# “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations

DEEP KNOWLEDGE ANALYTICS
*PHARMA DIVISION*

www.ai-pharna.dka.global

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# Introduction

Over the last few years, there was a tendency that has shown a decline in the pharmaceutical industry. This is connected to the numerous facts, starting from the R&D inefficiency and ending with the world markets landscape.

Therefore, pharmaceutical companies have a strong interest in improving their positions. For this purpose, they use AI in various areas of their activity, namely, medical image analysis and elaboration of electronic health records (EHRs), building disease ontologies, preclinical drug discovery, and clinical trials. In such conditions, the demand for the ML/AI talent, as well as for ML/AI technologies, is growing in pharmaceutical and healthcare industries and driving the formation of a new interdisciplinary field — data-driven drug discovery/healthcare. This is, undoubtedly, one of the key options for the further development of the pharmaceutical industry.

Progress accelerates at the same time as people with the background in the field of AI occupy leadership positions in top companies. Main market trends are driving the growth in the AI implementation in pharmaceutical and tech research, but the overall success depends strongly on the presence of highly skilled interdisciplinary leaders. They must be able to innovate, organize and guide in this direction.

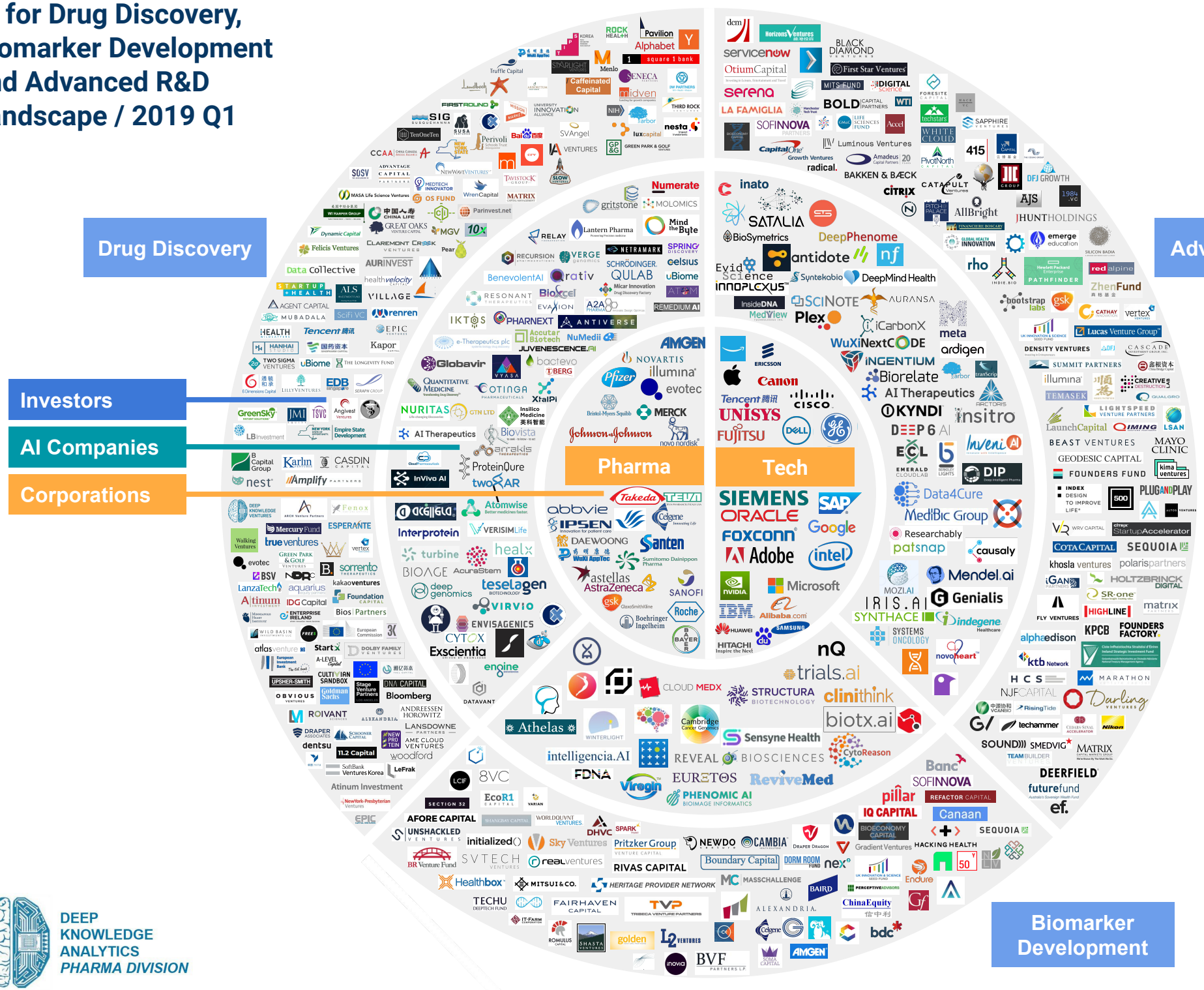
That is why, **the goal of this report** is to identify CEOs and board members, who are driving AI development in pharma and tech industries. This serves as an indicator for the companies, who are committed to using AI in their innovations processes and thus have a potential to improve their market position, comparing to their peers. To this extent, the presence of AI-friendly CEOs and Board members also indicates that the company is focused on increasing its R&D efficiency and thus is more likely to succeed in the drug discovery sector.

**The general mechanism** is as follows:
the decline of the pharmaceutical industry -> need to implement AI -> need for knowledge in the sphere of AI -> occupation of leading positions by people who have qualifications in AI -> accelerating applying of AI -> “restoration” of the pharmaceutical industry.

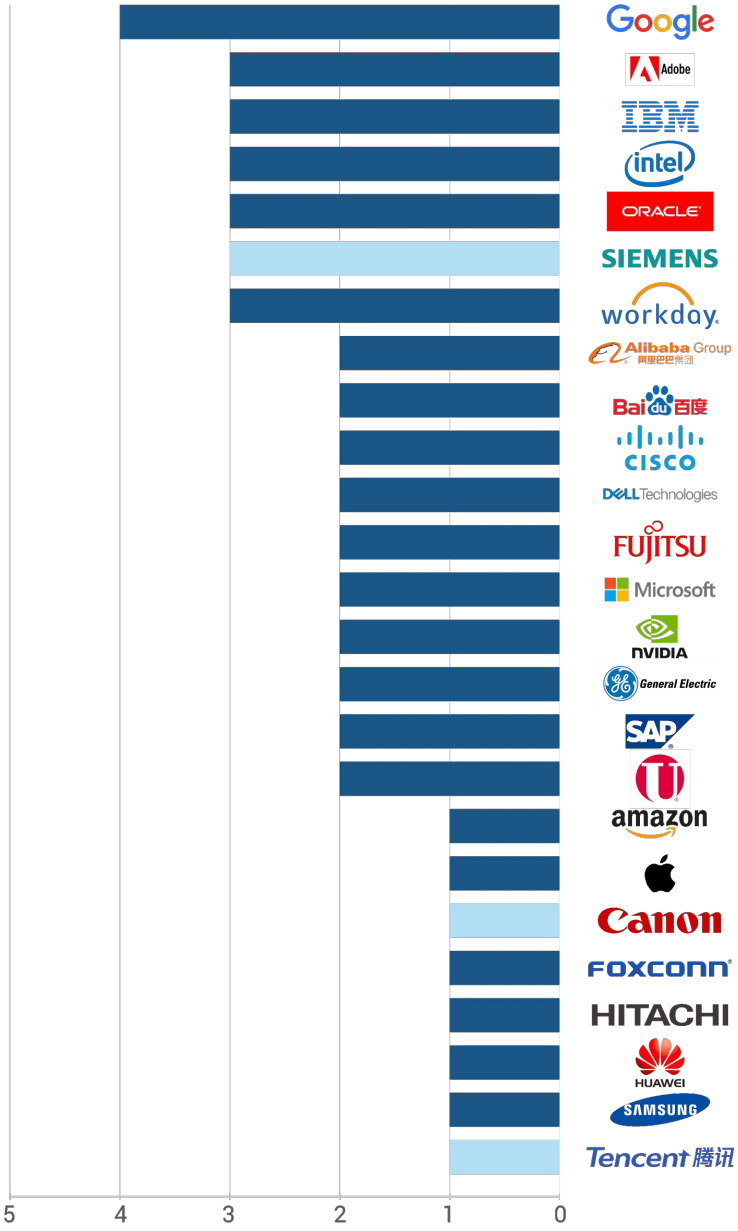
Thus, the relevance of this topic is explained by the need to advance the pharmaceutical industry, and in particular, the healthcare industry. The goal of the report is providing a “bird’s view” on the global leadership scene in the area of adopting AI-driven methods in drug discovery and healthcare to serve as a benchmark tool for indication of the most perspective pharma and tech corporations. Experience of tech corporations applying AI can be crucial in this framework.

# AI for Drug Discovery, Biomarker Development and Advanced R&D Landscape / 2019 Q1

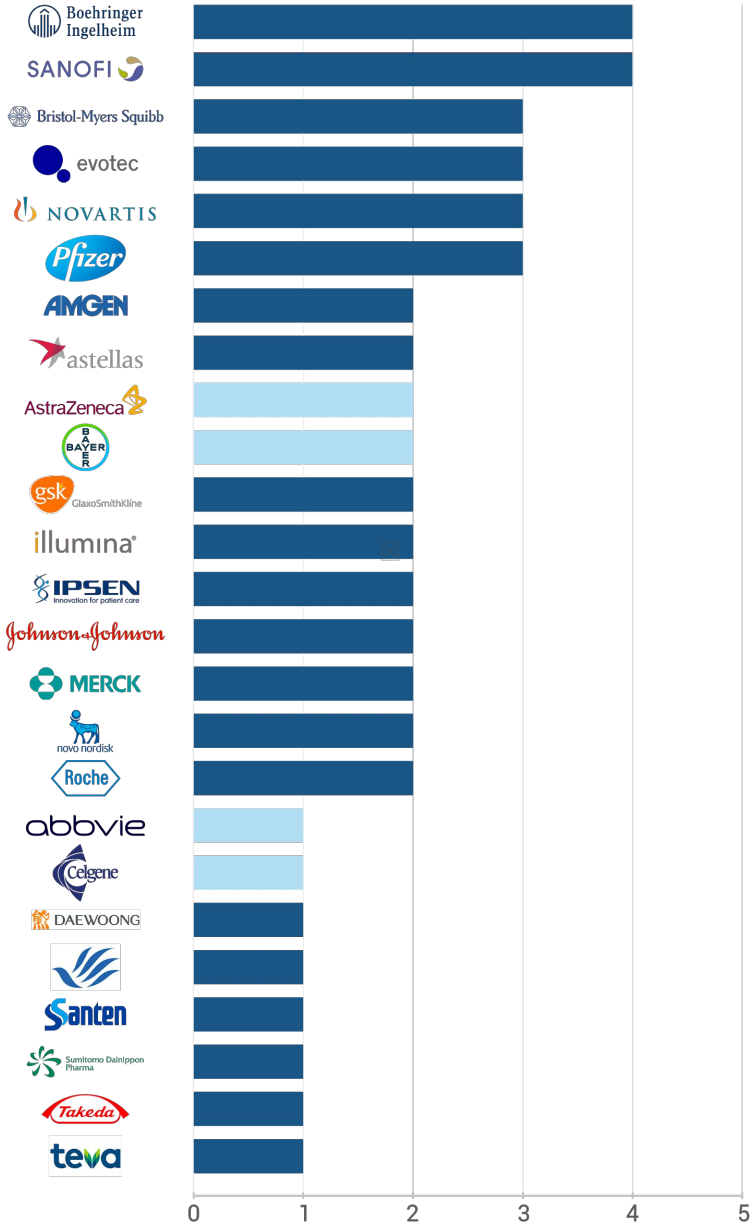
Companies - 150
Investors - 350
Corporations - 50



