Chapter VII
Novel Financial System
2020-2025 Perspective

- Introduction
- Venture Funds
- Progressive BioPharma
- Hedge Funds
- AgeTech Banks
- Pension Funds / Insurance Companies
- Longevity Trust
- Longevity Stock Exchange
- Derivatives
- Longevity Index Fund

"To finance longer life spans, we must convince individuals to start investing now for the long term. But longevity should be an asset that can be leveraged, not a curse."

- *Laurence D. Fink, BlackRock Capital, Chairman of the World's Biggest Investment Fund, with $6.28 Trillion under management.*

The current financial system was designed 50-100 years ago, at a time when no one could imagine that life expectancy could increase at all, nevermind to the extend with which it has actually increased in the past 50 years. To adjust to the current reality nations will have to endure multiple financial paradigm shifts, gand experience of several significant financial crisis cycles. And they will have to enable these shifts fast if they hope to avoid systemic stagnation, within the next 10-15 years.

The backbone of today's global financial system do not possess the resources or infrastructures needed to enable such rapid adaptation and adjustment. This is why this report concludes that the necessary changes required to weather this storm will be deep and fundamental shifts, almost equal to the creation of wholly novel financial system from scratch.

This chapter considers how a preliminary blueprint of the novel financial Longevity economy should be designed, and outlines major topics which will be covered in greater detail in a forthcoming special report later this year titled "**Novel Financial System".**

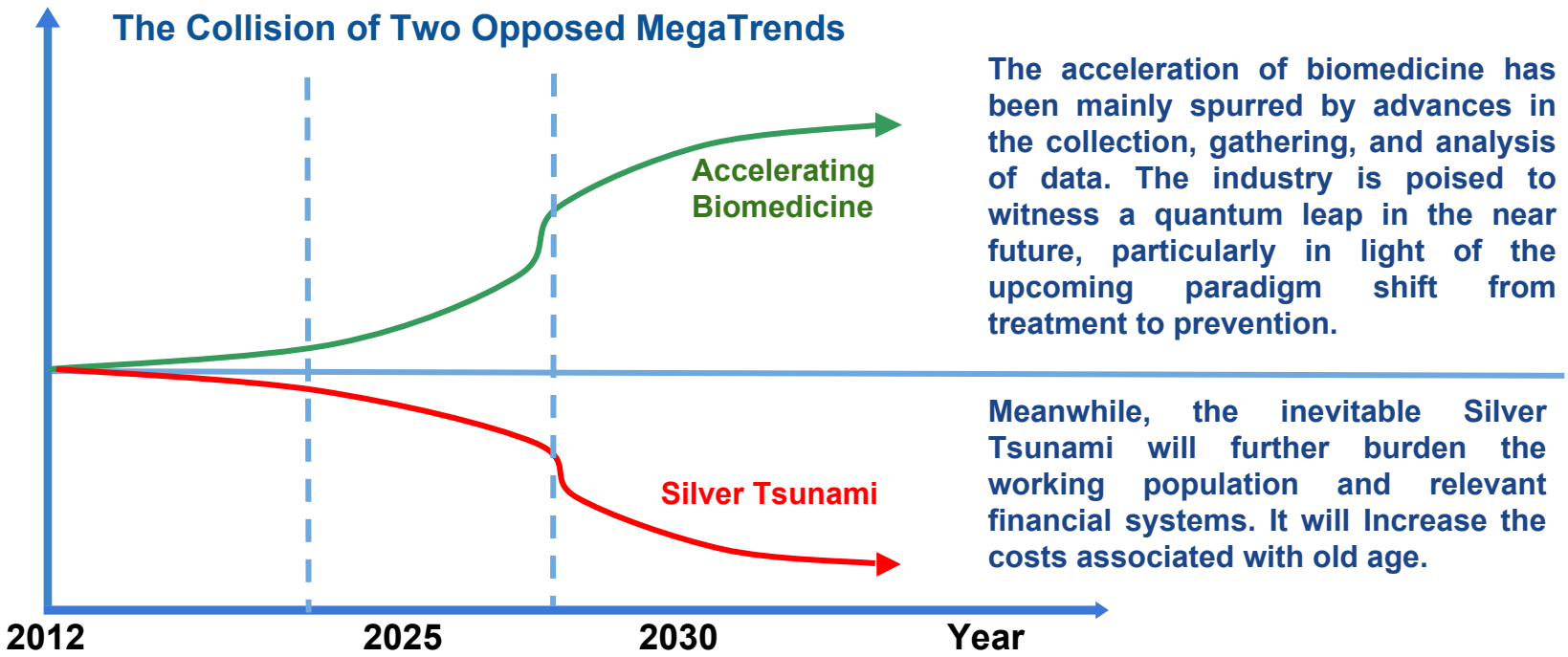
"The future of the longevity industry not only has the logical potential to become the wealthiest industry in all of history, but also represents the most ethical way of doing business."

- *Dmitry Kaminskiy, Managing Partner, Deep Knowledge Life Sciences.*

INTRODUCTION

In this chapter we will outline the collision of two global megatrends, about to collide like matter and antimatter, resulting in a global shockwave that will inevitably result in the creation of **Novel Financial System**.

- **The silver tsunami** (global aging population) described previously, and the concomitant global stagnation of the biopharma, national economies and healthcare systems.
- **The acceleration of biomedicine** as a result of its convergence with data science.



We consider the implications, opportunities and threats involved in this shift, and examine the range of tools at our disposal for making step-by-step predictions and forecasting for various possible futures. We analyze who will be left standing, who will thrive, and who will be swept away by the Silver Tsunami. The following chapter offers an overview of the factors involved with this analysis.

