Securities
- He holds an M.B.A. from The Wharton School of Business and an undergraduate degree from Brown University

Tristan Snyder
Partner

- Tristan is a Partner in AGC's Dallas office
- He has over 13 years of sector-specific investment banking experience, including tech-enabled services, SaaS, and cloud technologies
- Tristan has completed more than 45 M&A and capital raising transactions, totaling more than $4 billion in enterprise value
- Prior to AGC, he was Co-Head of Intrepid Investment Bankers' software and services practice
- He holds a B.A. in Business Admin & Finance from the University of Washington

AGCPARTNERS

2003
Founded

384
Transactions

10
Offices Globally

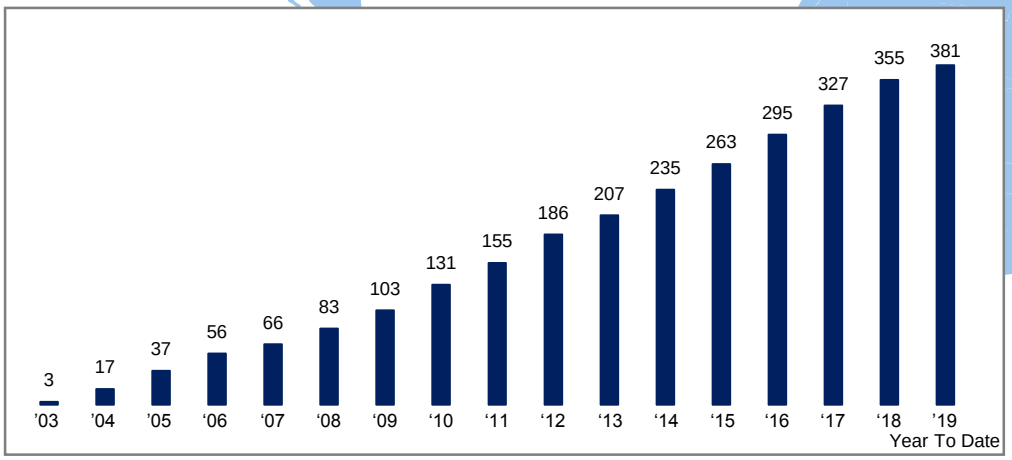
79
Cross-Border Transactions

3
Major Conferences

Global Leader in Tech Advisory – 384 Closed Deals

- AGC is consistently ranked as the most active pure-play tech boutique
- Plugged into every facet of the private tech capital markets with over 50 active engagements today
- Headquartered in Boston with offices in Atlanta, Austin, Chicago, Dallas, London, Los Angeles, Minneapolis, New York and Silicon Valley

AGC Cumulative Deal Count



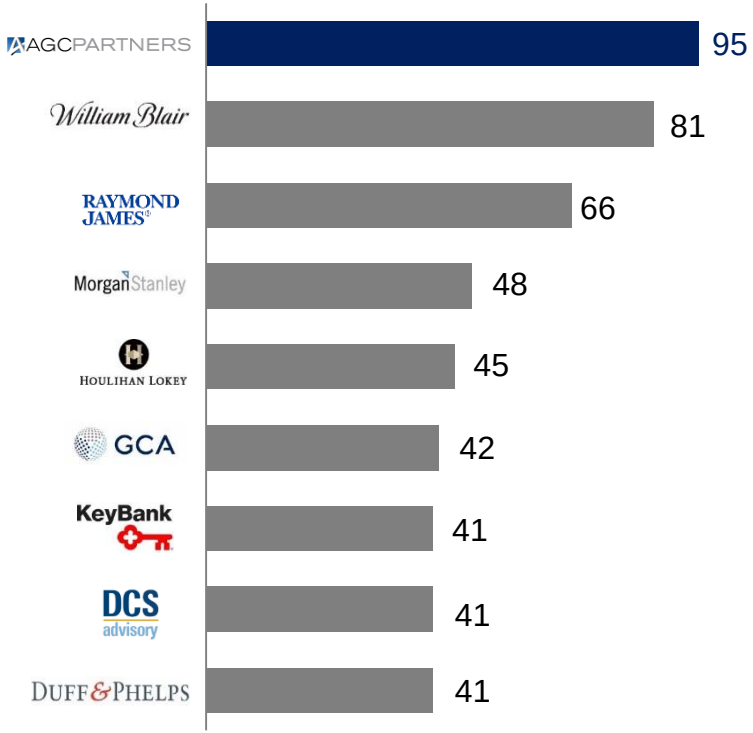
TOP DEALMAKERS (2014-2018)