# AI-Friendly CEOs and Board Members Distribution by **Tech Companies**



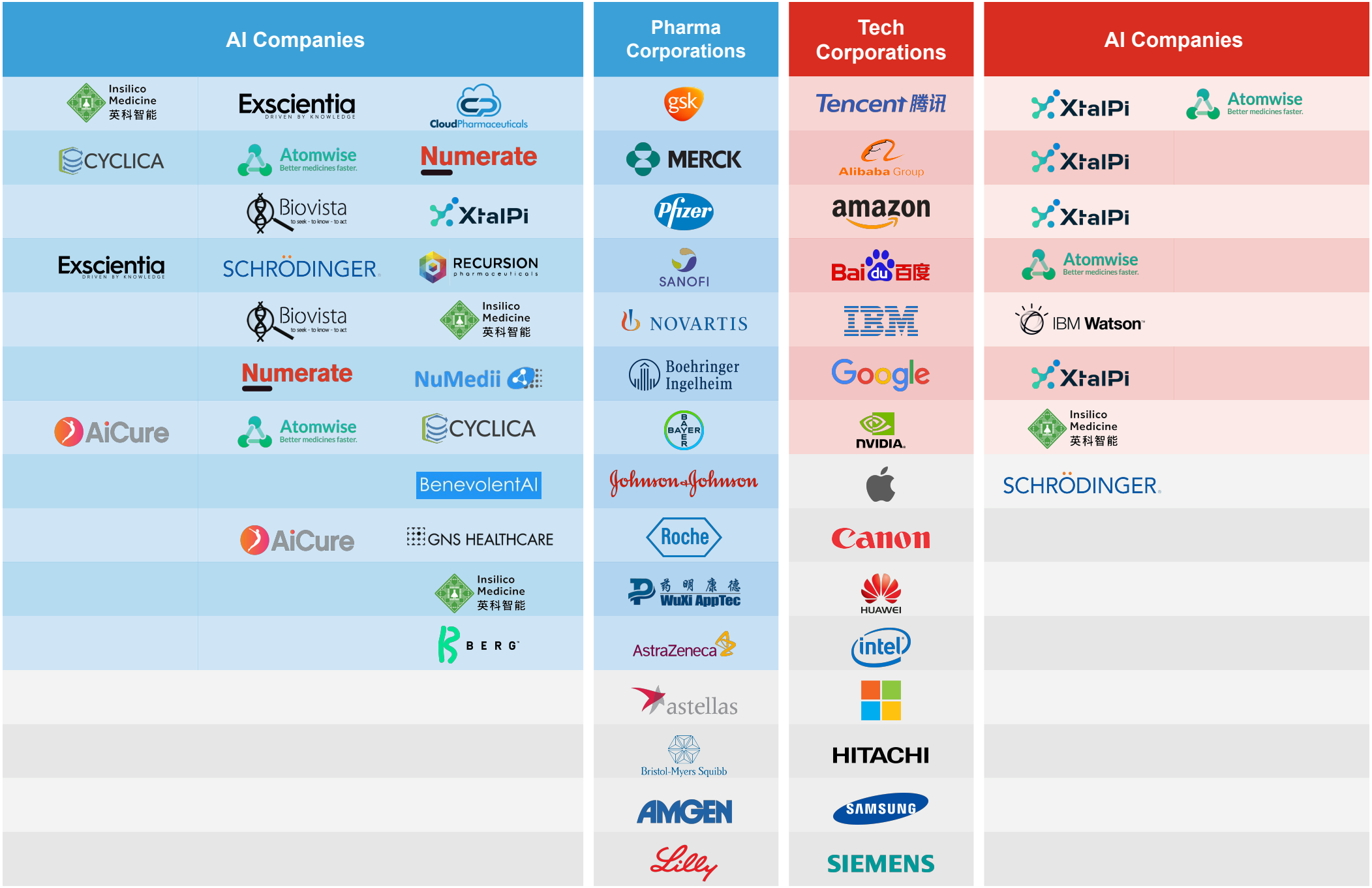

# AI-Friendly CEOs and Board Members Distribution by **Pharma Companies**



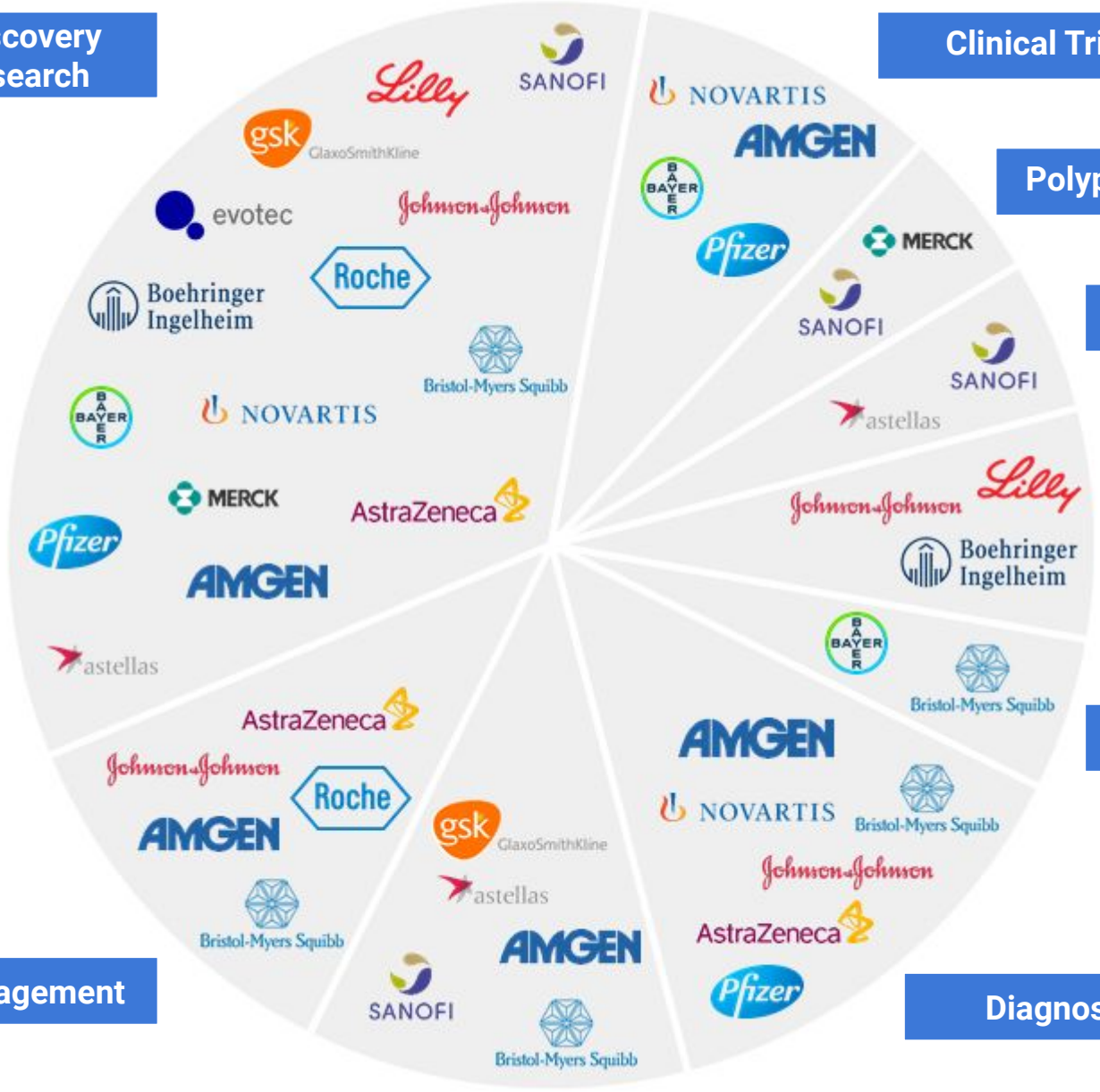

DEEP KNOWLEDGE ANALYTICS *PHARMA DIVISION*

# 50 Pharma and Tech Corporations Applying AI for Drug Discovery

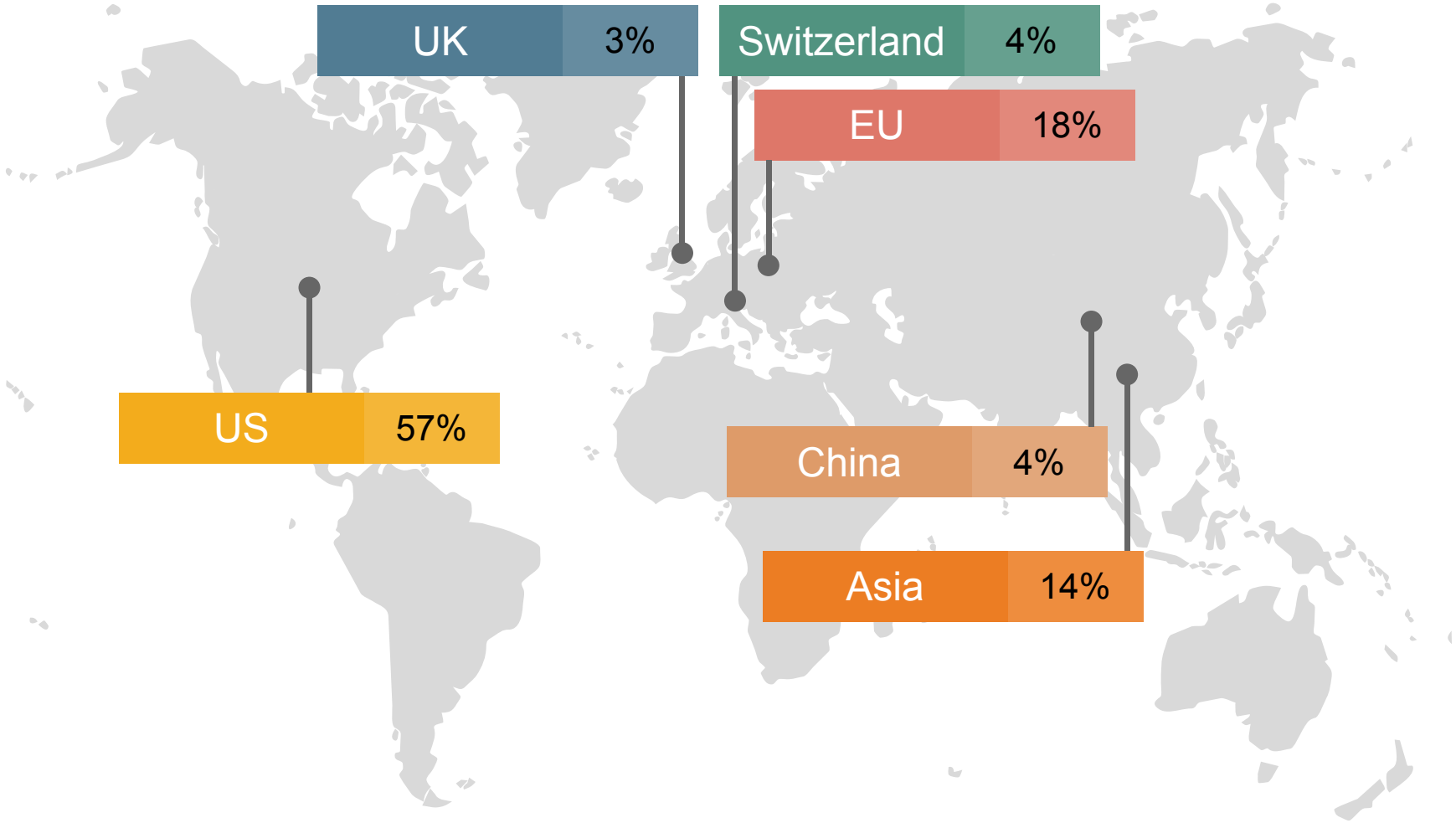
# AI for Drug Discovery Partnerships, Investments, Acquisitions Q1 2019



# AI Applications by Pharma Corporations



# 30 Corporations
## Applying Advanced AI in Healthcare and Drug Discovery




The industry is seeing an increasing level of regional diversification. Whereas historically the US has dominated the AI for Drug Discovery race in terms of number of AI companies, volume of investments and number of industry specialized conferences, in 2019 we are seeing an increased level of activity from the Asia and EU..

