

A New Framework to Address Increasing Complexity in AI & DeepTech

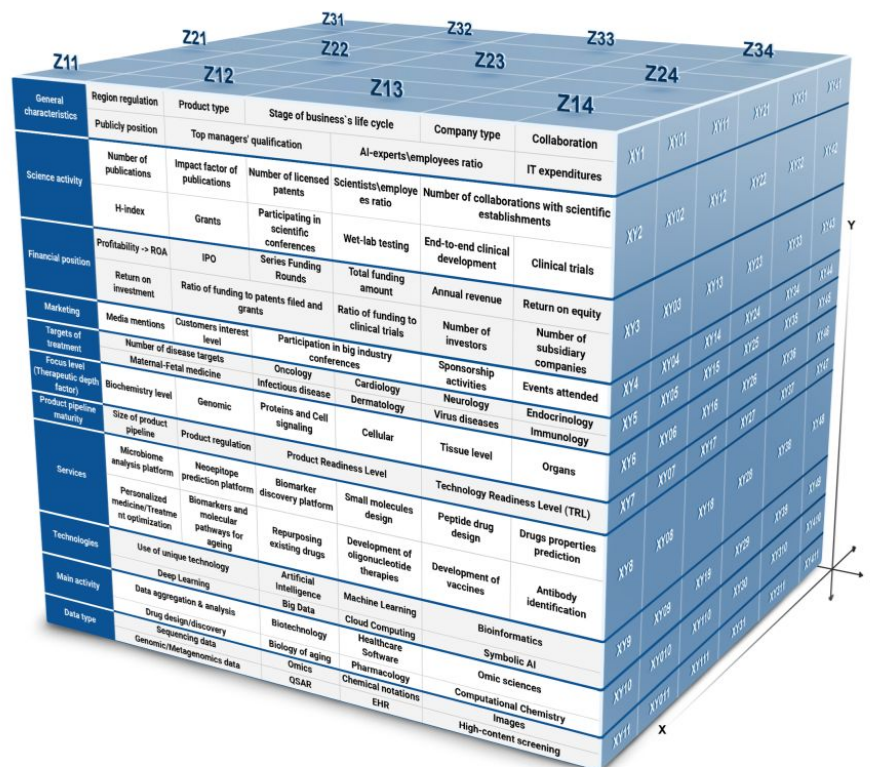
Five years ago, innovation was driven by advancements in a single domain. Today, change occurs at the intersection of two or more scientific and technological domains.

Deep Knowledge Ventures is a DeepTech investment fund that values knowledge so much that it has embedded the word knowledge in its name. The fund has two analytical subsidiaries that it considers among its most precious assets. One subsidiary, [Deep Knowledge Analytics](#) focuses on advanced DeepTech and the application of AI to Healthcare and Drug Discovery. The other subsidiary, [Aging Analytics Agency](#) focuses on the science, business, and economics of Longevity. Together these two subsidiaries drive the fund toward its long term strategic vision by identifying investment targets and systemizing due diligence in frontier technologies.

The intersection of science and technology is driving both the complexity and the pace of innovation in AI and DeepTech. Paradigm shifts are already occurring in industries dominated by deep science and emerging technologies. In the next five years, with the arrival of more advanced technologies, we will start to see even conservative and slow-moving industries transformed by innovation. Conservative industries will be forced to evolve in the face of significant technological change despite their natural conservatism.

Consider for instance the management of entire countries, or the governance of entities such as pension funds. These domains are neither technocratically driven nor marked by a rapid pace of innovation. They typically make their strategic decisions reactively rather than proactively. But, under the pressure of emerging technologies, and AI in particular, it is inevitable that even entities in ultraconservative domains will come to be driven by disruption and innovation.

We are at the beginning of a trend where the degree of complexity and the number of convergence points will increase exponentially.



Deep Knowledge Ventures' decision to focus specifically on the convergence of advanced science and technology was a deliberate choice. The creation of this 3D analytical framework was necessitated by the complexities of the sector and required for a pragmatic understanding of the industry in order to structure investment strategy. The development of multidimensional

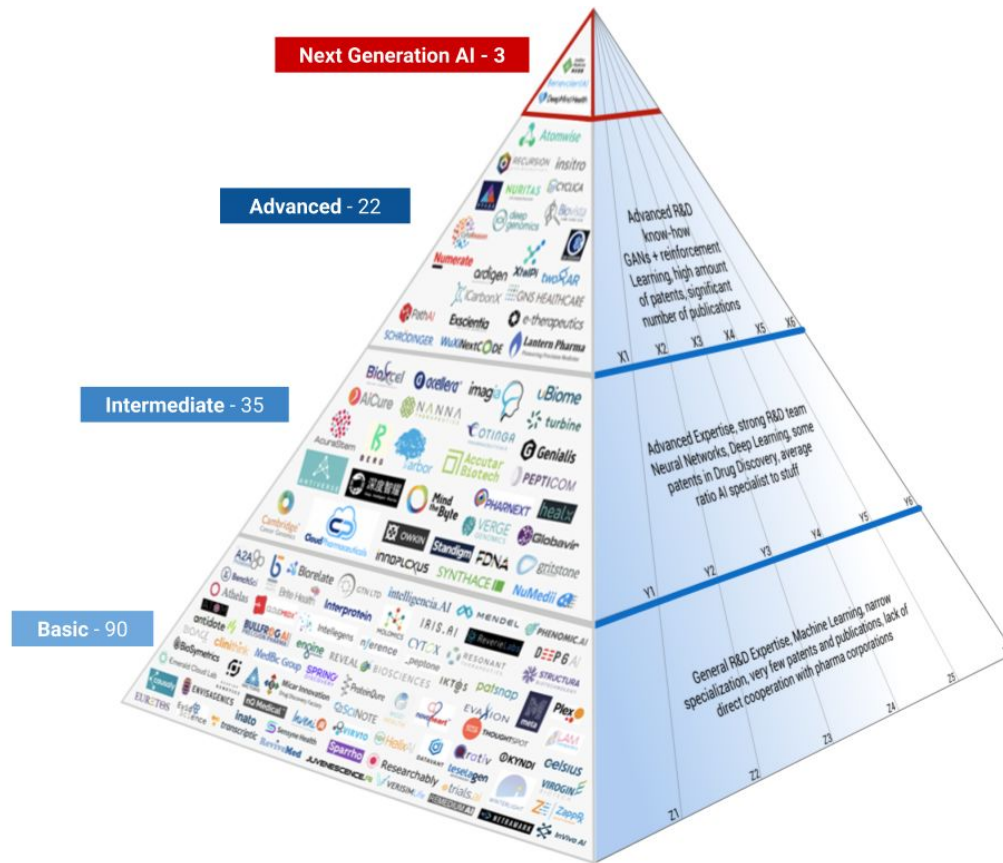
analytical frameworks that possess a level of complexity proportional to the industries they are analyzing is necessary to conduct effective analysis, forecasting, and benchmarking. Deep Knowledge Ventures has invested in a number of companies applying AI for Drug Discovery and Biomarker Development.