	Firm	# Trans.
1.	Morgan Stanley	179
2.	Raymond James	150
3.	William Blair	150
4.	Houlihan Lokey	129
5.	J.P. Morgan Securities	124
6.	**AGC Partners**	**120**
7.	Evercore Partners	119
8.	GCA Advisors	117
9.	Goldman Sachs	113
10.	Jefferies	92
11.	Lazard	79
12.	Petsky Prunier	79
13.	Mooreland Partners	78
14.	DCS Advisory	77
15.	Pagemill Duff & Phelps	74
16.	Bank of America Merrill Lynch	73
17.	Robert W. Baird	70
18.	Qatalyst Partners	69
19.	Arma Partners	68
20.	GP Bullhound	68
21.	KeyBanc Capital Markets	62
22.	Credit Suisse Securities	60
23.	Stifel, Nicolaus & Company	60
24.	Needham & Company	59
25.	Barclays Capital	53

Source: 451 Research

AGC is the Leading SaaS Investment Bank

451 Ranking of SaaS Advisory 2010 to 2019



Source: 451 Research

- **Over 95 SaaS transactions: we know what PE/Strategic firms need to make investment decisions**
- **AGC is proactive, versus reactive: we've fine-tuned an 18 step program that is completed at the beginning of every process, designed to:**
  - **Anticipate what the PE/Strategic commitment committee will need at the very outset**
  - **Enable fast decision-making and reduce follow on data requests**
  - **Ensure that bids incorporate what PE/Strategic firms typically look for late in diligence, reducing the risk of a re-trade or a cancelled bid**
  - **Help management save time by getting a deal done quickly, and maintain focus on driving business growth**

AGC's Strong Commitment to Life Sciences Tech and HCIT

SnapGene® sold to GraphPad a portfolio company of INSIGHT PARTNERS

SIKKA received a minority investment

Bernoulli® sold to capsule

Bernoulli® has been invested in by Strategic Investor

BLUE WILLOW Systems sold to PHILIPS

LIAISON has been acquired by opentext™

VIDISTAR® sold to HITACHI Inspire the Next

CUROVERSE sold to Veritas The Genome Company

PRIMORDIAL has been acquired by NUANCE

HealthWyse has been acquired by casamba

AVENTURA Situational Awareness sold to PHILIPS

HEALTH eCAREERS a wholly owned subsidiary of DHI sold to everyday HEALTH a subsidiary of j2 Global

TWSG The White Stone Group has been acquired by MEA NEA ACCEL KKR

QUMAS sold to accelrys®

Quantia has been acquired by pi Physicians Interactive Medicine in the Moment

greenphire has been invested in by Riverside

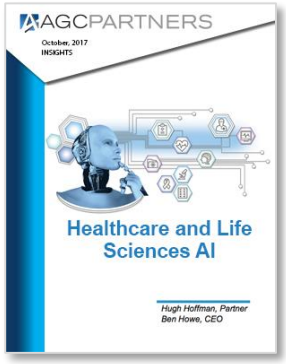
harmony has been acquired by Mediware®

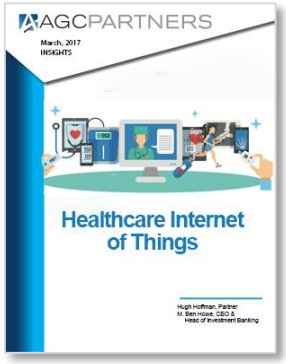
accelarad has been acquired by NUANCE

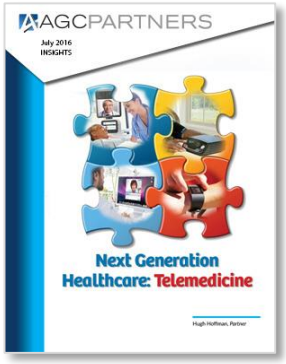
Qforma sold to SkilaMederi

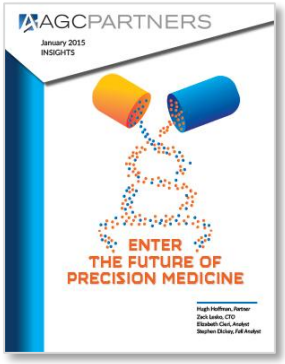
acuo TECHNOLOGIES has been acquired by LEXMARK