# Executive Summary

In recent years it has become clear that pharma has a serious problem with declining R&D productivity. Moreover, this trend is continuing and it seems not going to stop. One of the possible solutions is to apply AI in the process of drug discovery, but different obstacles have appeared connected with reluctance or lack of possibilities of AI implementation.

Thus, obvious is the fact that we can identify those CEOs and Board Members who support the use of AI in pharmaceutical companies' activities. According to the results of this research, the USA and Germany remain home for the largest number of AI experts among CEOs and Board Members. Being major innovation hubs, New York, San Francisco, Indianapolis, Ingelheim am Rhein, Basel and Tokyo are topping the list of cities with the largest numbers of TOP 100 AI-Friendly CEOs and Board Members working there.

It was found that the majority of the TOP 100 AI-Friendly list participants work in Biopharma rather than in Tech companies. However, AI-Friendly leaders usually possess deep technological backgrounds (Computer Science, including Artificial Intelligence, Data Science, Engineering, Statistics/Math), with some acquired level of expertise in life sciences. Also, they have a high number of peer-reviewed publications and a high level of citation. Going in more detail, 55% of CEOs and Board Members are focusing primarily on Drug Development, 42% - on activities connected with Artificial Intelligence only and 3% are the experts in both fields.

Concluding the review of the TOP 100 AI-Friendly list, it becomes obvious that these leaders have an enormous impact on the advancement of AI innovations in the pharmaceutical industry and healthcare. These industries should be using Artificial Intelligence (AI) to a far greater degree than at present, but progress has been painfully slow. The list of 100 AI-Friendly CEOs and Board Members is "the key" to the progress of biopharma and healthcare.

# Methodology for Ranking

The initial large pool of candidates (around 300) for the TOP AI-Friendly CEOs and Board Members list has been selected from multiple sources including:

- Top pharmaceutical and healthcare AI conference program lists
- Google Scholar
- Databases
- News
- Pharma and Tech corporations activities

Ranking is based on the analysis of the descriptive criteria (personal page descriptions, biographies, Linkedin and Bloomberg pages, public awards, article titles, news and PRs, and other text resources) and derived categorical metrics and formal numerical metrics (number of research citations in Google Scholar, RG score in ResearchGate, number of books/talks and articles, social media activity, number of educational diplomas in the field of AI etc).

Categorical variables are considered to be dimensions, descriptive attributes for univariate and bivariate analysis, and classification. Numerical variables are considered to be measures of the initial dataset.

To be nominated for the TOP 100 AI-Friendly CEOs and Board Members list, it was set to be a prerequisite for a candidate to have interdisciplinary technical skills and/or business/entrepreneurship/ decision-making skills in both of the area of AI.

The initial pool of around 300 top candidates has been shortlisted down to the top 100 list following an iterative approach, starting with the obvious differentiating parameters (top tech or business achievements) and gradually specifying additional parameters for the final rating.

## The rating calculation model

Is a first-order homogeneous polynomial that calculates a person's assessment variables and their relative impact weights (coefficients). Numeric variables were standardised. The weights of each variable have been logically designed to underline major contributions and impact (innovations, business achievements etc) and only augment them with less important, yet valuable, contributions (conference talks, social media activity etc).

The biggest emphasis was put on the activities of CEOs and board members in their corporations regarding AI applications and development.

# 25 Pharma Corporations Applying AI for Drug Discovery

| COMPANY NAME | BASED IN | WEBSITE |
|---|---|---|
| 1. AbbVie | United States | abbvie.com |
| 2. Amgen | United States | amgen.com |
| 3. Astellas Pharma | Japan | astellas.com |
| 4. Astrazeneca | United Kingdom | astrazeneca.com |
| 5. Bayer | Germany | bayer.com |
| 6. Boehringer Ingelheim | Germany | boehringer-ingelheim.com |
| 7. Bristol-Myers Squibb | United States | bms.com |
| 8. Celgene | United States | celgene.com |
| 9. Daewoong Pharmaceutical | South Korea | daewoong.com |
| 10. Evotec | Germany | evotec.com |
| 11. GSK | United Kingdom | gsk.com |
| 12. Ilumina | United States | illumina.com |
| 13. Ipsen | France | ipsen.com |
| 14. Johnson & Johnson | United States | jnj.com |
| 15. Merck | United States | merck.com |

# 25 Pharma Corporations applying AI for Drug Discovery

| COMPANY NAME | BASED IN | WEBSITE |
|---|---|---|
| 16. Mitsubishi Tanabe Pharma | Japan | mt-pharma.co.jp |
| 17. Novartis | Switzerland | novartis.com |
| 18. Novo Nordisk | Denmark | novonordisk.com |
| 19. Pfizer | United States | pfizer.com |
| 20. Roche | Switzerland | roche.com |
| 21. Sanofi | France | m-en.sanofi.com |
| 22. Santen | Japan | santen.com |
| 23. Sumitomo Dainippon Pharma | Japan | ds-pharma.com |
| 24. Takeda | Japan | takeda.com |
| 25. Teva Pharmaceutical | Israel | tevapharm.com |

# 25 Tech Corporations Applying Advanced AI-Technologies in Healthcare

| COMPANY NAME | BASED IN | WEBSITE |
|---|---|---|
| 1. Adobe | United States | adobe.com |
| 2. Alibaba | China | alibaba.com |
| 3. Amazon | United States | amazon.com |
| 4. Apple | United States | apple.com |
| 5. Baidu | China | baidu.com |
| 6. Canon | United States | usa.canon.com |
| 7. Cisco | United States | cisco.com |
| 8. Dell Technologies | United States | delltechnologies.com |
| 9. Foxconn Technology | Taiwan | foxconn.com |
| 10. Fujitsu | Japan | fujitsu.com |
| 11. Google | United States | google.com |
| 12. Hitachi | Japan | hitachi.com |
| 13. Huawei | China | huawei.com |
| 14. IBM | United States | ibm.com |
| 15. Intel | United States | intel.com |

# 25 Tech Corporations Applying Advanced AI-Technologies in Healthcare

| COMPANY NAME | BASED IN | WEBSITE |
|---|---|---|
| 16. Microsoft | United States | microsoft.com |
| 17. Nvidia | United States | nvidia.com |
| 18. Oracle | United States | oracle.com |
| 19. General Electric | United States | https://www.ge.com |
| 20. SAP | Germany | sap.com |
| 21. Samsung Electronics | South Korea | samsung.com |
| 22. Siemens | Germany | siemens.com |
| 23. Tencent | China | tencent.com |
| 24. Unisys | United States | unisys.com |
| 25. Workday | United States | workday.com |

# Pharma Corporations Collaborations with AI Companies

| | | |
|---|---|---|
| AMGEN | Biomarker discovery, drug development and testing | OWKIN, GNS HEALTHCARE (Driving Intelligent Interventions) |
| astellas | Biomarker discovery, drug development and repurposing | NuMedii, Biovista |
| AstraZeneca | Drug discovery, diagnostics | BERG, Alibaba.com |
| BAYER | Drug discovery, pharmacovigilance | genpact, CYCLICA |
| Boehringer Ingelheim | Drug discovery | bactevo, Nu |

# Pharma Corporations Collaborations with AI Companies

| | | |
|---|---|---|
| Bristol-Myers Squibb | Drug discovery | sirenas |
| evotec | Drug discovery | Immuneering, Exscientia |
| gsk GlaxoSmithKline | Biomarker discovery and drug development | Exscientia, CloudPharmaceuticals, INSILICO MEDICINE |
| Johnson & Johnson | Drug discovery, diagnostics, surgery | BenevolentAI, WINTERLIGHT, verily |
| Lilly | Drug discovery | transcriptic |

# Pharma Corporations Collaborations with AI Companies

| | | |
|---|---|---|
| MERCK | Drug discovery, polypharmacology | Atomwise, CYCLICA, Nu |
| NOVARTIS | Diagnostics, drugs clinical trials | QUANTUMBLACK, IBM Watson, PathAI |
| Pfizer | Drug discovery, testing and research | XtalPi, IBM Watson, CytoReason, Atomwise |
| Roche | Drug discovery, data management | VIEWICS, GNS HEALTHCARE, OWKIN, Exscientia |
| SANOFI | Drug discovery, repurposing and research, polypharmacology | RECURSION, Exscientia, Researchably, BERG |

# Research Associations between Pharmaceutical and Tech Corporations

Goal: to facilitate interaction between pharmaceutical and IT companies to implement AI in drug discovery.

**Machine Learning for Pharmaceutical Discovery and Synthesis Consortium**

Collaboration between the pharmaceutical and biotechnology industries and the departments of Chemical Engineering, Chemistry, and Computer Science at the Massachusetts Institute of Technology. This collaboration will facilitate the design of useful software for the automation of small molecule discovery and synthesis.

ALLIANCE FOR ARTIFICIAL INTELLIGENCE IN HEALTHCARE

AAIH and its member companies and organizations are applying state-of-the-art approaches and investing in advanced integrated programs to address society's need for new, more effective and accessible healthcare. The AAIH is a coalition of technology developers, pharmaceutical companies, and research organizations who have expressed the common goal of realizing the potential for AI in healthcare. We are providing a unified voice of the industry in established responsible, ethical, and reasonable standards for the development and implementation of AI in healthcare.

## Members (Pharma Corporations)

AMGEN, GlaxoSmithKline, Lilly, AstraZeneca, Bayer, Merck, Novartis, Janssen, Pfizer

## Members (Pharma Corporations)

GlaxoSmithKline, Janssen, Bayer

# Scientific Publications about AI in Drug Discovery

Commentary

*For reprint orders, please contact: reprints@future-science.com*

Future Medicinal Chemistry

## The convergence of artificial intelligence and chemistry for improved drug discovery

Clive P Green*[,1], Ola Engkvist[2] & Garry Pairaudeau[3]
[1]Sample Management, Discovery Sciences, IMED Biotech Unit, AstraZeneca, Cambridge, UK
[2]Hit Discovery, Discovery Sciences, IMED Biotech Unit, AstraZeneca, Gothenburg, Sweden
[3]Hit Discovery, Discovery Sciences, IMED Biotech Unit, AstraZeneca, Cambridge, UK
*Author for correspondence: clive.green@astrazeneca.com

AstraZeneca

Curr Top Med Chem. 2006;6(15):1579-91.