In 2018 it aggregated its industry intelligence under the umbrella of [*Deep Knowledge Analytics Pharma Division*](#) which has become the leading analytics entity in the AI for Drug Discovery sector. DKA publishes multiple open-source reports with the aim of accelerating the development of the entire sector and improving the implementation of AI in Pharma in particular. DKA also produces a number of specialized proprietary analytical reports for corporate clients and strategic partners.

The AI for Drug Discovery sector is focused on designing new blockbuster drugs - drugs that can generate at least \$1 billion annually. The objective of applying AI for Drug Discovery is to find more efficient and targeted ways to discover new drugs. Companies in the AI for Drug Discovery sector are focused on the needs of Pharma companies, which are trying to develop the next blockbuster drug aimed at a single disease and optimized for effectiveness in all patients equally. The Pharma business model which was established over 40 years ago has not evolved significantly since that time, and has some very obvious limitations.

In Personalized Precision Medicine drugs will be designed and optimized for each individual person and delivered using precisely tailored dosing methods developed for each individual.

As AI for Drug Discovery becomes more sophisticated, the focus will move to *Personalized Precision Medicine*. When we reach this milestone in the evolution of drug discovery, drug development companies will switch from blockbuster drugs to Personalized Precision Medicine, where drugs will be designed and applied using precise, individually tailored methods of dosing, drug cocktail composition, and accurate efficient delivery. Medicine will be optimized for each individual person and varied according to their genetics, current state of health, age, and many other parameters. The next major innovation in drug discovery will be moving away from single drugs optimized for entire patient populations, and towards increased personalization.

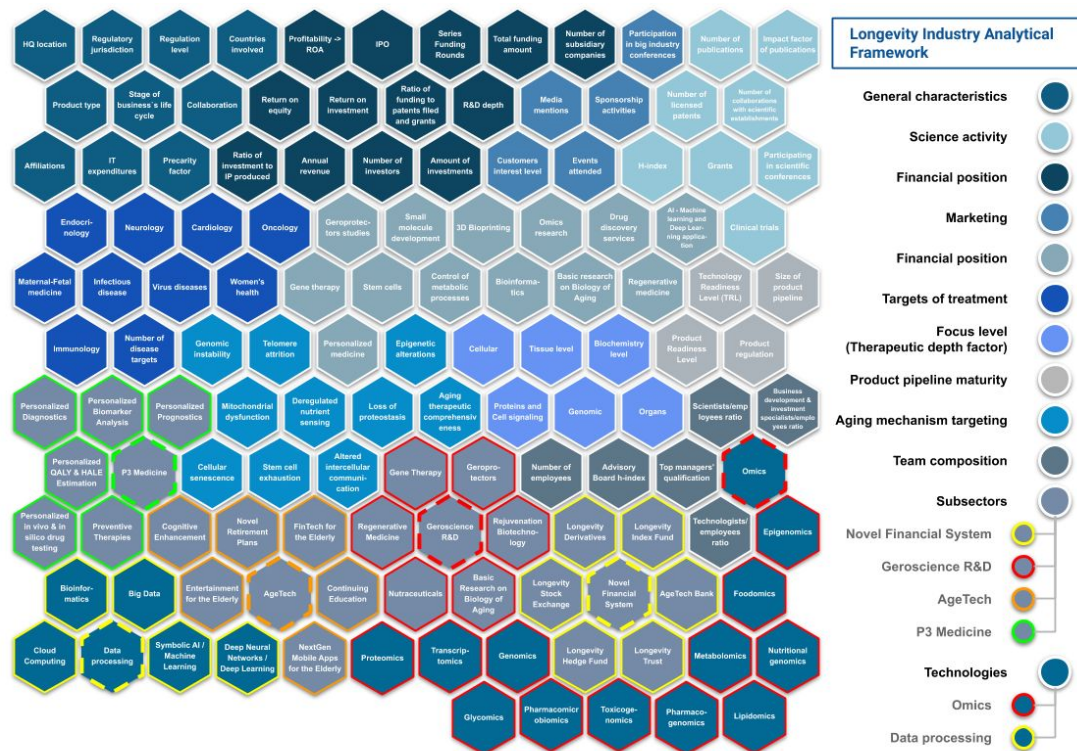


Deep Knowledge Analytics and Aging Analytics Agency are recognized among industry experts for the quality, rigor and periodicity of their industry benchmarking, and for employing quantitative analytical frameworks to rank industry entities, experts, technologies, and practical applications.

The Longevity sector is the most complex area in AI for Drug Discovery because Longevity requires complete optimization of health at the deepest level targeting biological systems that control disease.