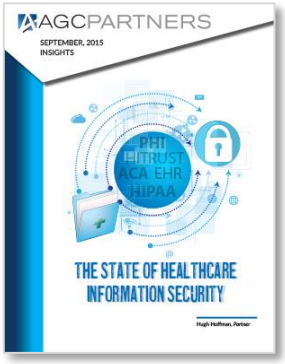
Recent Industry Reports





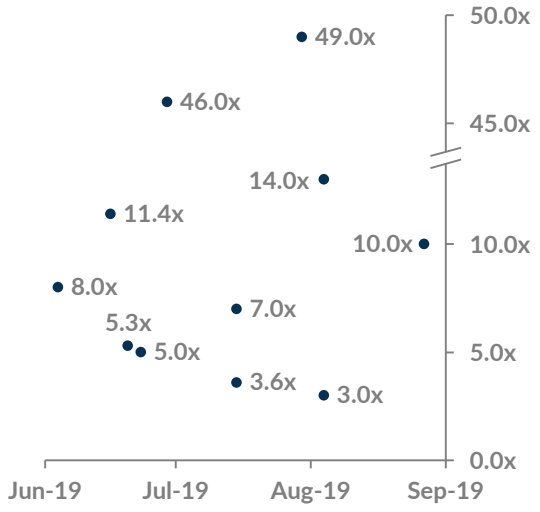






AGC's '19 Summer Momentum - 10 SAAS Deals in 2 Months

Target	Acquirer / PE	Sector
Perceptyx	TCV	HCM
WhiteHat Security	NTT Security	Cybersecurity
distil networks	imperva / THOMABRAVO	Cybersecurity
SnapGene® Software for molecular biology	GraphPad / INSIGHT PARTNERS	HCIT & Life Sciences
SIKKA	Confidential	HCIT & Life Sciences
mnubo	aspentech	IoT Data Analytics
Geezeo	jack henry & ASSOCIATES INC.	FinTech
iFood	AMADEUS®	FoodTech
THOUGHT INDUSTRIES	Luminate CAPITAL PARTNERS	EdTech
SaaS Cloud Access Governance	Identity Governance Provider	Cybersecurity
AllClear ID RRP Assets	experian.	Cybersecurity



Other 2019 Transactions

skuid financed by MARLIN EQUITY	gengo sold to LIONBRIDGE	appsee sold to servicenow	deepwatch financed by ABS CAPITAL PARTNERS	OpusCapita a wholly owned subsidiary of posti sold to PROVIDENCE EQUITY	mautic sold to Acquia	CRITERIA financed by SEP	KEYFACTOR financed by INSIGHT VENTURE PARTNERS	PRESTO Engineering sold to NEW ALPHA ASSET MANAGEMENT	SWIMLANE financed by	SIKKA received a minority investment	SECUREAUTH divested CORE SECURITY in a sale to helpsystems	Bernoulli sold to capsule

AGC Will Lead the Process from Start to Finish

Prepare Key Materials

1. Launch Note
2. Short Teaser Presentation
3. Detailed Company Presentation
4. Information Memorandum
5. 3 Statement Model 2016-2021
6. MRR & ACV Retention Analysis
7. Pipeline Analysis
8. Win-Loss Analysis
9. Market Sizing and Landscape
10. Competitive Analysis

Process Management

1. Contact Key Decision Makers
2. Maintain Process Activity Log
3. Hold Initial Buyer Calls
4. Schedule Management Meetings
5. Coordinate Management Roadshow
6. Provide Buyer M&A Profiles
7. Prepare Monthly Update Packages
8. Prepare Detailed Board Updates
9. Build Buyer Synergy Analysis
10. Manage Virtual Data Room

Negotiation & Closing

1. Bid Letter
2. Due Diligence Presentations
3. Working Capital Review
4. Term Sheet Template
5. Buyer Term Sheet Summaries
6. All Transaction Modeling
7. Term Sheet Negotiations
8. Transaction Agreement Summary
9. Transaction Agreement Negotiations
10. Closing Dinner!