## Machine learning techniques for in silico modeling of drug metabolism.

Fox T[1], Kriegl JM.

Author information

1 Department of Lead Discovery, Boehringer Ingelheim Pharma GmbH & Co. KG, 88397 Biberach, Germany.

Boehringer Ingelheim

Drug Safety
June 2018, Volume 41, Issue 6, pp 579–590 | Cite as

## Sorting Through the Safety Data Haystack: Using Machine Learning to Identify Individual Case Safety Reports in Social-Digital Media

Authors | Authors and affiliations

Shaun Comfort, Sujan Perera, Zoe Hudson, Darren Dorrell, Shawman Meireis, Meenakshi Nagarajan, Cartic Ramakrishnan, Jennifer Fine

Roche

Contents lists available at ScienceDirect

Bioorganic & Medicinal Chemistry Letters

journal homepage: www.elsevier.com/locate/bmcl

Digest

## Recent applications of machine learning in medicinal chemistry

Jane Panteleev[a,*,1], Hua Gao[a,*,1], Lei Jia[b,*,1]

[a] Amgen Discovery Research, 360 Binney St., Cambridge, MA 02141, USA
[b] Amgen Discovery Research, One Amgen Center Dr., Thousand Oaks, CA 91320, USA

AMGEN

Clinical Pharmacology & Therapeutics

Article | Open Access

## Innovation in Pharmacovigilance: Use of Artificial Intelligence in Adverse Event Case Processing

Juergen Schmider, Krishan Kumar, Chantal LaForest, Brian Swankoski, Karen Naim, Patrick M. Caubel

First published: 10 October 2018 | https://doi.org/10.1002/cpt.1255 | Cited by: 2

Pfizer

molecules

MDPI

*Review*

## Artificial Intelligence in Drug Design

Gerhard Hessler [1,*] and Karl-Heinz Baringhaus [2]

1 R&D, Integrated Drug Discovery, Industriepark Hoechst, 65926 Frankfurt am Main, Germany
2 R&D, Industriepark Hoechst, 65926 Frankfurt am Main, Germany; karl-heinz.baringhaus@sanofi.com
* Correspondence: gerhard.hessler@sanofi.com; Tel.: +49-(0)69-3054-0098

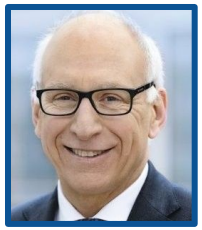
SANOFI

# Top-100 AI-Friendly CEOs and Board Members

1. Albert Bourla
2. Allan Hillgrove
3. Andre Hoffmann
4. Andreas Fisch
5. Andreas Neumann
6. Andrew S. Plump
7. Aneel Bhusri
8. Arleen Paulino
9. Benoît Potier
10. Bernard Charles
11. Bill McDermott
12. Bob Picciano
13. Bruce Burlington
14. Camilla Sylvest
15. Chano Fernandez
16. Charles M. Geschke
17. Chuck Robbins
18. Claus Braestrup
19. David Dorman
20. David Meek
21. Dennis Ausiello
22. Dimitri Azar
23. Dinesh C Paliwal
24. DongJin Koh
25. Dr Hal Barron
26. Emma Walmsley
27. Francis deSouza
28. Frank Calderoni
29. Geneviève Berger
30. Ginni Rometty
31. Giovanni Caforio
32. Gunnar Zukunft
33. Hiroo Sasaki
34. Hiroshi Nomura
35. Hubert Birner
36. Iain Ferguson Bruce
37. Ian Read
38. Irving Tan
39. Jay Flatley
40. Jeffrey Preston Bezos
41. Jen-Hsun Huang
42. Jennifer Taubert
43. Joachim Hasenmaier
44. Juergen Mueller
45. Kare Schultz
46. Kemal Malik
47. Kenneth C. Frazier
48. Laurent Attal
49. Lawrence J. Ellison
50. Leslie A. Brun
51. Liang Hua
52. Lin Yuanqing
53. Mads Krogsgaard Thomsen
54. Lawrence Culp
55. Marc de Garidel
56. Mark Hurd
57. Mark Perry
58. Martha Pollack
59. Masami Yamamoto
60. Masayuki Mitsuka
61. Melanie Lee
62. Michael (John) Evans
63. Michael S. Dell
64. Naveed Shams
65. Nir Kaldero
66. Olivier Brandicourt
67. Omar Ishrak
68. Catherine Lesjak
69. Paul Fonteyne
70. Paul Stoffels
71. Peter Altabef
72. Reid Hoffman
73. Richard W. Barker
74. Risa Lavizzo-Mourey
75. Robert A. Bradway
76. Robert H. Swan
77. Robin Li
78. Robynne Sisco
79. Roland Busch
80. Roxanne S. Austin
81. Safra A. Catz
82. Satya Nadella
83. Sergey Brin
84. Seung-Ho Jeon
85. Severin Schwan
86. Shantanu Narayen
87. Sundar Pichai
88. Tatsuya Tanaka
89. Terry Gou
90. Tim Cook
91. Toshiaki Higashihara
92. Toshio Takiguchi
93. Tracy Frey
94. Vasant Narasimhan
95. Vicki Sato
96. Vishal Gupta
97. Werner Lanthaler
98. Wolfgang Plischke
99. Xian-Sheng Hua
100. Yoshihiko Hatanaka

# “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations

Albert Bourla
*Pfizer*



Allan Hillgrove
*Boehringer Ingelheim*

Andre Hoffmann
*Roche*

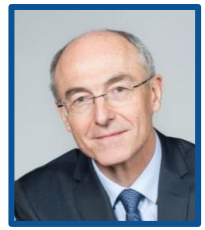
Andreas Fisch
*Novartis*

Andreas Neumann
*Boehringer Ingelheim*

Andrew S. Plump
*Takeda*

Aneel Bhusri
*Intel*

Arleen Paulino
*Amgen*

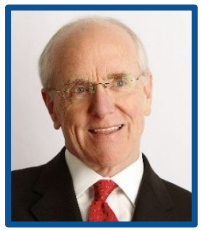


Benoît Potier
*Siemens*

Bernard Charlès
*Sanofi*

Bob Pi Bill McDermott
*SAP*

Bob Picciano
*IBM*



Bruce Burlington
*AstraZeneca*

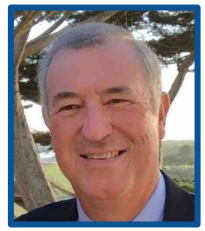
Camilla Sylvest
*Novo Nordisk*

Chano Fernandez
*Workday*

Charles M. Geschke
*Adobe*

Chuck Robbins
*Cisco*

Claus Braestrup
*Evotec*



David Dorman
*Dell Technologies*

David Meek
*Ipsen*

Dennis Ausiello
*Pfizer*

Dimitri Azar
*Novartis*

Dinesh C Paliwal
*Bristol-Myers Squibb*

DongJin Koh
*Samsung Electronics*

Dr Hal Barron
*GSK*

# “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations

Emma Walmsley
*GSK*

Francis deSouza
*Illumina*

Frank Calderoni
*Adobe*

Geneviève Berger
*AstraZeneca*

Ginni Rometty
*IBM*

Giovanni Caforio
*Bristol-Myers Squibb*

Gunnar Zukunft
*Siemens*

Hiroo Sasaki
*Astellas Pharma*

Hiroshi Nomura
*Sumitomo Dainippon Pharma*

Hubert Birner
*Evotec*

Iain Ferguson Bruce
*Tencent*

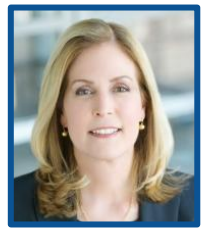
Ian Read
*Pfizer*

Irving Tan
*Cisco*

Jay Flatley
*Illumina*

Jeffrey Bezos
*Amazon*

Jen-Hsun Huang
*Nvidia*



Jennifer Taubert
*Johnson & Johnson*

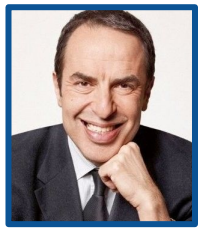
Joachim Hasenmaier
*Boehringer Ingelheim*