In the most advanced stage, AI for Drug Discovery will focus on *Precision Health* and *Healthy Longevity* rather than *Precision Medicine*. The Longevity sector is the most complex area of AI for Drug Discovery because Longevity focuses on prevention rather than treatment. Longevity requires complete optimization of health at the deepest level targeting biological systems that

control disease. This stage will mark the shift from precision medicine to precision health, developing drugs not for just single diseases, but entire states of patient health. The Precision Health stage is the most complex and will require the most advanced next-generation technologies.



Aging Analytics Agency's Proprietary Longevity Industry Classification and Benchmarking Framework uses dozens of specially-designed and specifically weighted quantitative metrics and sub-metrics to identify the specific scientific, technological, executive management and business development strengths, weaknesses and prospects of Longevity Industry companies.

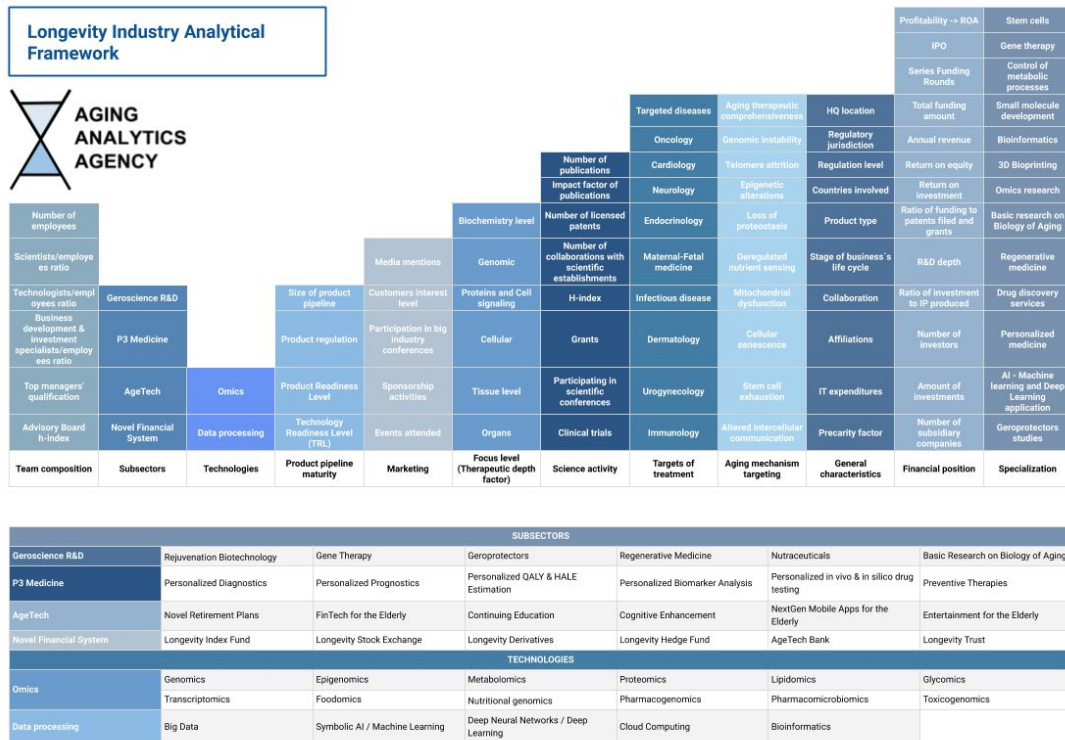
Precision Health will be 100x more complex than current models.

The most sophisticated tools will be required to assess companies working in the field of Precision Health and Longevity. Compared to the current business models and technical approaches to the discovery, design and delivery of drugs, the shift towards Personalized Precision Medicine will be 10x more complex and multidimensional, and correspondingly the further shift from Precision Medicine to Precision Health will be 100x more multidimensional and complex.

The methods used for industry analysis, investment target identification, and due diligence during these two oncoming paradigm shifts will be proportionately more advanced, multidimensional and sophisticated than they are today. Current methods are already insufficient to handle the complexity of the AI for Drug Discovery sector. Tools currently used for strategic decision making will become obsolete as biopharma shifts from blockbuster drugs to Personalized Precision Medicine and eventually to Precision Health.

By 2030 business models underlying Precision Health will be standard in developed countries.

Although some analysts predict that the shift to Precision Health is decades away, our forecasts show that it is quite reasonable to expect that the approaches and business models underlying Precision Health will be standard in developed countries by 2030. In fact, in many countries significant elements will be achieved by 2027. Intermediate steps like personalized advanced biomedicine capable of delivering elements of precision health will be achievable in some regions as early as 2025.