AGC will be a 24/7 partner to it's clients throughout the entire process and carry the workload

The Global Leaders in Tech Strategic Advisory

Rob Buxton
Partner
San Francisco

Eric Davis
Partner
Boston

Linda Gridley
Partner
New York

Jon Guido
COO
Founding Partner
Boston

Hugh Hoffman
Partner
Minneapolis

Ben Howe
CEO
Founding Partner
Boston

Doug Hurst
Partner
New York

Fred Joseph
Partner
Boston

Maria Lewis Kussmaul
Founding Partner
Boston

Elena Marcus
Partner
Los Angeles

Mike Parker
Partner
Chicago

Bob Renner
Partner
Atlanta

Greg Roth
Partner
San Francisco

Dennis Rourke
Partner
Boston

Charlie Schopp
Partner
Boston

Tristan Snyder
Partner
Dallas

Jim Stone
Partner
Austin

Sean Tucker
Partner
London

Russ Workman
Partner
Boston

Longstanding Relationships with PE firms and Strategics

Trusted Advisor of Financial Sponsors

- High volume of successful transactions with and for financial sponsors and their portfolio companies
- Relationships developed over the long term providing AGC access and credibility with key decision-makers
- In depth insights into each financial investor's unique investment criteria, approach and behavior

Trusted Advisor of Strategic Buyers

- Strong relationships and a proven track record with the leading strategic acquirers
- Knowledge of development roadmaps + buy vs build priorities allows us to strategically position businesses to achieve optimal outcomes
- Deep sector expertise ensures unique and customized positioning for each buyer

Leading Private Equity Clients

Tech Giant Strategic Acquirers

AGC's Unrivaled Experience in the PE Marketplace

AGC Engineers High Valuation Outcomes

Majority and Minority Growth Capital

Client	Investor	Revenue Multiple
SS&C	The Carlyle Group	8.0x
certify	K1	6.1x
Titus	Blackstone	4.2x
Zapproved	Vista Equity Partners	8.4x
Saviynt	Carrick Investing more than capital	6.5x
erecruit	Guidepost Growth Equity	6.0x
Arxan	TA Associates	10.0x
Criteria	SEP Sumeru Equity Partners	6.5x
Buildium	SEP Sumeru Equity Partners	5.7x
litmus	Spectrum Equity	6.4x
zscaler	Lightspeed	10.0x

Strategic Acquisitions

Client	Acquirer	Revenue Multiple
Prolexic	Akamai	8.5x
Blue Willow Systems	Philips	15.3x
iSIGHT Partners	FireEye	7.4x
Solutionary	NTT	6.8x
FMCGDirect	Deluxe	5.8x
mnubo	aspentech	ND
L2	Gartner	8.4x
Simplygon	Microsoft	14.5x
Primordial	Nuance	ND
Lieberman Software	Bomgar	4.8x
Boomi	Dell	20.0x

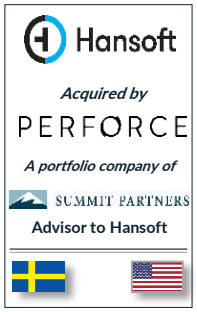
AGC is at the Center of the Private Equity Buy and Build Ecosystem

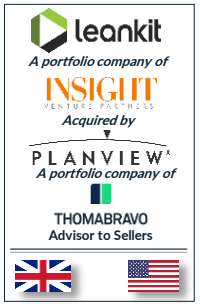
- Buy and Build is the primary driver of valuation creation, typically through 3 add-on acquisitions per platform deal
- There were over 1,500 Private Equity Technology deals in the last 18-months
- 1,000 of those deals were add-on acquisitions, which are ever increasing given the growing base of platform portfolio companies

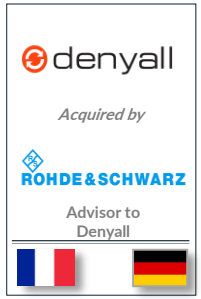
Long History with the Top Strategic Technology Buyers