Juergen Mueller
*SAP*

Kare Schultz
*Teva Pharmaceutical*

Kemal Malik
*Bayer*

Kenneth C. Frazier
*Merck*



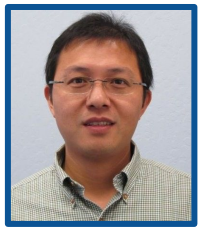
Laurent Attal
*Sanofi*

Lawrence J. Ellison
*Oracle*

Leslie A. Brun
*Merck*

# “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations

Liang Hua
*Huawei*

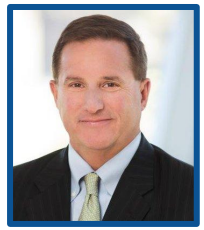


Lin Yuanqing
*Baidu*

Mads Krogsgaard Thomsen
*Novo Nordisk*

Lawrence Culp
*General Electric*

Marc de Garidel
*Ipsen*



Mark Hurd
*Oracle*

Mark Perry
*Nvidia*

Martha Pollack
*IBM*

Masami Yamamoto
*Fujitsu*

Masayuki Mitsuka
*Mitsubishi Tanabe Pharma*

Melanie Lee
*Sanofi*

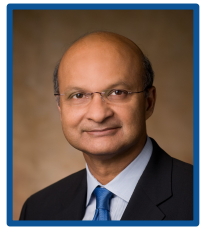
Michael (John) Evans
*Alibaba*

Michael S. Dell
*Dell Technologies*

Naveed Shams
*Santen*

Nir Kaldero
*Google*

Olivier Brandicourt
*Sanofi*



Omar Ishrak
*Intel*

Catherine Lesjak
*General Electric*

Paul Fonteyne
*Boehringer Ingelheim*

Paul Stoffels
*Johnson & Johnson*

Peter Altabef
*Unisys*

Reid Hoffman
*Microsoft*

Richard W. Barker
*Celgene*

Risa Lavizzo-Mourey
*Intel*

Robert A. Bradway
*Amgen*

# “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations


Robert H. Swan
*Intel*

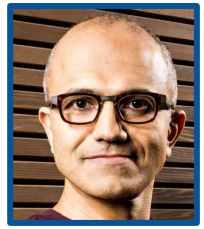

Robin Li
*Baidu*


Robynne Sisco
*Workday*


Roland Busch
*Siemens*


Roxanne S. Austin
*AbbVie*


Safra A. Catz
*Oracle*


Satya Nadella
*Microsoft*


Sergey Brin
*Google*


Seung-Ho Jeon
*Daewoong Pharmaceutical*


Severin Schwan
*Roche*


Shantanu Narayen
*Adobe*


Sundar Pichai
*Google*


Tatsuya Tanaka
*Fujitsu*


Terry Gou
*Foxconn Technology*


Tim Cook
*Apple*


Toshiaki Higashihara
*Hitachi*


Toshio Takiguchi
*Canon*


Tracy Frey
*Google*


Vasant Narasimhan
*Novartis*


Vicki Sato
*Bristol-Myers Squibb*


Vishal Gupta
*Unisys*

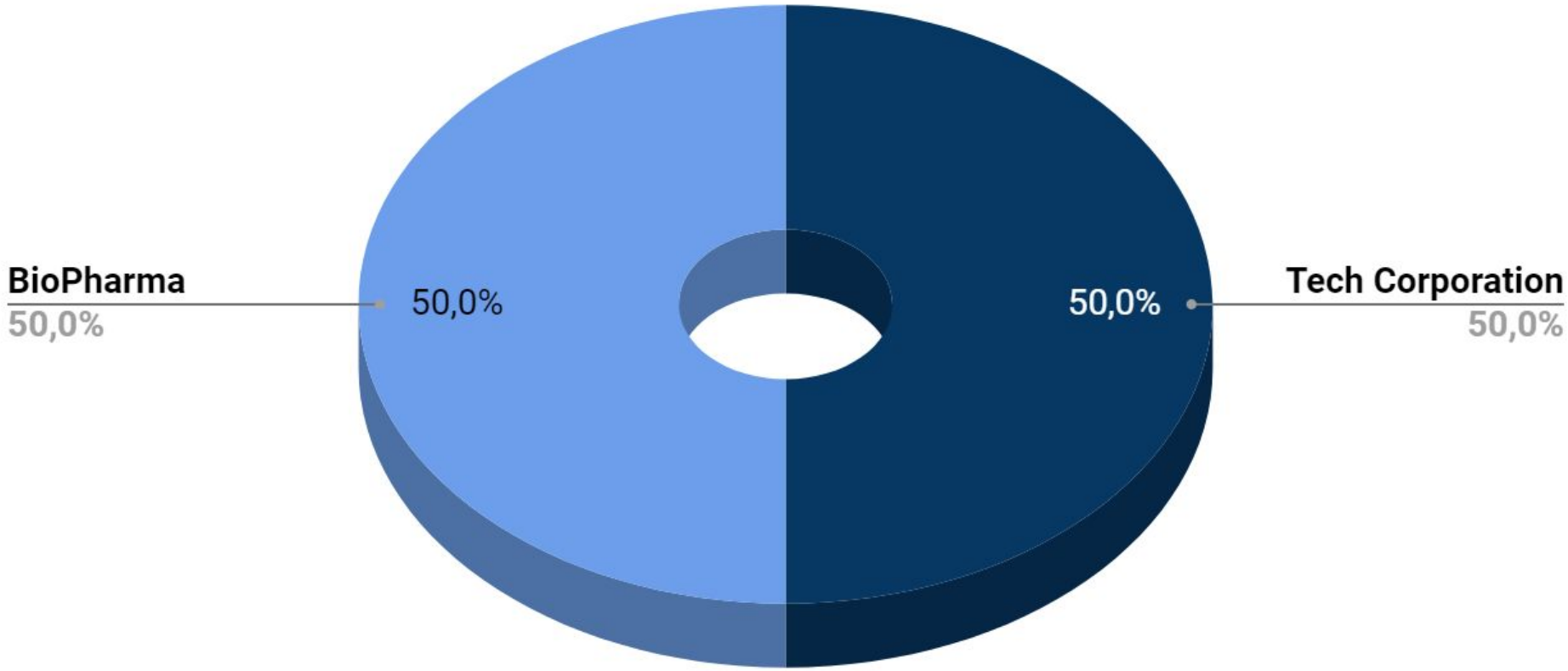

Werner Lanthaler
*Evotec*


Wolfgang Plischke
*Bayer*


Xian-Sheng Hua
*Alibaba*


Yoshihiko Hatanaka
*Astellas Pharma*

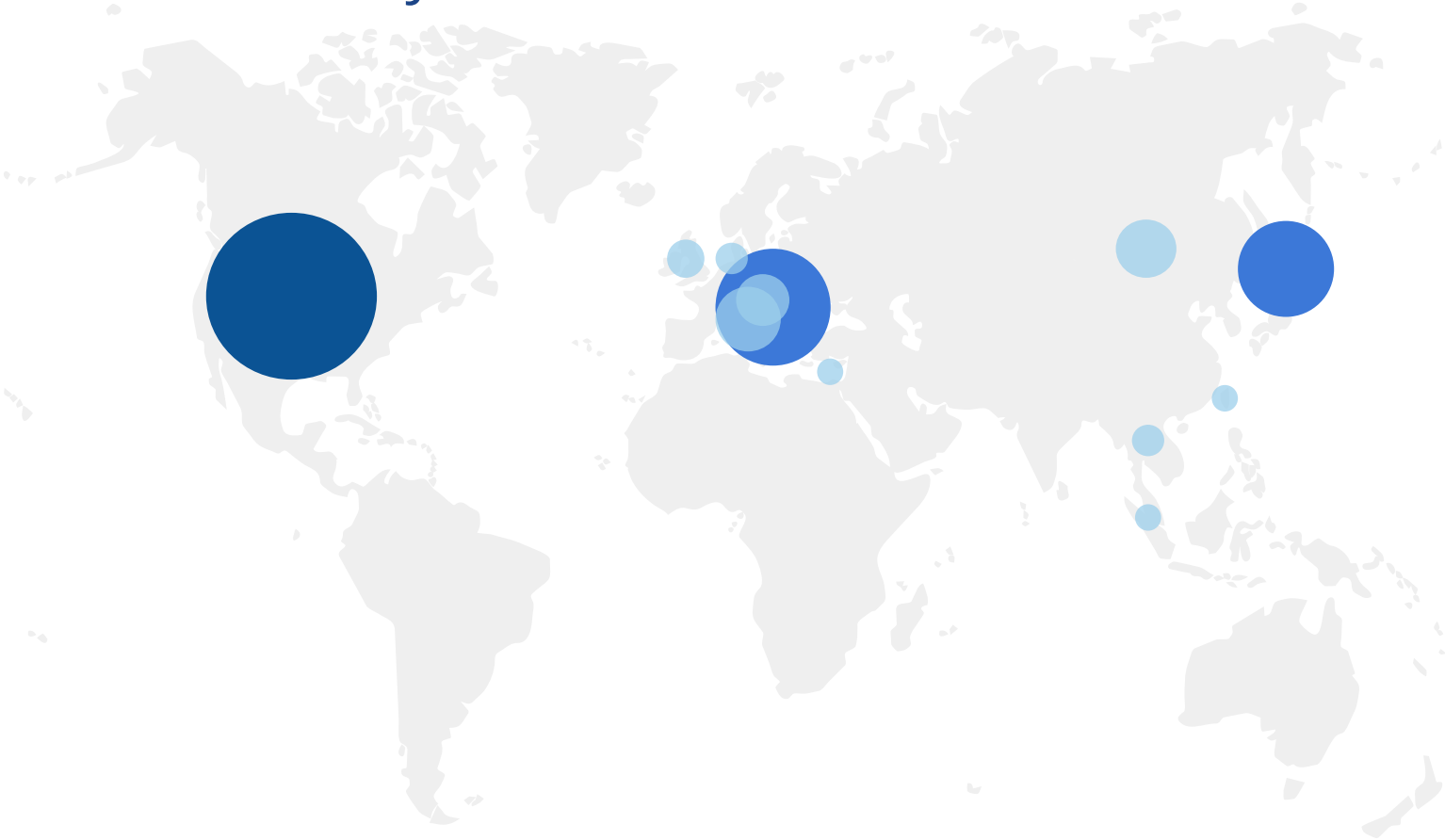
# AI-Friendly CEOs and Board Members by Type of Corporation




The diagram above shows the division between the type of corporation AI-Friendly CEOs and Board Members are working for.

The breakdown is even, with both Tech and BioPharma Corporations having exactly 50 AI-Friendly CEOs and Board Members each. That means that BioPharma Corporations has caught up with Tech Companies in pursuit of top management that, among other things, have a keen eye for the potential of AI technologies in companies activity.

# 100 AI-Friendly CEOs and Board Members Dislocation

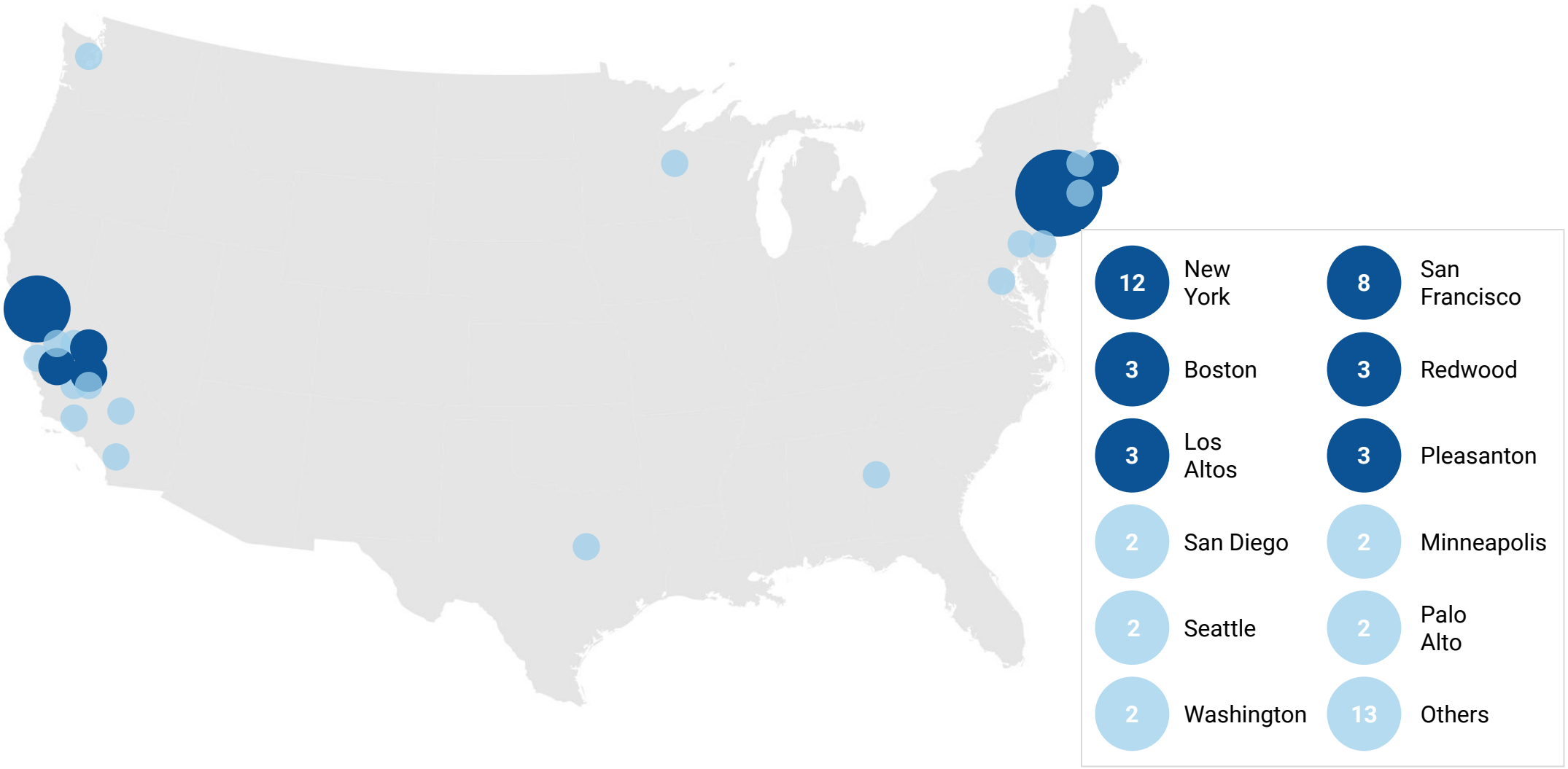


This map shows the geographic distribution of the AI-friendly CEOs and Board Members in Pharma and Tech Industries.