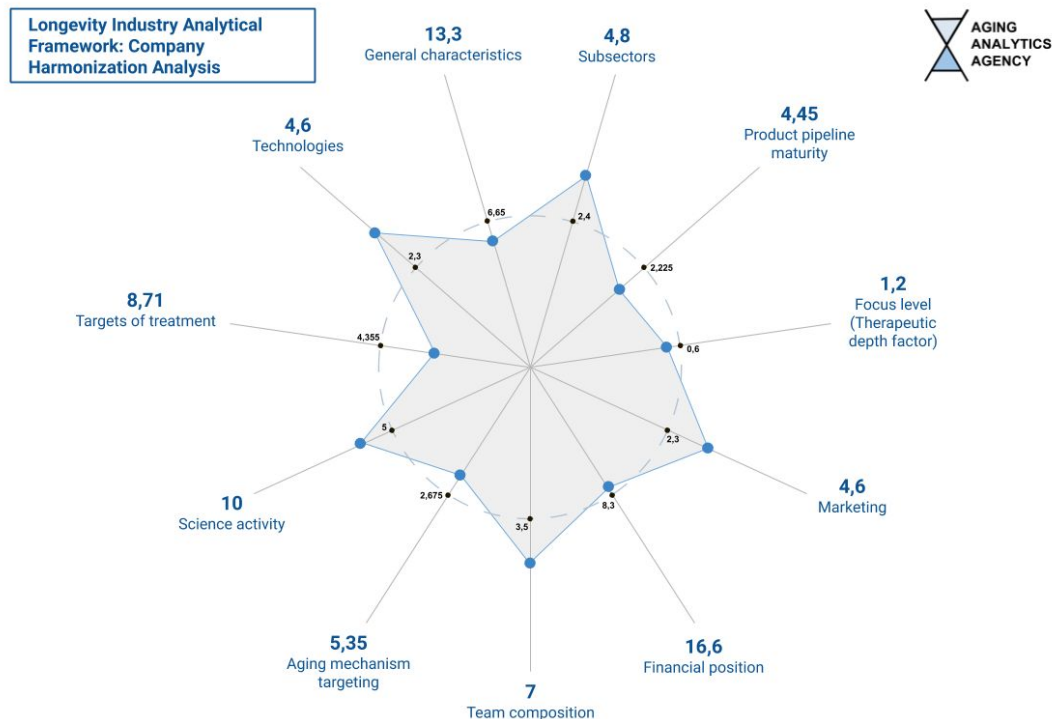


The proprietary analytical frameworks used by Deep Knowledge Analytics and Aging Analytics Agency utilize hundreds of parameters to quantify, benchmark and forecast developments in frontier-technology driven industries and also structure those metrics and their importance in highly organized and multi-dimensional ways in order to efficiently manage the volume of data involved in comparative analyses.

Doctors in precision health clinics will be hands-on and patient-centric.

We expect to see intermediate progress towards this shift as early as 2023. This will include the widespread use of AI for blockbuster drug discovery, and the shift from the single-drug-fits-all business model towards Personalized Precision Medicine. During this time major changes will occur in healthcare. Healthcare decisions will be transferred from doctors to IT-systems and progressive healthcare clinics will be managed by technical engineers and IT-company executives. The doctor's role will shift to being hands-on and patient centric. Preventative health clinics will be managed by engineers. Doctors in these clinics will be similar to mechanical engineers in aerospace. Maintenance of patient health will be transferred from doctors to IT-systems, and clinics will be managed by people using methods currently used in the aerospace

Over the past several years, our two analytical agencies have published tens of thousands of pages of open-access, free-of-charge reports on the AI for Drug Discovery and Longevity sectors. We produced these reports primarily to gain a broad understanding of these industries, in order to lay the groundwork for understanding exactly who is active, what they are doing, and who among them is progressing or regressing. Based on the traction already achieved with these analytical reports, both agencies are now working on expanding the application of these analytical frameworks to new topics and sectors. We are crystalizing a solid foundation of deep industry intelligence into robust analytical systems, equations, algorithms, approaches and methods.

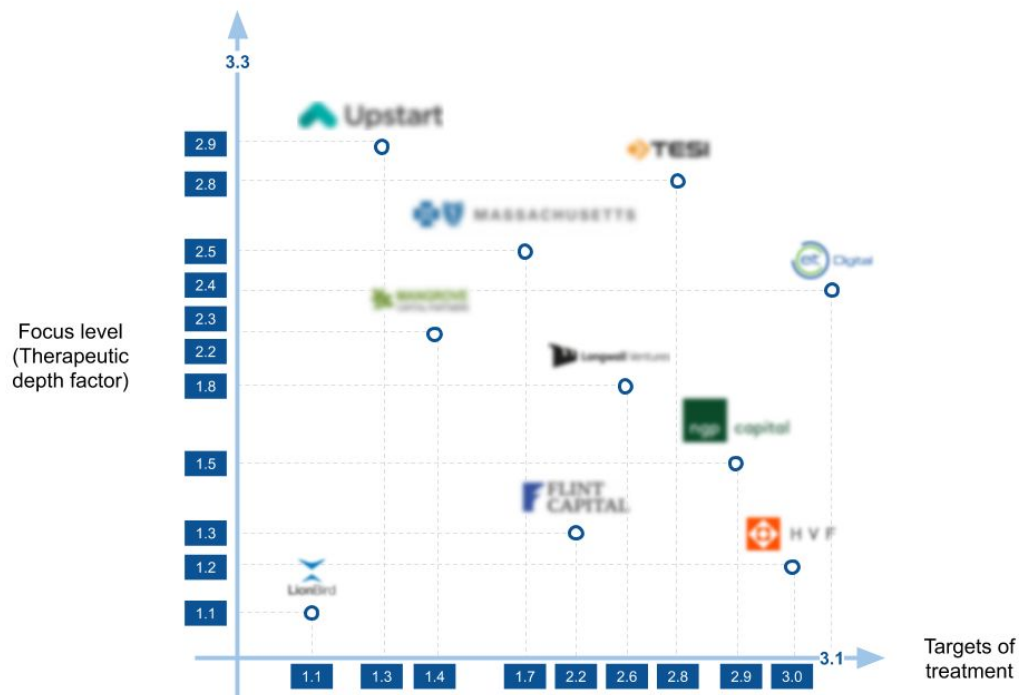


The proprietary reports produced by Aging Analytics Agency and Deep Knowledge Analytics utilize a variety of insightful comparative analyses including company harmonization analyses

showing how companies compare in terms of the ratio of their strengths in key areas including scientific validation, business development, marketing, financial position, executive management composition, technology pipelines, and other relevant domains.

Since its inception in 2013, Aging Analytics Agency has been applying systematic methodologies to create different types of analytical frameworks that define and classify distinct scientific domains, technologies and applications. These methodologies are continually refined to maintain relevance with the changing dynamics of each industry where they are applied. In fact, we continually to refine *all* areas of these comparative analysis systems, including the specific metrics used to conduct market studies, the mathematical formulas used to combine them, and the advanced visualization techniques used to make this complex information comprehensible.