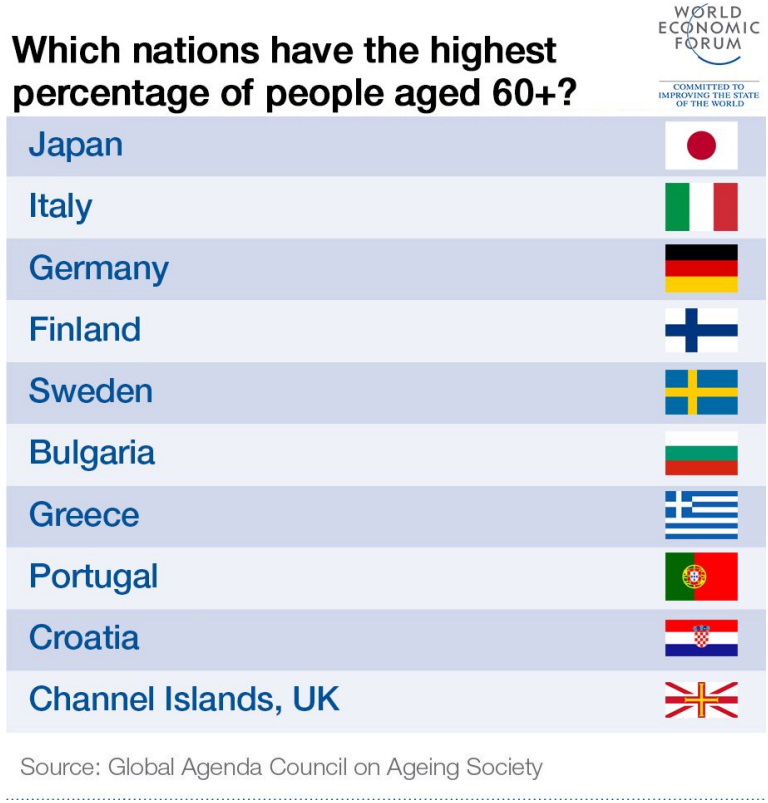
The Big GAP.

The current Biophrama and Healthcare industries were able to extend Life Expectancy but not QALY/DALY. This created the BIG GAP.

One of the issues exacerbating the decline of today's global financial system is the Big Gap between life expectancy and QALY (Quality-Adjusted Life Years) and DALY (Disability Adjusted Life Years). Due to advancements made by healthcare systems and BioPharma, people are now living longer, but not healthier, and without a corresponding increase in their QALY and DALY.

This chapter outlines how and why novel financial system will be necessary to mobilise global defences against the silver tsunami. It is argued that this can only be implemented on time by small, versatile technocratic governments, and with this in mind several global hot spots of longevity finance are identified and justified.

One of the most illustrative case-studies of this gap is Japan, which experienced an economic boom 50 years ago that nearly allowed them to exceed the USA in terms GDP; , concomitantly, Japan's life expectancy also nearly outgrew life expectancy in the US, although without an equal increase in its citizens' healthspan.



This gap created a significant negative impact on Japan's national economy, which has been suffering for the past 20 years as a result. Japan's government has spent massive efforts in financial engineering to account for this gap, but have only succeeded in delaying the collapse of their economy, not fixing the fundamental cause behind it. Japan and its major financial institutions should be motivated more than any other nation today in adopting a combination of advancements in biomedicine and advancements in financial science to synergistically avoid stagnation and collapse in the face of this Big Gap.

Data Science for the Novel Longevity Financial System

Novel financial system will require implementation of the most advanced data-science technologies empowered by AI. Previously, the synergetic development of advancements in data science and financial science allowed for the creation of massively more powerful financial engineering methods.

Similarly, synergetic advancements in health data science and financial science, empowered by AI, can enable the creation of novel financial entities that harness the enhancement of QALY and HALY in order to generate profit, thus incentivizing both nations and the main institutions in their financial ecosystems to boost national economies and GDP via enhancement of QALY and HALY.

The remainder of the chapter catalogs the main successors of existing financial institutions, hybrid entities that absorb the existing financial institutions of today, and spawn novel institutions to take the place of those destined to die out, some of which will evolve naturally from existing entities, and some of which will thrive on the extinction of the ones they will replace.

This chapter considers specific entities and institutions related to this novel financial longevity industry, and charts possible pathways toward the optimal development of this nascent industry, with a particular focus on Venture Funds, Index Funds, Hedge Funds, Progressive Healthcare Corporations, Longevity Trusts, AgeTech Banks, Longevity Stock Exchanges, Longevity Derivatives, Longevity Composite Index.

Formulating a New Class of Assets Relevant to the Novel Financial Industry

In addition to the development of tangible metrics and parameters to predict the success of financial institutions in adapting to the longevity industry, it is also crucial to define **novel assets** derived from the novel financial industry.

Those values should take into account the following considerations:

1. Regarding health as an asset

2. Understanding the nuance between precision medicine and precision health. If financial instruments are tied to the halting of biological ageing, they can be secured as special financial instruments and transformed into derivatives. This can serve as a definition of precision health as well as health as an asset. This makes it a separate concept to precision medicine.

3. Measuring the number of active retirees: elderly people who are active investors rather than passive deposit-holders for instance

4. Measuring the number of people who were converted from active members of society to active elderly entrepreneurs

5. Monitoring the improvement of the ratio of workers contributing to social services, like medicare, against the number of elderly dependents.

Tangible Metrics for the Novel Financial Longevity Industry

We must be extremely thorough when establishing novel financial instruments for the longevity industry; a crucial part of that process will rest upon devising appropriate and fitting metrics and parameters. A new framework must be established that takes into account all tangible, measurable parameters, which would be aggregated into a weighted average. Such a framework would enable us to better assess the performance of the financial entities employing those novel instruments.

The parameters will be observed in applied P3 medicine and the performance of a healthcare system focused on prevention more broadly. Precision diagnostics, advanced prognostics, personalised experimentation and preventative treatment can form part of the P3 medicine scoring of clinics, and provide metrics for the linking of their longevity-enabling technologies to financial instruments.

The performance of entities in the novel financial longevity industry should be exposed in some mathematical formula that quantifies their performance in relation to biomedicine parameters.