The majority - more than half - reside in the US. Germany and, Japan are also particularly attractive countries for these experts.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 57 | USA | 10 | Germany | 9 | Japan | 6 | France | 4 | China | 4 | Switzerland |
| 3 | United Kingdom | 2 | Denmark | 2 | South Korea | 1 | Israel | 1 | Taiwan | 1 | Singapore |

# US AI-Friendly CEOs and Board Members Dislocation in US




This map shows the geographic distribution of the AI-friendly CEOs and board members in pharma and healthcare within the United States. New York, San Francisco, Boston, Redwood, Los Altos and Pleasanton stand out as favored locations for these individuals.

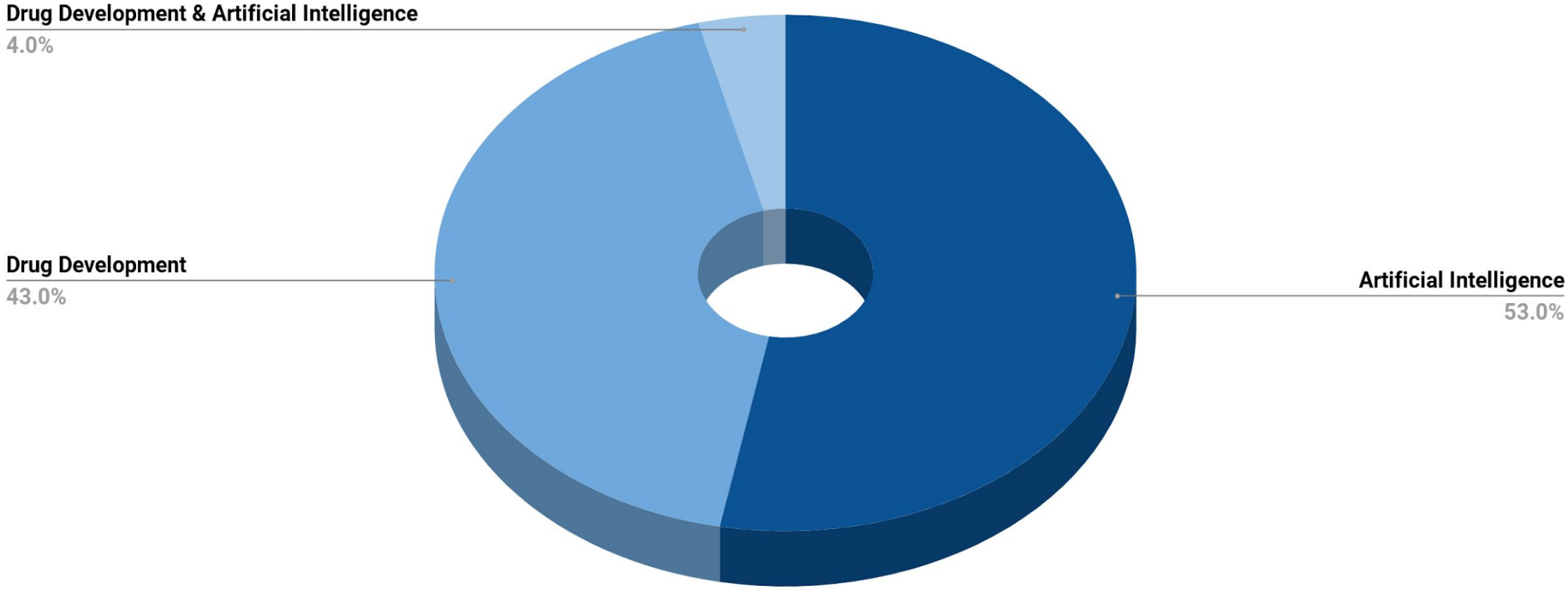
# 100 AI-Friendly CEOs and Board Members outside America

## Distribution by City

| | | | |
|---|---|---|---|
| 8 | Tokyo | 4 | Basel |
| 3 | Ingelheim am Rhein | 3 | London |
| 3 | Munich | 3 | Paris |
| 2 | Bagsvaerd | 2 | Boulogne-Billancourt |
| 2 | Hamburg | 2 | Walldorf |
| 1 | Beijing | 1 | Hangzhou |
| 1 | Hong Kong | 1 | Osaka |
| 1 | Puteaux | 1 | Seoul |
| 1 | Shenzhen | 1 | Singapore |
| 1 | Suwon | 1 | Taipei |
| 1 | Tel Aviv | | |

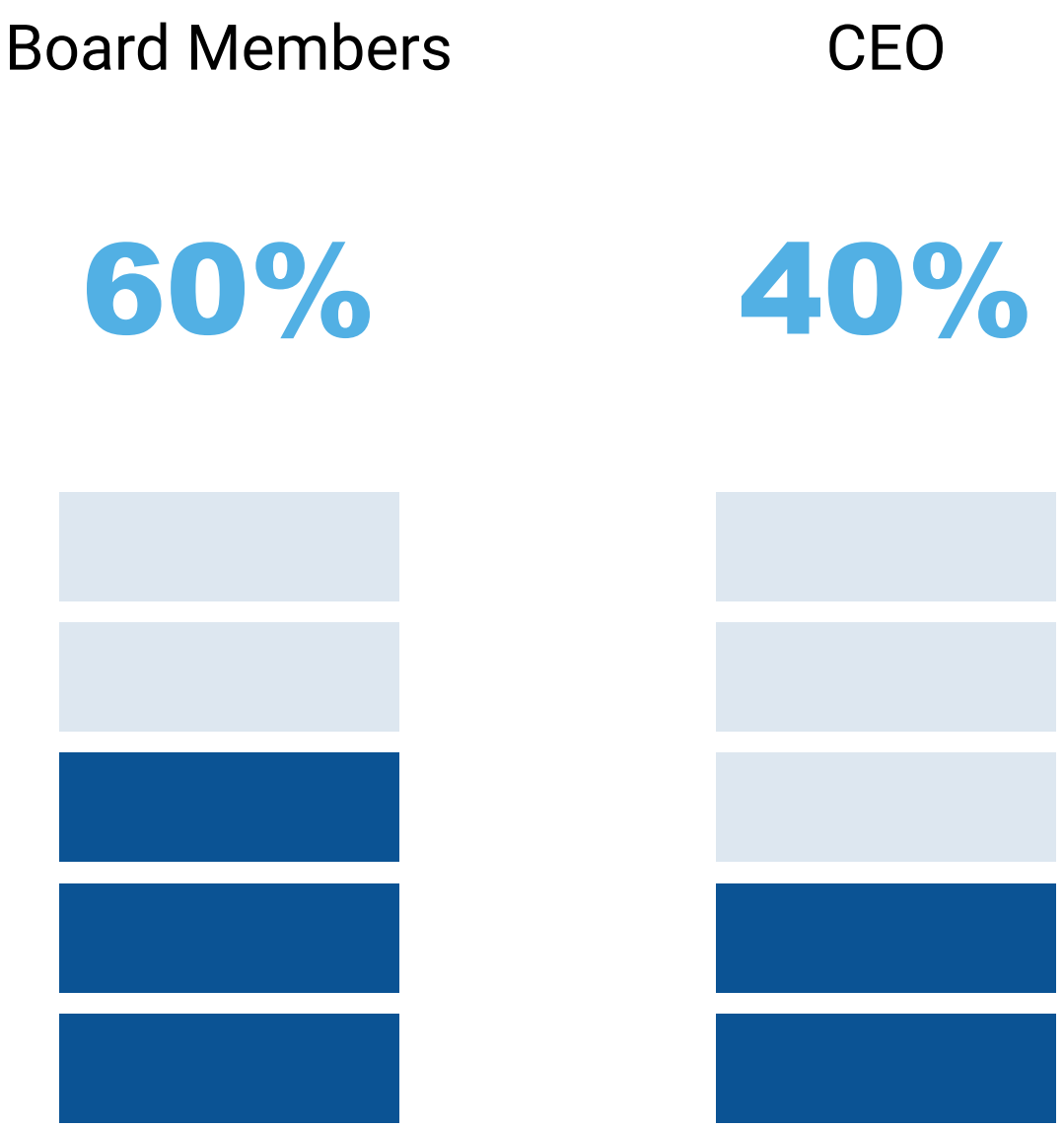
This map shows that most of the top AI-Friendly leaders in pharma and tech reside in outside of America. With Tokyo being the most attractive city for this kind of experts.

# Specialization of 100 AI-Friendly CEOs and Board Members of Pharma and Tech Corporations




The diagram above shows that AI-friendly CEOs and Board Members are predominantly specialized in either Drug Development or Artificial Intelligence, whereas CEOs and Board Members working at the intersection of the two disciplines represent a small fraction of the total. AI for Drug Discovery companies need much higher levels of expertise in traditional biopharmaceutical science (biochemistry, biology, biomedicine, etc.) and in core AI techniques. Therefore, CEOs and Board Members which belong to this group are well-qualified and have rich experience through practice and education in both fields.

# 100 AI-Friendly CEOs and Board Members Distribution by Position




The figure on the left shows the distribution of top-100 AI-Friendly CEOs and Board Members by the position they are currently occupying. Board Members account for more than half of the total number of executives. Since Board Members are responsible for guiding organizations, while a CEO holds management duties, it is more common for the former to set the tone for a company's performance and to commit to new technologies, such as AI.

# Financials: Pharma Corporations

| COMPANY NAME | SALES - 5 YR. GROWTH RATE | OPERATING MARGIN - 5 YR. AVG. | QUICK RATIO | RETURN ON EQUITY - 5 YR. AVG. | RETURN ON INVESTMENT - 5 YR. AVG |
|---|---|---|---|---|---|
| AMGEN | 4.92 | 40.22 | 2.53 | 28.74 | 11.42 |
| ASTELLAS | 6.23 | 15.33 | 1.76 | 11.87 | 11.14 |
| ASTRAZENECA | -7.29 | 17.97 | 0.73 | 15.71 | 7.89 |
| BAYER | -0.29 | 13.80 | 0.92 | 11.07 | 5.28 |
| BOEHRINGER INGELHEIM | - | - | - | - | - |
| BRISTOL-MYERS SQUIBB | 6.61 | 22.45 | 1.79 | 23.60 | 13.92 |
| EVOTEC | 34.30 | 14.77 | 1.33 | 12.27 | 9.54 |
| GSK | 0.36 | 25.02 | 0.37 | 82.33 | 15.25 |
| ELI LILLY | 1.22 | 13.40 | 0.85 | 18.27 | 9.00 |
| JOHNSON & JOHNSON | 2.03 | 25.03 | 1.01 | 21.24 | 14.00 |
| MERCK | -0.8 | 24.38 | 1.06 | 15.29 | 8.26 |
| NOVARTIS | 0.17 | 19.79 | 0.83 | 11.96 | 8.41 |
| PFIZER | 0.79 | 22.24 | 1.27 | 13.51 | 6.50 |
| ROCHE | 3.97 | 26.88 | 1.11 | 41.08 | 19.05 |
| SANOFI | 2.66 | 16.22 | - | 7.36 | 4.9 |

Sales growth rate, TOP 3: Evotec, Astellas, Amgen. Evotec significantly outperformed other companies, but it's important to consider that they have a significantly smaller revenue (EUR 257.6 mln) than other companies in the industry.
Operating margin, TOP 3: Amgen, Roche, Johnson & Johnson. Amgen is the largest biotech company which focuses on serious dIseases and that may explain their profitability (these drugs are not cheap).
Quick ratio, TOP 3: Evotec, Amgen, Astellas. Though Amgen has a relatively good quick ratio, the company has a high long-term debt position (LT Debt to Equity ratio=236). The same could be said about some other companies as well (GSK's LT Debt to Equity ratio=1512).
ROE, TOP 3: GSK, Roche, Amgen. GSK has performed brilliantly here, also considering that Return on Equity (TTM)=279.
ROI, TOP 3: Roche, Johnson & Johnson, GSK.