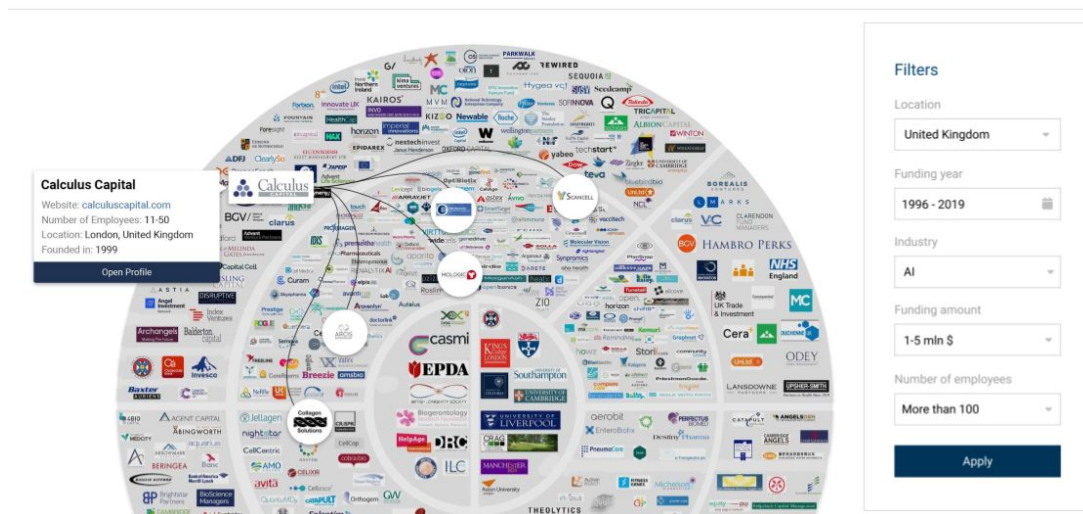
Product Pipeline Comparative Analysis
Therapeutic Depth vs. Breadth Ratio



The proprietary analytical reports produced by Aging Analytics Agency and Deep Knowledge Analytics utilize a variety of insightful comparative analyses, including comparison charts showing the ratio of therapeutic breadth to therapeutic depth of companies' product and service pipelines. These ongoing proprietary analytics have consistently been accompanied by the

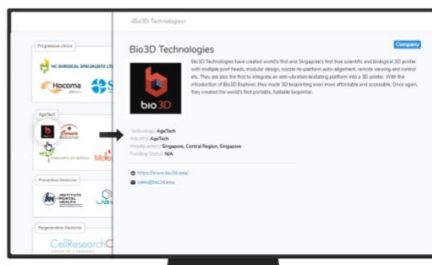
production of vast open-access landscape overviews of the Longevity industry including particular geographic regions, and specific technological domains, in many cases more than 1,000 pages in length.

The purpose of producing these broad landscape overviews is to serve as an analogue of Wikipedia or Encyclopedia Britannica for the Longevity industry, widely disseminating ongoing developments in the global Longevity Industry in order to promote its continued growth, expansion and refinement. They also serve an important secondary purpose as well: laying the groundwork for a comprehensive understanding of the entire scope of the industry across the globe, and facilitating a greater comprehension of the specific industry players, their activities, and their interconnections. These reports establish the necessary foundation upon which more targeted, relevant and complex analyses can be executed.



This interactive online Longevity Industry Database will feature customizable filtering of data and data visualization, and machine learning-driven smart matching to automatically provide users with relevant and valuable networking and partnership suggestions. Furthermore, in the latter half of 2019, Aging Analytics Agency will be aggregating the large volume of data contained in its report profiles into an online Longevity Analytics Platform and database featuring interactive visuals which can transform static analytical reports into dynamic infographics updated in real-time.

Aging Analytics Agency's beta prototype Longevity Industry Analytics Platform is live and available at mindmaps.aginganalytics.com. The official version will launch in **Q3 2019**, featuring **10,000 entities** classified into the four key sub-sectors. Built to serve as the next-generation solution for industry optimization, it will equip all participants with tangible tools for stakeholder smart-matching, with a strong focus on cross-discipline dialogue and synergetic cooperation.



Aging Analytics Agency's interactive online IT platform will turn static data and mind maps into dynamic data-driven environments where Longevity industry data can be filtered, visualized and interacted with in useful and interesting ways. This platform will enable complex interaction between industry entities and stakeholders and will provide a dynamic lens through which to view emerging trends and activities in the global Longevity industry. Once created, this platform will be continuously updated with real-time industry developments and will be significantly upgraded with the integration of additional advanced visualization, data analysis and stake-holder smart-matching capabilities.

This work on the development of sophisticated, multidimensional comparative analysis frameworks and methodologies has culminated in a strong reputation among industry stakeholders. We have become the primary source of industry data and analytics for a number of leading organizations, including in the case of Deep Knowledge Analytics the AI for Drug Discovery focused hybrid hedge fund AI-Pharma, and in the case of Aging Analytics Agency the Longevity-focused hedge fund [Longevity.Capital](#), and the recently-established [UK All-Party Parliamentary Group for Longevity](#).



The All-Party Parliamentary Group for Longevity, launched in Q1 2019, is dedicated to turning the problem of Aging Population into the opportunity of Healthy Longevity for the UK, with a strong focus on accelerated developments in preventive medicine, innovations in healthcare, the synergetic convergence of AI and advanced biomedicine, and financial reform for pension systems.