The parameters are:

1. **HALE (Health adjusted life expectancy)**
2. **QALY (Quality adjusted life years)**
3. **Biological age with respect to chronological age**
4. **The level of innovation in P3 medicine clinics**
5. **Research and development, with respect to technology readiness level (R&D TRL)**
6. **Practical applications technology readiness level (practical applications TRL)**
7. **The average number of productive years, i.e. the years when people are actively adding to a nation's GDP**

Tying Wealth to Health via Tangible Metrics

HALE

Biological Age vs Chronological Age

QALY

P3 Clinic Innovation Score

Number of Years in Workforce

R&D TRLs

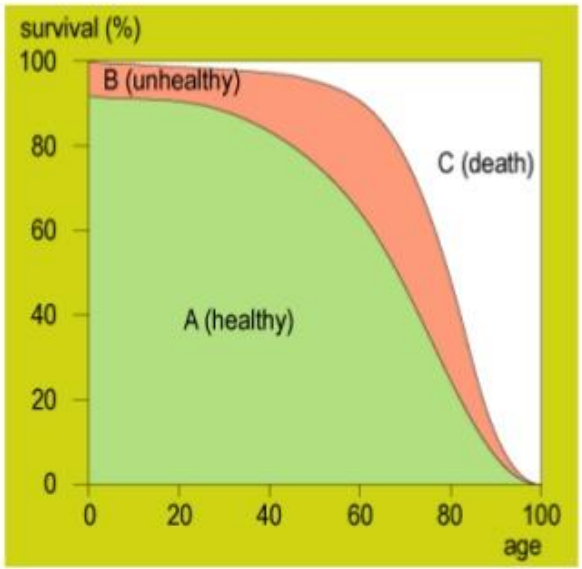
Practical Applications TRLs

Precision Health & Health as an Asset: Tying Health to the Performance of Financial Instruments

The Integration of Health Data Science with Financial Data Science

Health Adjusted Life Years

Health adjusted life years can be measured relative to HALE (Health adjusted life expectancy) and DALY (Disability adjusted life years)



Health Adjusted Life Expectancy (HALE)
The number of years that a person can expect to live in good health

Health gap indicator =
Disability-Adjusted Life-Years (DALY)
Number of years spent in ill health and the number of years lost due to premature mortality.

A = time lived in good health
C = time lost due to premature mortality
Life expectancy = A + B
Health expectancy indicators (e.g. healthy life expectancy and HALE) = A + f(B)
Health gaps indicators (e.g. DALYs) = C + g(B)

B = time lived in poor health

By age 65, half of the population represented by the graph are still healthy, with around 15% being ill. The rest have already died. By 80, merely 20% are still in good health while almost 20% have died.

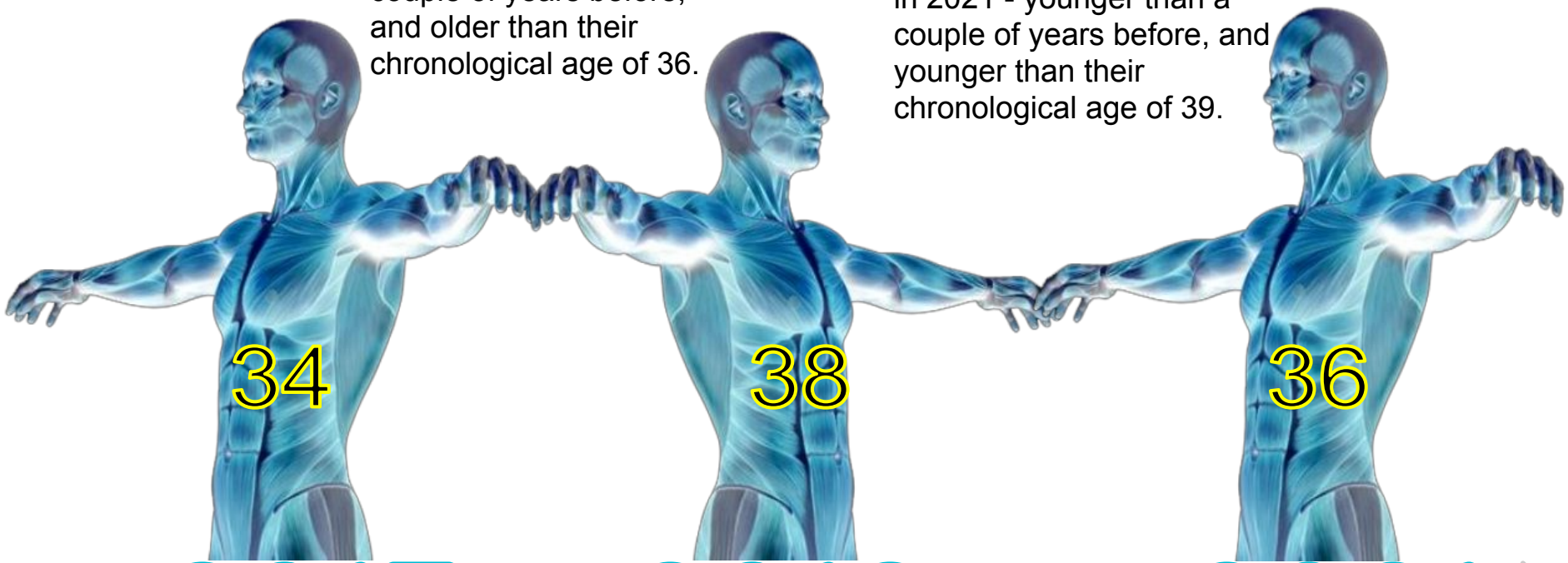
The rest are ill. Very few reach age 100, and even fewer reach 100 in good health. This highlights the proportion of longevity that is at present associated with ill health, and the importance of extending health itself alongside number of years lived.

Source: http://www.slideshare.net/hanzeuniversity?utm_campaign=profiletracking&utm_medium=sssite&utm_source=ssslideview

- Biological Age vs Chronological Age
- HALEs: Health-Adjusted Life Years
- QALYs: Quality-Adjusted Life Years

A patients may see that their **biological age** is 38 in 2019 - older than a couple of years before, and older than their chronological age of 36.

Then, after use of P3 medicine they may see that their **biological age** is 36 in 2021 - younger than a couple of years before, and younger than their chronological age of 39.