# Financials: Tech Corporations

| COMPANY NAME | SALES - 5 YR. GROWTH RATE | OPERATING MARGIN - 5 YR. AVG. | QUICK RATIO | RETURN ON EQUITY - 5 YR. AVG. | RETURN ON INVESTMENT - 5 YR. AVG |
|---|---|---|---|---|---|
| ALIBABA | 51.21 | 31.27 | - | 31.22 | 22.25 |
| AMAZON | 25.62 | 3.11 | 0.85 | 15.23 | 6.62 |
| APPLE | 14.78 | 30.01 | 1.35 | 37.80 | 25.74 |
| BAIDU | 37.22 | 23.63 | - | 31.45 | 21.30 |
| CANON | 1.16 | 8.55 | 1.40 | 7.74 | 6.55 |
| GOOGLE | 18.95 | 26.68 | 5.99 | 15.28 | 14.20 |
| HITACHI | -1.06 | 5.44 | 0.99 | 10.42 | 6.80 |
| HUAWEI | 10.16 | 30.89 | 2.24 | 8.35 | 8.55 |
| IBM | -5.65 | 19.98 | 1.21 | 86.09 | 19.07 |
| INTEL | 1.92 | 25.70 | 1.83 | 19.14 | 13.93 |
| MICROSOFT | 4.06 | 26.37 | 2.44 | 24.12 | 15.10 |
| NVIDIA | 11.57 | 18.33 | 6.99 | 16.92 | 13.31 |
| SAMSUNG ELECTRONICS | 4.12 | 13.79 | 1.87 | 15.87 | 14.96 |
| SIEMENS | 1.68 | 8.46 | 0.83 | 15.41 | 7.15 |
| TENCENT | 39.76 | 36.97 | 1.36 | 30.42 | 20.97 |

Sales growth rate, TOP 3: Alibaba, Tencent, Baidu. All of them are Chinese companies that are about to become dominant AI players in the world with the support of Chinese government.
Operating margin, TOP 3: Tencent, Alibaba, Huawei. That means that these Chinese giants make the most profit on a dollar of sales.
Quick ratio, TOP 3: Nvidia, Google, Microsoft. These American companies are fully equipped with enough assets to be instantly liquidated to pay off its current liabilities.
ROE, TOP 3: IBM, Apple, Baidu. Their management teams are above average at using the companies' assets to create profits.
ROI, TOP 3: Apple, Alibaba, Baidu. This indicates that investments they make are quite efficient (AI plays an important role here).

# Tech Executives Join the AI

Every self-respecting tech executive should board the train. It certainly seems that they've successfully done it. Some have a more cautious approach to it, e.g. Tim Cook (better known as Tim Apple) has warned that the 'dangers are profound' if AI falls into the wrong hands. Nevertheless, they all are largely optimistic about AI, investing a lot of money in many AI initiatives. Some of them are already paying off.
Chinese tech giant **Alibaba** has developed some AI-related technological advances that helped power Singles' Day last year resulted in $30 billion in sales for China's Single's Day.

Furthermore, Alibaba's revenue from cloud computing increased 84% year-over-year to RMB6,611 million (US$962 million) and from innovation initiatives and others increased 73% year-over-year to RMB1,333 million (US$193 million) as well.
It is to be noted that China's hype train is looking really good. The support given by the **Chinese government** is irreproachable and the tech companies are clearly benefiting from it. With plans to build a $1 trillion AI industry by 2030, China is on a path to overtake the United States as the world's leader in technology.

One of the more promising companies is **Nvidia**, because of the company's lead in AI chips and platforms. The world's leading tech companies use NVIDIA's graphics processing units (GPUs) for their AI data centers. Already, more than 1,200 companies use NVIDIA's hardware and software for their AI inference platforms. Data centers are one of the company's largest long-term opportunities for their AI chips. Management believes that its total addressable market in data centers (driven by AI) will be worth $50 billion by 2023.

Apple on Thu, Dec 20, 2018, said **John Giannandrea**, the company's recently appointed senior vice president of artificial intelligence and machine learning strategy, is now part of the company's executive team. He reports to Apple CEO Tim Cook. Giannandrea joined Apple in April after nearly eight years at Google, where he ultimately became the leader of the search, along with machine intelligence and research.
That's only one of the examples of poaching among AI specialists which is becoming more and more popular.

Though sometimes the reverse happens. **Tencent** lost one of its key AI chiefs when Tong Zhang quit to take up an academic role. Some industry players attributed his departure to Tencent's historic penchant for setting up teams to compete with each other, as he headed one of several AI labs. Others noted that the attractions that draw AI scientists to big corporations, such as the money, abundant data and use cases, can often sour when they realize the subsequent sacrifice in autonomy.

# Billions will be Spent on AI Drug Development

*“The most important force that could change the medical field is artificial intelligence”, Baidu CEO Robin Li.*

Mr. Trump was right all along. It will be ‘billions and billions’. Not only pharma companies will be spending their money. Tech giants are on their way.

**Canon Medical Systems** (China) Co, the medical equipment arm of Canon Inc, has set up a research center in China with over 100 laboratory technicians and has plans to establish one more such facility. Canon Medical executives said they are driven by optimism that the Chinese market will offer many opportunities to further explore applications of artificial intelligence or AI in medical imaging solutions.

Mitsubishi Tanabe Pharma and **Hitachi** have become the latest companies attempting to use artificial intelligence (AI) to more efficiently develop drugs. The aim of the collaboration is to use Hitachi’s advanced digital technology, including AI, to shorten the development period for new drugs and reduce development costs while reducing the possibility of expensive trial failures.

Another example of a tech-giant making advances into healthcare through AI is **Google’s** DeepMind Health, in this case, working in partnership with Moorfields Eye Hospital NHS Foundation Trust in London, developing technology to address macular degeneration in aging eyes.

# Notable **CEOs and Board Members**

Amazon

“I think healthcare is going to be one of those industries that is elevated and made better by machine learning and artificial intelligence. And I actually think Echo and Alexa do have a role to play in that.”

***-Jeff Bezos,*** *CEO of Amazon*

**Source**

Pfizer

Pfizer has been investing in artificial intelligence with the goal of democratizing its value across stakeholders. Specifically, they engaged in a crowdsourcing event to identify improved drug combinations and patient selection strategies. As with the rest of the industry, Pfizer is keen to shorten the drug development lifecycle through AI technologies. Bourla could be a multiplier for advanced technologies to support drug research and there’s potential for an increase in scale of Pfizer’s AI capabilities, ultimately resulting in new drug approvals.

*-Said about* ***Albert Bourla****, CEO of Pfizer*

**Source**

GSK

“With this acceleration of science and technology, we should all expect some material shifts in the way our industry operates, in who our competitors and partners are as we use digital, data and analytics fundamentally to transform the way we discover and develop medicines; the way we interact with patients and consumers and healthcare professionals,”

***-Emma Walmsley****, CEO of GSK*

**Source**

# Notable **CEOs and Board Members**

GSK
Glaxo will seek collaboration opportunities around new technologies, while also focusing on machine learning and analytics. “We will be instituting not only new science and new technologies, but also trying to modify the culture to make it much more amenable to the kind of innovation I’ll be outlining,”

***-Dr Hal Barron,*** *Board member of GSK*
**Source**

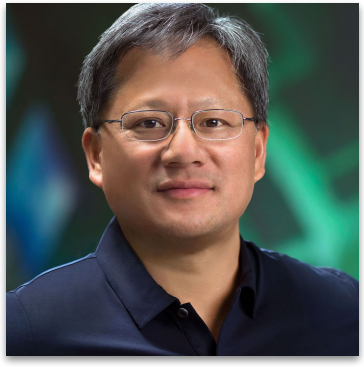
IBM
“Cognitive healthcare (artificial intelligence) is mainstream and real. It has entered mainstream life and care; it is going to live on the cloud; and it is already changing everything about the way we approach health.”

***-Ginni Rometty,*** *CEO of IBM*
**Source**

IBM
“Dr. Pollack has published extensively on artificial intelligence, on topics ranging from natural-language processing to automated planning and temporal reasoning.  Her research has had a significant focus on the design of AI technologies to assist people with cognitive impairment.”

*-Said about* ***Martha Pollack,*** *Board member of IBM*
**Source**

# Notable **CEOs and Board Members**



Nvidia

“GPU-powered deep learning is already at the heart of many applications that amaze and delight us every day. At Austria’s Johannes Kepler University, researchers are using GPU-powered deep learning to determine the toxicity of new drugs, work that can accelerate the discovery of new treatments. And at the University of Toronto, scientists are attacking genetic diseases, such as autism, by applying deep neural networks to advance the study of the human genome.”

***-Jen-Hsun Huang,*** *CEO of Nvidia*

**Source**

Merck

“When we talk about the arc of the natural history of the disease, when we talk about the arc of innovation, I just look at my company and say, there was a period of time when Merck survived on anti-infectives and vaccines that are still critical to healthcare. That led us to the anti-hypertensives, which led us to the cholesterol drugs, which led us to the HIV drugs, which are now leading us to the cancer drugs. So it’s important for us to see the natural arc of innovation, and if we start saying we can’t pay for these drugs today, we know what’s going to happen to the arc.”

***-Kenneth C. Frazier,*** *CEO of Merck*

**Source**

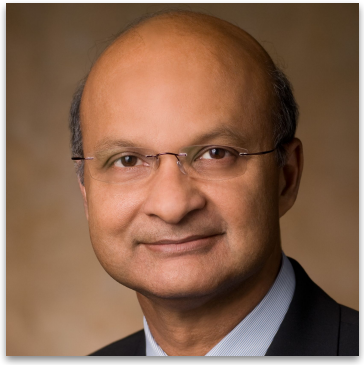
Sanofi

“First, techniques such as AI can be used to help doctors make better diagnoses. Patients with diseases such as melanoma and dermatosis can be diagnosed online by photos and artificial intelligence. Second, during treatment, doctors and patients can achieve more interaction with the help of a digital platform to better meet the personalized and diverse needs of patients. Third, from the perspective of the industry, each component - be it new drug research and development, clinical development, market access or promotion - can leverage digital technology and solutions.”