CASK *Acquired by* Google — Advisor to Cask	LIAISON *A portfolio company of* verdane MERCK *Acquired by* opentext — Advisor to Liaison	L2 *A portfolio company of* GENERAL CATALYST *Acquired by* Gartner — Advisor to Sellers	Geezeo *Acquired by* jack henry & ASSOCIATES INC. — Advisor to Geezeo	WhiteHat SECURITY *A portfolio company of* JMI EQUITY *Acquired by* NTT — Advisor to WhiteHat	UiPath *A portfolio company of* GENERAL CATALYST Guidepost *Acquired by* SAS — Advisor to Sellers	ManageIQ *Acquired by* redhat — Advisor to ManageIQ	appsee *Acquired by* now — Advisor to appsee	BLUE WILLOW Systems *Acquired by* PHILIPS — Advisor to Blue Willow Systems	
LOGFIRE *A portfolio company of* edisonpartners *Acquired by* ORACLE — Advisor to LOGFIRE	CLOUD CRUISER *Acquired by* Hewlett Packard Enterprise — Advisor to Cloud Cruiser	BOOMI *Acquired by* DELL — Advisor to Boomi	HEALTH eCAREERS *A wholly owned subsidiary* DHI *Acquired by* everyday HEALTH *A wholly owned subsidiary* j2 Global — Advisor to Sellers	analytics *Acquired by* nielsen — Advisor to Sellers	harvest.ai *Acquired by* amazon — Advisor to Sellers	Fundamo *Acquired by* VISA — Advisor to Fundamo	LIVE LOOK *Acquired by* ORACLE — Advisor to Sellers	EXTEND MEDIA *Acquired by* CISCO — Advisor to ExtendMedia	
iSIGHTPARTNERS *A portfolio company of* BESSEMER VENTURE PARTNERS *Acquired by* FireEye — Advisor to iSight Partners	bowstreet *Acquired by* IBM — Advisor to Bowstreet	orderTalk *Acquired by* Uber — Advisor to orderTalk	Apteligent *A portfolio company of* GV SCALE Venture Partners *Acquired by* vmware — Advisor to Sellers	active endpoints *Acquired by* Informatica — Advisor to Active Endpoints	CODESHIP *Acquired by* cloudbees — Advisor to Codeship	progenet *Acquired by* TIBCO — Advisor to Proginet	InventionMachine *Acquired by* IHS Markit — Advisor to Invention Machine	Where *Acquired by* ebay — Advisor to Where	

Over 75 Cross-border Transactions Since Inception







Over 800 Private Tech Companies Participate in our Conference Series

	San Francisco	London	Boston	Total
Attendees	1,375	354	600	2,329
Private Companies	485	112	225	822
Investors	343	85	190	618
Strategics	233	26	50	309
Total 1-on-1 Meetings	3,000	915	1,950	5,865

Select Strategic Attendees

amazon
Microsoft
Google
cisco
ORACLE
IBM
now
paloalto NETWORKS

Select Private Equity Attendees

THOMABRAVO
KKR
FP FRANCISCO PARTNERS
TPG GROWTH
MARLIN EQUITY PARTNERS
VISTA EQUITY PARTNERS
Advent International GLOBAL PRIVATE EQUITY
SILVERLAKE
INSIGHT VENTURE PARTNERS
PROVIDENCE EQUITY
Goldman Sachs
Blackstone

What Clients Say About Us

Skuid needed a highly dedicated financial advisor…

"We chose AGC Partners because of their reputation with high-growth software businesses and investors. AGC's understanding of the industry and key players led to Skuid securing a terrific new partner in Marlin for our investors, shareholders, customers and employees."

– Skuid sold to Marlin Equity Partner

We are delighted with the awesomeness…

"We were one united team and AGC worked relentlessly to get a fantastic outcome, that exceeded our initial expectations. Deals are complex, but I took great comfort in knowing [the] team [was] in my court. We started this journey as a client, we end as family"

– Titus sold to Blackstone

AGC was instrumental in helping us navigate this process…

"The AGC team did a great job of understanding the Criteria story and identifying the decision makers at the financial partners whose goals and philosophy were well aligned with ours."

– Criteria sold to Sumeru Equity Partners

I would highly recommend AGC…

"The AGC team had solid subject matter expertise and their approach to our engagement was thoughtful and ultimately produced a very positive outcome for our shareholders, customers, employees and the acquiring business. [The] team played a key role in the timing of the process, the positioning of the business overall and in every stage leading to Closing."

– Liaison sold to OpenText

The AGC Team exceeded expectations…

"AGC's commitment was evident in working seemingly round-the-clock to respond to the dozens of parties involved in the deal. In the end, the board and executive team are very pleased with the outcome and we are now working with an investment partner that will help us scale through the next phase of growth."

– Zapproved sold to Vista Equity Partners

It was a pleasure to have them on our team…

"The AGC team was instrumental in ensuring the success of our transaction. They served as trusted advisors through every step of the process, with intense focus on every detail and proven knowledge of companies and deals like ours."

– Certify sold to K1 Investment Management

Pure Tech-Focused Approach to M&A & Growth Capital Advisory

M&A ADVISORY

Up to $1 billion in valuation

GROWTH CAPITAL

Primary and Secondary minority equity and debt

SECTOR EXPERTS

Deep vertical and horizontal practices

ENGAGED PARTNERS

Partner led engagement teams

HIGH IMPACT TECH FOCUS

Exclusive focus on tech advisory

EXCEPTIONAL OUTCOMES

381 transactions completed to date