Biological Age over Time

Chronological versus Biological Age

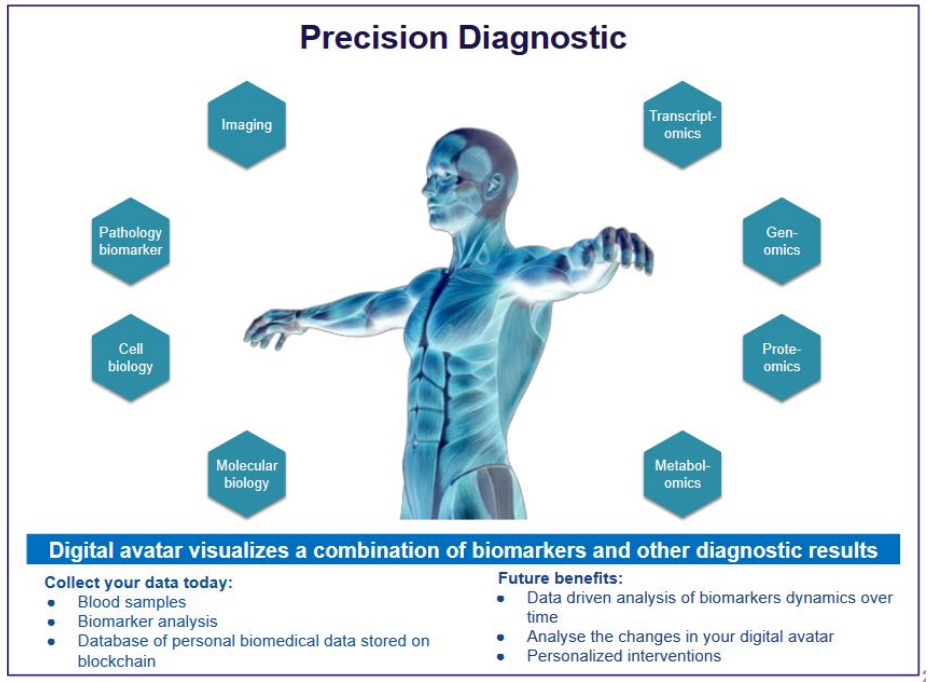
Chronological Age

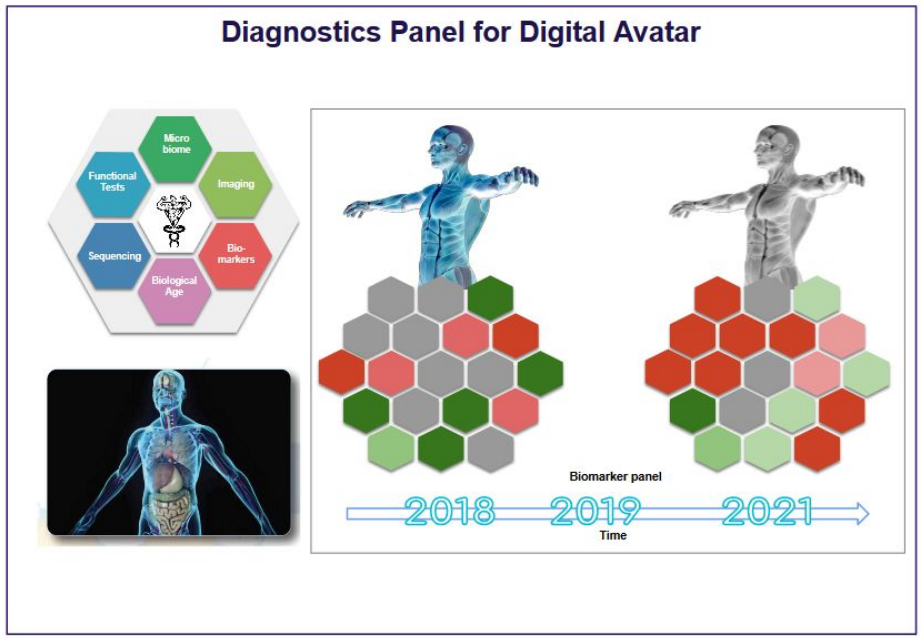
- Measures how many times you, in this body, have revolved around the sun
- Cannot be altered by mind/body approaches
- Has little relevance to how you feel and function

Biological Age

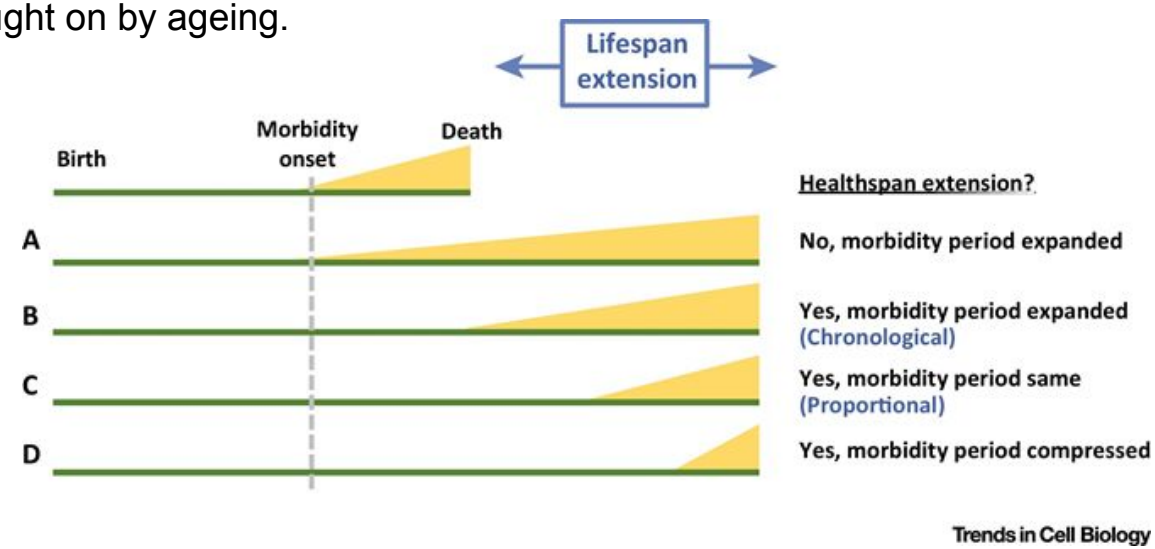
- Measures how well your physiological systems are functioning
- Can be reversed by attending to your health
- Is the most important component of the aging process

https://www.pinterest.com/pin/497999671268388652/?autologin=true





While **lifespan** refers purely to the number of years a person is expected to live, **healthspan** looks specifically at the number of healthy years someone can be expected to live: years that are free from the diseases and disabilities brought on by ageing.