***-Olivier Brandicourt****, CEO of Sanofi*

**Source**

# Notable **CEOs and Board Members**



Intel / Medtronic

The real value of AI is in making more efficient use of the human resources in healthcare. “They should be supplemented with real, grounded database knowledge that helps make better decisions and provide better care.”

***-Omar Ishrak,*** *CEO of Medtronic, Board member of Intel*

**Source**

Galvanize / Google

“Everything about finance, everything about drug discovery, healthcare issues, quantum computing can actually provide us an answer to it.”

***-Nir Kaldero,*** *CEO of Galvanize,Google Advisor*

**Source**

Johnson & Johnson

J&J top executive after announcing a number of collaborations, including Leveraging AI to Predict Neurodegenerative Diseases:

“Our highest priority is to improve the health of people around the globe, and each collaboration announced today represents a unique opportunity to explore novel therapeutics, medical devices and consumer health solutions.By advancing transformative healthcare innovations together with entrepreneurs, academic centers and institutions, we are one step closer to addressing many pressing global healthcare challenges.”

***-Paul Stoffels****, Board member of Johnson & Johnson*

**Source**

# Notable **CEOs and Board Members**

Siemens
“Siemens now employs around 800 experts for data analysis and AI. In recent years, they’ve made many AI-based successes possible in industrial environments, for example with healthcare AI that enables Siemens to support doctors in evaluating thousands of X-ray images, and thus in ensuring more reliable diagnoses and better treatment for patients”

***-Roland Busch,*** *Board member of Siemens*
**Source**

Microsoft
“AI can change the trajectory of healthcare if properly used.”

***-Satya Nadella,*** *CEO of Microsoft*
**Source**

Google
“Brin`s investment in Parkinson’s disease (PD) research, highlights his transformative support of The Michael J. Fox Foundation (MJFF), and the work being done at 23andMe, the personal genetics company. The collaboration helps share the risk of drug discovery and gives Pfizer access to a worldwide network of experts on LRRK2.”

***-About Sergey Brin****, Board member of Google*
**Source**

# Notable **CEOs and Board Members**

Roche
Three years ago, the Basel-based group secured a majority stake of more than one billion dollars in the US company Foundation Medicine, which specializes in the digital analysis of genome data. Roche now wants to link this with Flatiron's data sets in order to generate even deeper insights into the interaction between genetic factors and drug therapies in cancer treatment.

***-Severin Schwan,*** *CEO of Roche*
**Source**

Pfizer / Adobe
"We continue to think content and data and how content and data come together is really how this magic happens. ... It's all about what is the right content being delivered based on the intelligence,"

***-Shantanu Narayen,*** *CEO of Adobe, Board member of Pfizer*
**Source**

Google
"So tomorrow, if AI can shape healthcare, it has to work through the regulations of healthcare … In fact, I see that as one of the biggest areas is where the benefits will play out for the next 10 – 20 years."

***-Sundar Pichai****, CEO of Google*
**Source**

# Notable **CEOs and Board Members**

Apple
"We can achieve both great artificial intelligence and great privacy standards. It's not only a possibility, it is a responsibility. In the pursuit of artificial intelligence, we should not sacrifice the humanity, creativity, and ingenuity that define our human intelligence."

***-Tim Cook,*** *CEO of Apple*
**Source**

Canon
“We are very proud to have started this cutting-edge collaborative research which will lead to the development of next-generation MRI technology at leading medical institutions both in and outside Japan. We anticipate that this research will prove to be of great value by providing higher-resolution images for clinical diagnosis.”

***-Toshio Takiguchi,*** *Board Member of Canon*
**Source**

Google
“Our team's mission is to "Synthesize the customer voice and drive Google alignment around our education and enterprise solutions."

***-Tracy Frey****, Board Member of Google, Director of Strategy, Cloud AI at Google*
**Source**

# Notable **CEOs and Board Members**

Amgen

Next-generation sequencing allows researchers to sort through the three billion DNA base pairs that produce the muscle, hair, bones, enzymes and antibodies that produce us, and sometimes pinpoint the spots where things have gone awry.“This information has led to the development of drugs for cancer that extend lives and improve quality of life, as well.And there will be many, many more to come.”

***-Tyler Jacks,*** *Board Member of Amgen*

**Source**

Novartis

“I really see artificial intelligence being at the heart of the company, but it's going to take time. This is a long journey.”

***-Vas Narasimhan,*** *CEO of Novartis*

**Source**

Evotec

“Our investment in Exscientia represents Evotec’s single biggest equity placement to date and in, what we feel, is the world’s leading AI technology company”

***-Werner Lanthaler****, CEO of Evotec*

**Source**

# Notable **CEOs and Board Members**

Alibaba
When an emergency arose, City Brain could immediately find the relevant data, such as suspect vehicles, cars involved in accidents, and even criminal suspects. After analyzing relevant data, it can also optimize traffic for the entire city. Going one step further, City Brain can even predict such a situation before it happens. For instance, it can tell you where traffic jams will occur in the next 10 minutes. City Brain is also capable of making predictions much earlier and deploy police and medical resources in advance. It can even prevent traffic accidents by instituting preemptive traffic control and policing.

***-Xian-Sheng Hua,*** *Board Member of Alibaba*
**Source**

Calico / Roche
“Calico focuses on learning about and then combating aging and age-related diseases. The subsidiary uses AI to make sense of large datasets as well as to automate certain lab processes.”

***-Arthur Levinson,*** *CEO of Calico, Board member of Roche*
**Source**

Sanofi
“We have an environment with robots, artificial intelligence and virtual reality equipment and we ask a new team of workers every morning, who have never felt that environment, to come in and challenge them to do tasks by lunchtime. It's astonishing how quickly they learn.”

***-Bernard Charles****, Board Member of Sanofi*
**Source**

# Notable **CEOs and Board Members**

IBM
“Watson and its analytic functionalities are going to help companies stay on the cutting edge of technology and make sure they’re serving their clients in the most forward-thinking way possible – and that includes healthcare organizations aiming at better quality of care for patients.”

***-Bob Picciano,*** *Board Member of IBM*
**Source**

Evotec
“We are very excited to collaborate with Immuneering on its unique AI-driven approach to ligand identification. This is a significant opportunity to develop novel drugs targeting disorders of lysosomes that drive different clinical presentations in many rare genetic metabolic and neurodegenerative diseases with high unmet medical need. We look forward to exploring the powerful combination of these technologies and enhancing our drug discovery capabilities in our core areas of focus.”

***-Cord Dohrmann,*** *Board Member of Evoteck*
**Source**

Novartis
“The Future is Now: Artificial Intelligence in Ophthalmology and Retina.”

***-Dimitri Azar****, Board Member of Novartis*
**Source**

# Notable **CEOs and Board Members**

Sanofi / l'Oréal

New data processing techniques are combined with artificial intelligence to foster and support scientific discoveries. Digital tools now extend to molecular modelling and rapid-result testing robots, to continue to guarantee us high standards for quality, efficacy and safety.

***-Laurent Attal,*** *Board Member of Sanofi Executive Vice-President l'Oréal*

**Source**

Baidu

“Baidu Research brings together global research talent to work on AI technologies in areas such as image recognition, speech recognition, high performance computing, natural language processing and deep learning. Baidu Research comprises four labs: the Silicon Valley AI Lab, the Institute of Deep Learning, the Big Data Lab and the Augmented Reality Lab.”

***-Lin Yuanqing,*** *Board Member of Baidu*

**Source**

# Conclusions

It is an axiom that CEOs and Board Members need to properly understand how applying of Artificial Intelligence in Pharma and Tech can be used to help them meet their goals. Moreover, its applying will become a new dimension that will be used by the financial community to determine current and future market valuations of organisations.

Simply explained, CEOs and Board Members who are AI-friendly and able to demonstrate the use of AI in adjacent areas, especially in Pharma or Healthcare, will be valued higher than their peer organisations who are not using any form of AI in their operations. We predict that the use of AI by companies will become a standard component analyzed by fund managers to evaluate companies for investment.

According to our research, top-100 AI-Friendly CEOs and Board Members occupy their positions in top-30 Pharma and Tech companies. Most of them operate in the Pharma industry whereas only 34% serve in Tech corporations in some capacity. Only 3% of top-100 CEOs and Board Members have intense experience through practice and education both in Drug Development and Artificial Intelligence fields. This fact makes it possible to draw conclusions about kind of such people uniqueness. Only 20 CEOs among 30 Pharma and Tech companies are AI-Friendly and support the idea of AI implementation in Healthcare industry.

The geographic distribution of top-100 AI-Friendly CEOs and Board Members is characterized by their concentration in the US, Germany and Japan. Therefore, mentioned above countries are pretendents to be attractive research, innovation and business centres for AI in Pharma experts abroad, attracting and holding on to the best talents in AI, and to considerably expand their capacities in the field of AI. We predict, that this statistics may substantially change over the coming years in favor or China, firstly -- due to a strong government support for AI-driven healthcare and pharma initiatives, secondly -- due to relatively lower bureaucratic and regulatory barriers for “controversial” research, and thirdly -- due to an emerging trend for a “reverse migration” of Chinese top experts from Western countries back to China.

Consequently, all the information provided in this report allows leaders in Pharma and Tech to garner facts they can confidently relay to their executive teams so they can make informed decisions when thinking about AI adoption.

# Next Editions Overview

Next edition of the report will concern profound research on “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations. The list of CEOs and Board Members will be expanded to 150 executives from a broadened number of companies in the pharmaceutical and technology industries.

The main focus will be made on the contribution of market makers in development of AI technologies for Drug Discovery and implementation of powered deep learning techniques into research and development of new medical treatments. CEOs and Board Members will be ranked by the impact of their work in deep learning, whether this is the work that can accelerate the discovery and development of new drugs.

In the next edition of TOP 150 “AI-Friendly” CEOs and Board Members of Pharma and Tech Corporations will be announced what companies are the key players in the development and implementation of the AI for DD. Also, the readers will find out what is the ranking of “AI-Friendly” executives among industries and how can the contribution of powered deep learning techniques for Drug Discovery be measured and evaluated. The answers on the questions will be structured and visualized with interactive mindmaps, graphs and easy-to-follow spreadsheets with useful information.

The report will deliver:

- A thorough analysis of the performance of pharma and tech AI corporations considering their relation to AI for Drug Discovery industry;
- CEOs and Board Members of Pharma and Tech Corporations ranking by various dimensions and measures;
- Analysis of key market players in the AI for Drug Discovery and Biomarker Development landscape.

DEEP
KNOWLEDGE
ANALYTICS
*PHARMA DIVISION*

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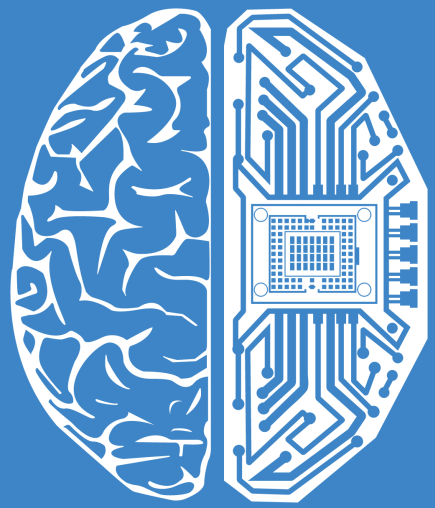

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