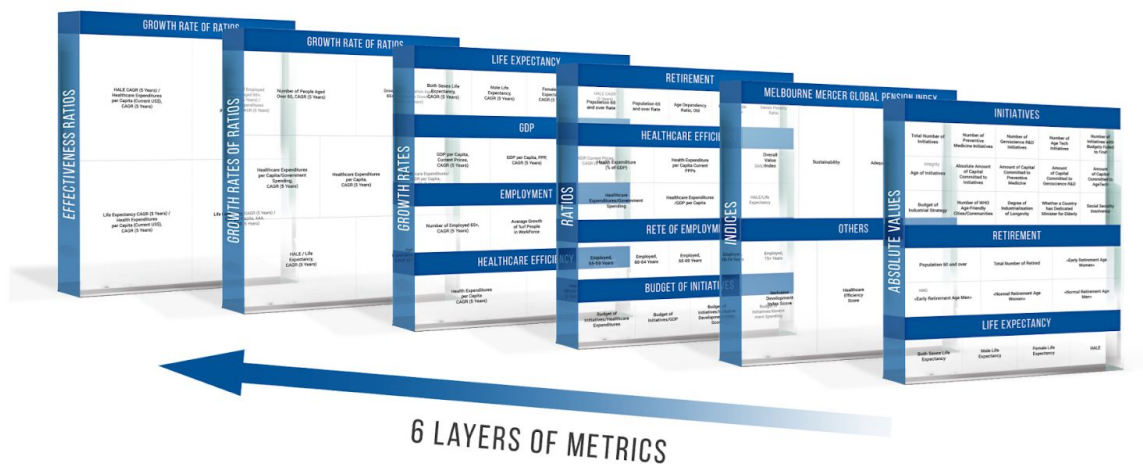
Aging Analytics Agency has experienced a new development in the evolution of its overall analytical focus. Previously it was focused on specific sectors of the biomedicine industry and scientific / technological domains relating to Longevity. In response to work with several Government-related organizations globally, such as the All-Party Parliamentary Group for Longevity, and to recent enhancements to its executive management team (such as Eric Kihlstrom, former Director of the UK Government-led £98 Healthy Aging Industrial Strategy Challenge Fund), the agency has begun to focus significant resources on the production of sophisticated open-access and proprietary analytics on the topics of Longevity Governance and Governmental Development Plans, and on the intersection of Longevity and the Advancing Financial Industry of Pension Funds and Insurance Companies, and global market of financial instruments and derivatives related to *Longevity Risk*.



Aging Analytics Agency's recent *National Longevity Development Plans: Global Overview 2019* report necessitated an unprecedented level of data aggregation, parsing, and analysis in order to arrive at its benchmarking of Government-led National Longevity Development Plans, Projects and Initiatives.

The first of these activities was a 315-page open-access report from Aging Analytics Agency entitled [National Longevity Development Plans: Global Overview 2019](#). This report, which was presented in UK Parliament as part of the All Party Parliamentary Group for Longevity on May 7, 2019, delivers a detailed international overview of the projects, initiatives and efforts that various countries around the world are making to combat the issues associated with Aging Population and to promote the extension and maintenance of their citizens' Healthy Longevity.

This report necessitated the development of specifically-designed analytical metrics with which to judge the strength, proactiveness, and relevance of various government-led Longevity-related development initiatives. Taken into account were 77 parameters, each consisting of several dozen data points, with specific weight factors given in proportion to their relevance and likelihood of delivering tangible deliverables such as an increase in National Healthy Longevity (measured by Health-Adjusted Life Expectancy), and a reduction in the economic burden of Aging Population.



The metrics developed for Aging Analytics Agency's *National Longevity Development Plans: Global Overview 2019* report are broken down into 6 distinct layers, with specific ratios being derived from 1st layer metrics, specific metric ratios and growth rates of ratios being derived from 3rd-layer metrics, effectiveness measures being derived from 4th layer metrics, and effectiveness measure growth rates being derived from 5th layer metrics.

The international Longevity initiative benchmarking used in this report was developed with the aim of predicting the capabilities of specific nations to implement new Longevity Industrial Strategies within the next four years, and to proactively transform their healthcare systems to embrace the paradigm shift from treatment to prevention. The report assessed the activities and initiatives of nations in the same way that Deep Knowledge Analytics and Aging Analytics Agency would have assessed the capability for corporations, such as Pharma or Tech corporations to embrace frontier technologies like AI in Drug Discovery, assessing quantitative metrics in order to conduct benchmarking, trend identification and forecasting.

However, the agency's analysts encountered one specific problem during the first stage of this process. Consider that the effective analysis of the AI for Drug Discovery sector requires taking into account at least 100 data points, while the Longevity Industry necessitates taking into account at least 300 data points, in proportion to their respective levels of complexity. Conducting pragmatic and tangible analysis of the activities of entire governments and nations on the front of Healthy Longevity requires taking into account over 1000 data points due to the combination of the larger scale of activities.

We also found that a number of countries analyzed in the report failed to disclose certain data to major sources of international statistics, such as the United Nations, World Health Organization, and the World Economic Forum. Presumably in some cases such data would cast a negative light on the country's current state of Healthy Longevity and healthcare efficiency.