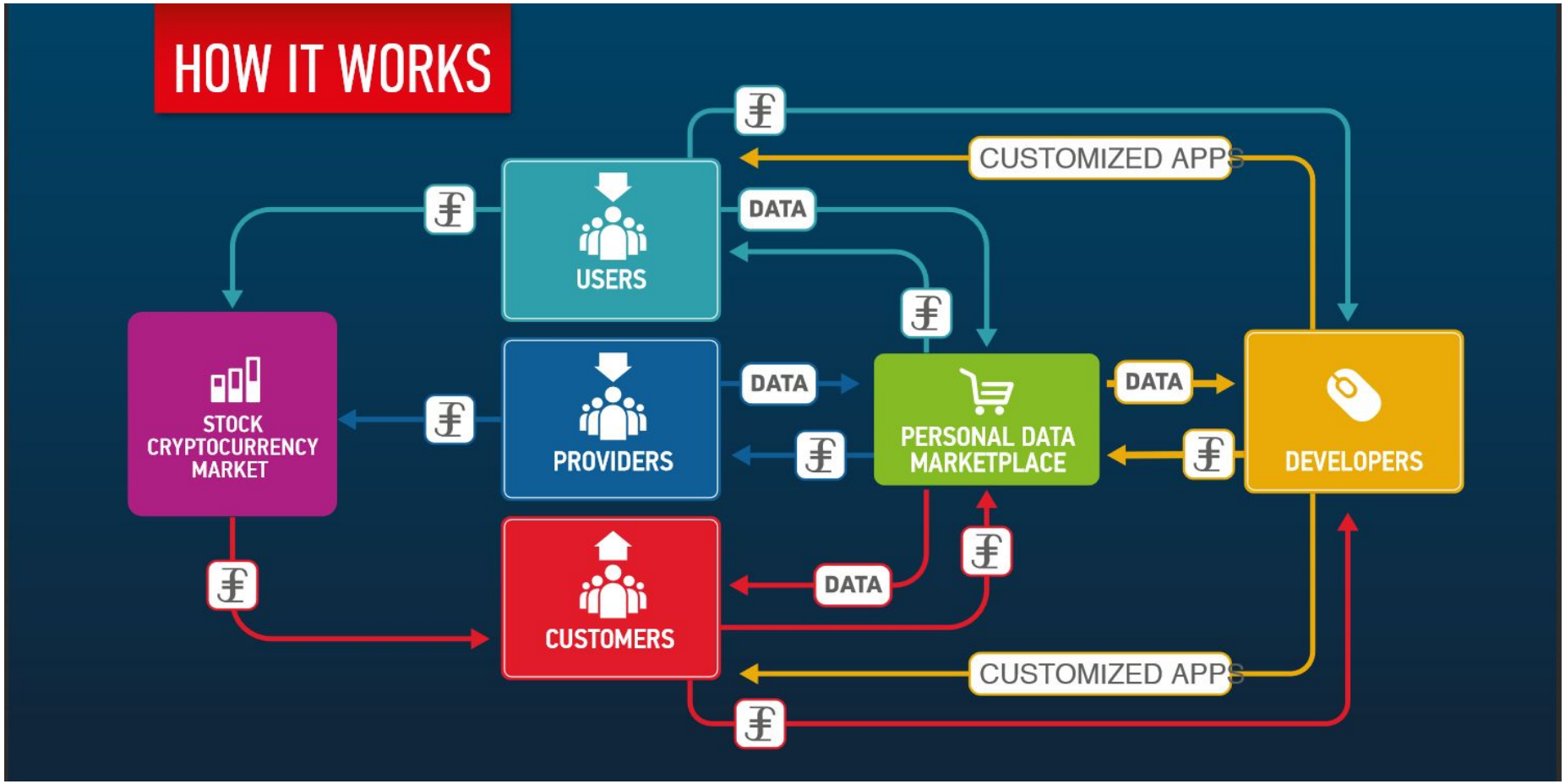
P3 medicine is an incoming approach to medicine that is governed by three Ps: precision, prediction, and prevention.

This approach will be key to delivering on the promises of geroscience and will have a big impact on worldwide lifespan and healthspan. With enough progress, more people will live disease-free lives regardless of age; lifespan and healthspan will converge to one metric. Specifically, **precision medicine** refers to the practice of measuring and accounting for individual differences at the genetic, environmental and lifestyle level for each person. As such, it ties in with the personalisation of medicine.

The extent to which new clinics implement technologies falling under the P3 umbrella can be quantified through scores. Predictive health, on the other hands concerns itself with using the precision data to forecast health events in the life of a given individual. Health, as an **asset** in its own right, will be monitored alongside biological age. Health preservation will be enabled using the framework of precision health as the next stage of precision medicine.

Tying Healthcare Data to the Financial Industry: Longenesis as a Case Study

Longenesis was born out of a partnership between Insilico Medicine, a biotechnology company focused on deep learning for drug discovery and biomarker development, and the Bitfury Group, one of the largest private infrastructure providers in the Blockchain ecosystem. The pair aim to foster a decentralized ecosystem for exchange and utilization of human life data. They plan on achieving this by building a revolutionary platform that marries nextgen artificial intelligence and blockchain technologies. Their ultimate mission is to improve human performance, extend life, and prevent disease.



"Longevity is a blessing. And as an investor, it provides you opportunities to benefit from compounding and to have a longer investment horizon. But if you don't prepare for it, you are left with two options: Work longer in life, perhaps much longer than you'd like, or hope you've been good to your children and that they'll be willing to care for you in your old age. And, second, I hope you'll speak out. Longevity is an issue of social justice that will have a more profound impact on your generation than on any generation before. If we don't start to address it – not just in this country but globally – we're going to see fewer job prospects for young people, higher unemployment, lower growth and many older people – maybe your parents – left without the means to support themselves."

- ***Larry Fink, Chairman of Blackrock Capital***

"There will come an age when our average life expectancy will reach 200 years."

-Masayoshi Son, CEO of SoftBank and Vision Fund.

Key Financial Industry Influencers on the Subject of Longevity and Long Term Planning

Leading figures in financial industry are beginning to steer CEOs to new ways of thinking about the success and impact of their businesses, and the ways in which shareholders are able to assess the trajectory a company is taking in terms of profits from the perspective of a longer term, holistic impact that includes **social**, **environmental** and **governmental** matters.

Chair of **Vanguard** ($4.5T assets) Bill McNabb and chief executive of **BlackRock** ($6.3T) Larry Fink both issued letters to CEOs covering these exact points. Nine other asset managers joining McNabb in sending his message bring the group's total asset value to $15T.

Mr. McNabb suggested a shift from the current quarterly earnings schedule to at least a **5-year** or longer outlook on the profits as well as "interactions with society", as a measure of a company's global impact.

According to Fink, these impacts should stretch to all stakeholders: "Companies must benefit all their stakeholders, including shareholders, employees, customers and the communities in which they operate."

Bill McNabb

https://www.ft.com/content/a28203d8-067d-11e8-9650-9c0ad2d7c5b5

Larry Fink

http://fortune.com/businessperson-of-the-year/2016/larry-fink-19/

"The entire system is now wired toward the short term. Banks and securities firms grow revenue from the velocity of money. So they have a short-term incentive. Media, especially in the online age of the 24/7 news cycle, draw traffic from hyper-focusing on the latest developments… But they should do just the opposite, taking advantage of their longer investment horizon to keep their money working for them. Because let's face it – if you have 25, 30 or 40 years to save for retirement and 20 or 30 years to fund in retirement, you should not be worrying about what's happening this second, today, this week – even this quarter."

- ***Larry Fink, Chairman of Blackrock Capital***

"People are living longer than ever before, dramatically altering the financial challenges of retirement. Increased longevity is a blessing, but it's an expensive one because that translates into the need for a bigger retirement nest egg and access to secure, retirement-long income. As our survey suggests, many Americans simply won't have the money they need to enjoy their longer lives if they don't start investing differently."

- ***Rob Kapito, President of Blackrock Capital***

"I'm actually pretty optimistic about the U.S. economy. But Europe's got real challenges. A lot of that is due to the demographics in Europe. China has been the engine of growth for the world for the last 20 years, or the last 10 years in particular, but that's not sustainable. So you're looking at a world where growth is going to be more challenged than it's been, unless you see some really big jumps in productivity."

- ***Bill McNabb, Chair of Vanguard***

Key Players in the Tech Industry on the Subject of Longevity and Long Term Planning

"Every country needs a Minister for the Future"

- ***Mark. R. Benioff, Chairman and CEO of Salesforce***

"The opportunity to raise the quality of life is the biggest business opportunity going"

- ***Anand Mahindra, Chairman and Managing Director of Mahindra & Mahindra***

"With some longer term, moonshot thinking around healthcare and biotechnology, I believe we can improve millions of lives"

- ***Larry Page, CEO of Google***

Death never made any sense to me.

- ***Larry Ellison, Founder of Oracle***

"The biggest change in the world today is that the young don't learn from the old, they teach the old about the world today.

We do not want to just define issues; we want to help to create solutions.

Change can be frightening, and the temptation is often to resist it. But change almost always provides opportunities - to learn new things, to rethink tired processes, and to improve the way we work.

The more we think about how to harness the technology revolution, the more we will examine ourselves and the underlying social models that these technologies embody and enable, and the more we will have an opportunity to shape the revolution in a manner that improves the state of the world.

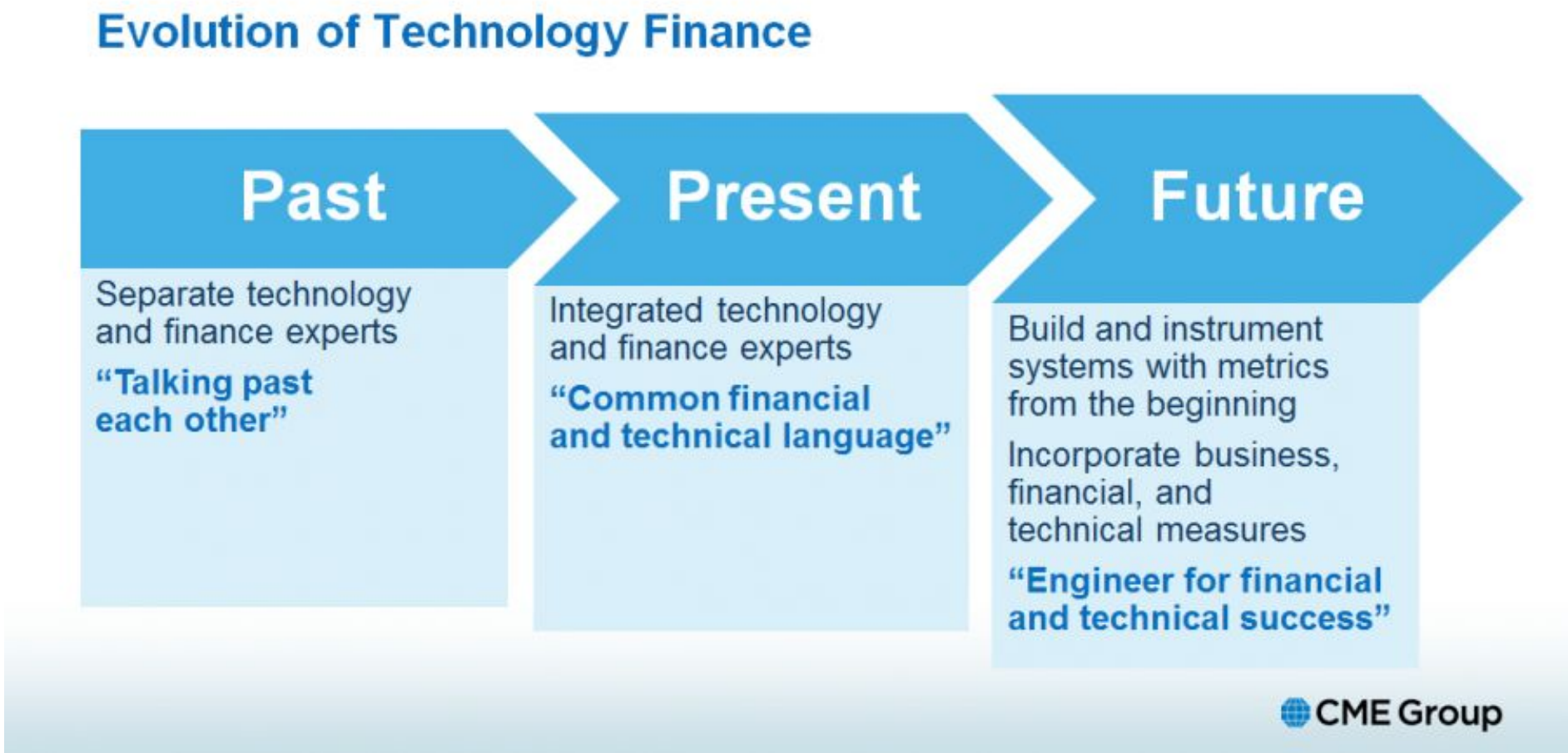
As all these trends happen, the winners will be those who are able to participate fully in innovation-driven ecosystems by providing new ideas, business models, products and services, rather than those who can offer only low-skilled labour or ordinary capital.