Transforming Aging from a Challenge to an Opportunity



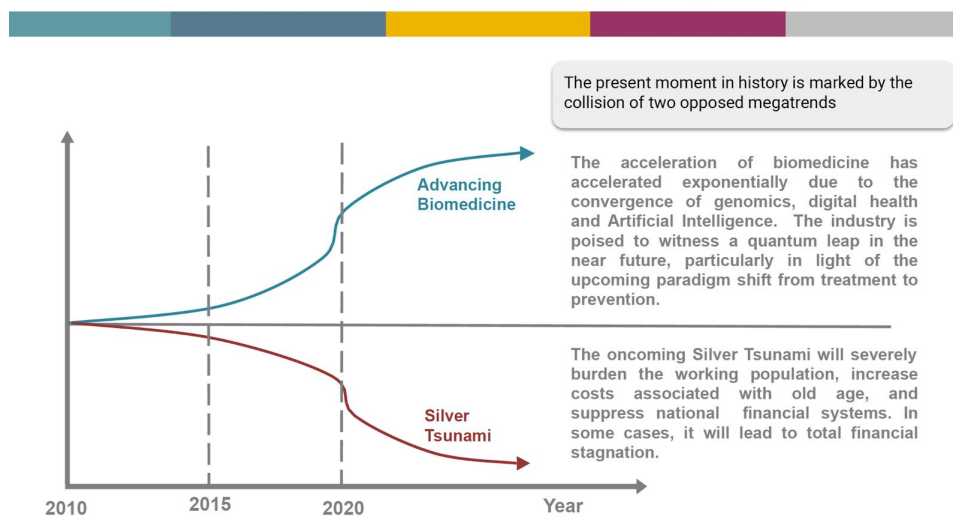
Aging Analytics Agency's upcoming proprietary Advancing Financial Industry Longevity / AgeTech / WealthTech report offers key strategic insights on how large financial corporations can tap into the multi-trillion dollar market of people in retirement, and retune their existing business models to avoid stagnation under the economic pressures of a rapidly aging population, transforming Aging from a challenge to an opportunity.

Aging Analytics Agency is currently working on the production of a proprietary analytical report focused on the intersection of [Longevity, AgeTech and the Financial Industry](#), a domain dominated by an even higher degree of complexity than government-led national Longevity

development initiatives. The first edition of this report will be followed by a number of special case studies focused on specific sectors within the Financial Industry, assessing the activities, prospects and capabilities of large financial institutions, including pension funds and insurance industries, to enter the growing Longevity financial industry and adjust their business models to increasing life expectancies.

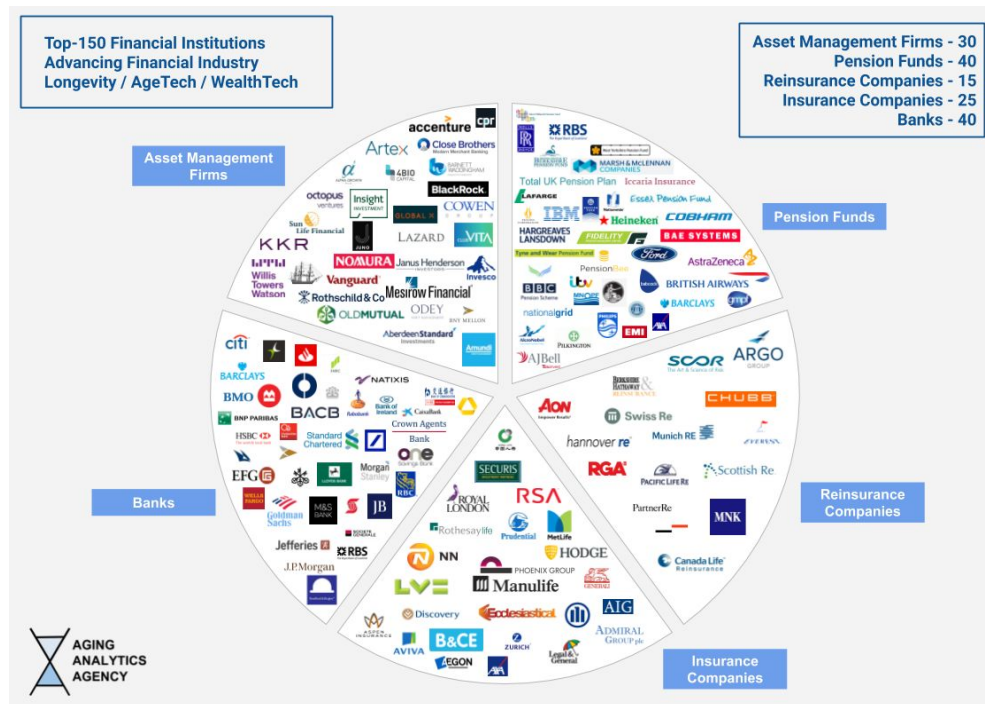
The major analytical deliverables, insights, trends and data from these special case studies will be aggregated and assembled into new, extended and updated editions of the main, industry-wide landscape overview reports. These reports will be released every financial quarter, incrementally increasing the precision and actionability of industry analysis, and depth of its forecasts.

Collision of Two Opposed Longevity Megatrends



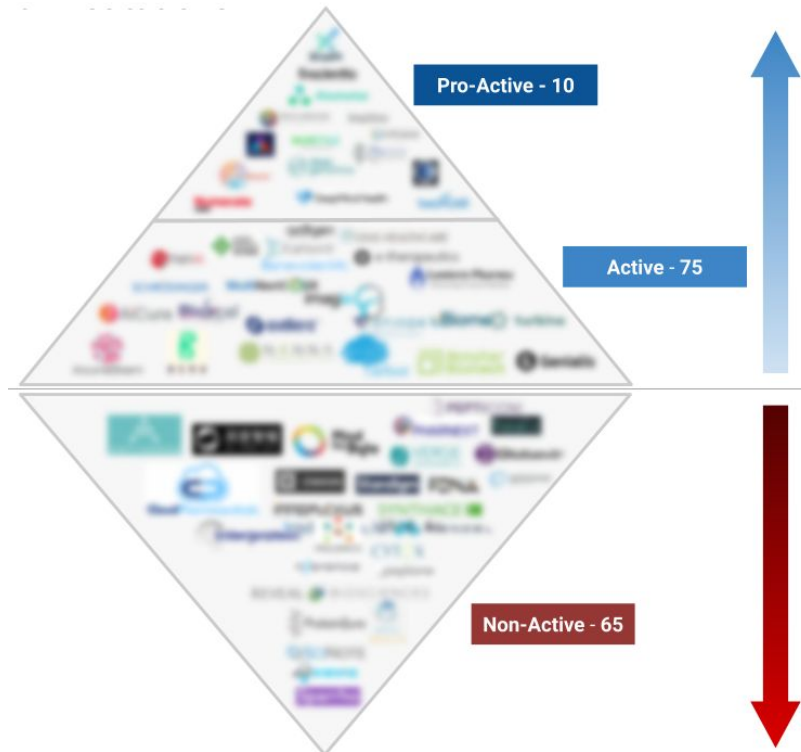
The present moment in history is characterized by the convergence and oncoming collision of two opposing Longevity Megatrends: advanced biomedicine, which can increase Healthy Longevity and reduce the burden of aging populations, and the silver tsunami, which threatens to shrink the size of working populations, strain existing age-dependency ratios, and potentially break national healthcare systems if not addressed proactively.