Interaction across the physical, digital and biological domains that make the fourth industrial revolution fundamentally different from previous revolutions."

- ***Klaus Schwab, Founder and Executive Chairman of the World Economic Forum***

The Evolution of Financial System

As seen over a timeline, the evolution of technology finance according to CME Group emphasises the **engineering approach** to finance, and the need for systems using adequate **metrics**. Having systems that take note of business, finance and tech as a whole unit with complementary parts is essential to the success of future finance.



Longevity Forces Long-Term Thinking

The most important initial factor in determining how the financial future of the longevity industry will pan out is the unwieldiness of current global political systems and their electoral cycles. The future financial landscape will be shaped by the following factors:

- In global democracies, the national governments are forced to reconsider their position every 4-5 years
- Corporate presidents are working towards quarterly reports, with deadlines based on their quarterly survival as a top priority

Yet the potential technological solutions outlined in this volume - HALE and QALY increasing technologies which solve the healthcare economic crisis, rebalance GDP and stem the tide of the silver tsunami - pertain to a time horizon of about a decade.

There is therefore no sustained impetus for governments or corporate executives to knuckle down and implement any such strategy. The only long-term players in this picture are investors, and as such the strategic burden falls upon them.

But even unleashing the power of investors requires a **long-term national strategy or a framework for absorbing, integrating and implementing** novel converging technologies as they arrive. Furthermore this would need to be developed in the next coming years.

Novel investment strategies for different types of investors, from small venture funds up to national sovereign funds, should be developed based on the novel paradigm of tangible metrics and pragmatic forecasting.

Financial Futurism

Dictionary.Com defines 'futurism' as: ***"The study or forecasting of trends or developments in science, technology, political or social structure, etc."***

So intertwined are the fates of technology and finance at this juncture in history that predicting them calls for a form of **'financial futurism'**.

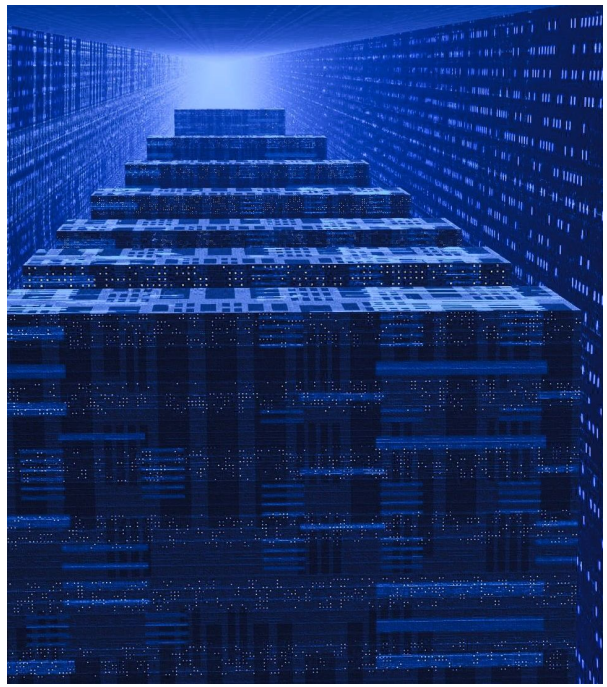
In this chapter we apply forecasting methods to identify possible scenarios and create a roadmap for how financial entities could evolve from scratch in the novel financial realm.

The Pathway toward Financial Futurism

Looming changes to the global financial system resulting from the convergence of two collapsing megatrends, the Silver Tsunami and advancing Longevity industry, will shake the global financial system.