Each new edition will provide a more sophisticated, comprehensive and precise understanding of the challenges and opportunities related to Longevity, as well as what financial institutions such as private wealth and retail banks, pension funds and insurance companies should do to benefit from the oncoming collision of two opposed Longevity MegaTrends: Advancing Biomedicine and Silver Tsunami.



Aging Analytics Agency's mind map of the top 150 financial institutions with relevant activities in the Longevity sphere, classified into several subcategories including banks, asset management firms, pension funds, insurance companies and reinsurance companies.

Aging Analytics Agency's analytical framework and methodology for its upcoming proprietary *Advancing Financial Industry* report takes into account both the concrete, visible Longevity-related activities of financial institutions, and also the lack of activity and the future prospects for growth and entry into Longevity-related markets, assigning both positive and negative ranking.



The production of this report has necessitated the development of specifically-designed analytical metrics (along with unique weight factors and overall metric and sub-metric structuring and layering) in order to measure the prospects, proactiveness and opportunities that major financial institutions face against the challenges of Aging Population and the opportunity of Healthy Longevity, and what tangible measures they can take to transform the problem and deficit-model of aging into an opportunity and asset-model of Longevity.

The global AgeTech, Longevity Finance and Advanced Longevity Derivatives market is a multi-trillion dollar opportunity set to either make or break large financial institutions such as banks, pension funds and insurance companies, who can either expand and evolve to capture this emerging market, or stagnate under the pressures of an aging population.

Next Multi-Trillion Underdeveloped Market for Financial Institutions



“ The one billion retired people globally are a multi-trillion dollar opportunity for business ”
— Dmitry Kaminskiy interview in the Financial Times.

The global Longevity financial industry is a multi-trillion dollar opportunity for progressive banks, asset management firms, pension funds and insurance companies, and one that is both extremely large, multidimensional and complex, and also one possessing several very interesting features. Its scale is on the level of several tens of trillions of dollars, and yet it is marked by a distinct lack of innovation within the past 50 years, a resistance to embracing technological change, and to re-tuning business models in a manner that is relevant for the dynamic of scientific and technological progress. There are already fundamental changes taking place in the financial industry specifically due to innovations in Longevity, and we can expect to see a paradigm shift in their standard operating procedures, products, services, and core business models directly in response to advances in Longevity not within the next several decades, but within the next 2-5 years.

InvestTech Solutions

Deep Knowledge Ventures will continue to support the production of advanced analytical reports focused on frontier technology-driven industries through its analytical subsidiaries. Our objective is to develop next generation analytical frameworks with a wider scope of metrics and overall analytics, to apply efficient methods to cross-sector analysis between different industries. We plan to apply existing and new analytical frameworks to the design of new InvestTech solutions. These InvestTech solutions are novel investment technologies and strategies that will be applicable for the third decade of the twenty-first century. This is the only relevant way to implement the long-term strategic vision of Deep Knowledge Ventures.

About Deep Knowledge Ventures

[Deep Knowledge Ventures](#) is a leading investment fund focused on the synergetic convergence of DeepTech verticals, frontier technologies and technological mega-trends. Deep Knowledge Ventures is renowned for its use of sophisticated analytical systems for investment target identification and due-diligence. Major investment sectors include AI, Precision Medicine, Longevity, Blockchain and InvestTech. [@DeepTech_VC](#)

About Deep Knowledge Analytics

[Deep Knowledge Analytics](#) is the DeepTech analytical arm of Deep Knowledge Ventures, specializing in forecasting the convergence of technological mega-trends, conducting special case studies, and producing advanced industry analytical reports on the topics of AI, DeepTech, GovTech, Blockchain, FinTech and Invest Tech. DKA's Pharma Division is the leading analytical entity specifically focused on providing deep intelligence on the Pharma industry and the AI for Drug Discovery sector, and serves as the main source of market intelligence and analytics for AI-Pharma, a specialized hybrid hedge fund. [@DK_Analytics](#)

About Aging Analytics Agency

[Aging Analytics Agency](#) is the world's premier provider of industry analytics on the topics of Longevity, Precision Preventive Medicine, Economics of Aging, and the convergence of technologies such as AI and Digital Health and their impact on the healthcare industry. The company provides strategic consulting services in areas related to Longevity, and currently serves as the primary source of analytics for the specialized index hedge fund Longevity.Capital, and for the UK All Party Parliamentary Group for Longevity. [@AgingAnalytics](#)

This article was written by Margaretta Colangelo and Dmitry Kaminskiy.

[Dmitry Kaminskiy](#), General Partner at Deep Knowledge Ventures, is based in London. Dmitry is Head of International Development of the Secretariat for the All Party Parliamentary Group for Longevity and Managing Trustee of the Biogerontology Research Foundation.

[Margaretta Colangelo](#), Managing Partner at Deep Knowledge Ventures, is based in San Francisco. Margaretta serves on the Advisory Board of the AI Precision Health Institute at the University of Hawai'i Cancer Center.