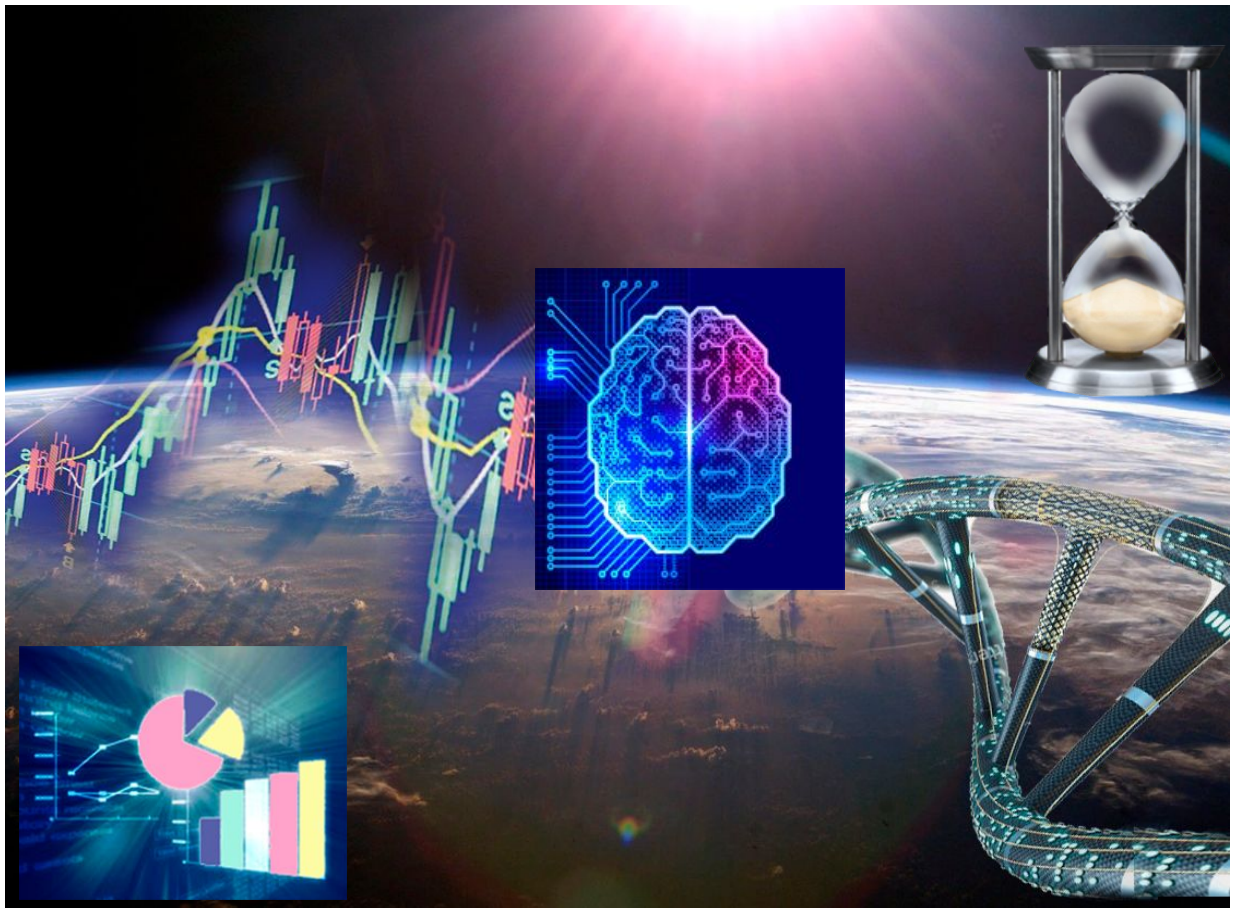
Financial institutions that don't adapt will not survive in their present form

After the tsunami has passed, such economies will have reformed themselves beyond recognition, absorbed by novel financial institutions and systems, or transformed by government initiatives of progressive technocratic countries.



"There have been many well documented efforts to predict the future of biomedical progress, but is there any good reason why the same logic could not be applied for the financial sphere? Many thought leaders have made reasoned predictions on how some fragments of collapsing financial systems will evolve, adapt and adjust to increasing life expectancy. We should work to assemble the framework of scenarios regarding the evolution of financial system in the next 10 years, and create the pathways that will be able to neutralize collapses and accelerate the dynamic of progress of the longevity industry, with a focus on extension of healthy period of life for the betterment of all of humanity."

- Dmitry Kaminskiy, Managing Partner, Deep Knowledge Ventures



The following pages give an initial overview on how several potential types of financial institutions could and should operate in the next 5 - 10 years in the face of these changes.

Venture Funds

As our first step in financial futurism we ask: What will be the future of venture funds in the wake of this paradigm shift?

The identification of biomarkers of aging, and further progress in the use of AI for clinical trials will open up the following doors for longevity-focused venture funds:

- Venture funds will end their focus on Big Pharma as main acquisitors of their portfolio companies .
- The new main acquisitors may became IT-giants, government-backed funds (such as Vision Fund), or those BioPharma corporations which will prove capable of reinventing themselves into progressive healthcare corporations of 21st century.
- Many will become technology progress-driven, rather than Big Pharma-driven.
- The market will be able to assess whether the portfolios of funds are structured in a manner that brings about maximum QALY and HALY for a population. These assessments will utilise technology for predictive analysis e.g. the use of AI to rate the likely positive impact of venture funds based on their portfolio structures. They might factor in TRLs and similar methods of quantifying technological maturity.
- VC firms will move toward the use of tangible, quantifiable and concrete metrics ties to biomarkers of aging and TRL levels for the valuation of their portfolio companies, and for measuring the performance of the fund itself.
- With the introduction of such concrete metrics, investment in biotech will not to be the gambling as it is now. The longevity-focused VC funds of the future will rise or fall based on their ability to deliver HALE and QALY. Thus, this novel type of venture funds would transform longevity into a data science. As biomarkers are refined and this novel financial system prospers, investment in longevity will become a form of data science.

At present, VC funds categorize companies according to seed, series A, series B, etc.; the stage of a company's development moving forward will become less important while **TRL levels** and the level of the technology **accordingly to other tangible metrics** will become much more important, because they will provide **data driven** analysis that allows for something close to mathematical calculations of how valuable a portfolio company is.

Micro Index Funds

Micro Index Funds (a more sophisticated version of a venture fund) will bet not on the potential exit of one portfolio company (akin to “finding a needle in a haystack”) similar to betting in a casino but will instead bet on the rise of specific niches within the Longevity industry, which could be assessed and forecast in a very logical and quantified manner using multiple instruments for predictive analysis. Such types of venture funds could be thought of as macro venture funds or micro-index funds.

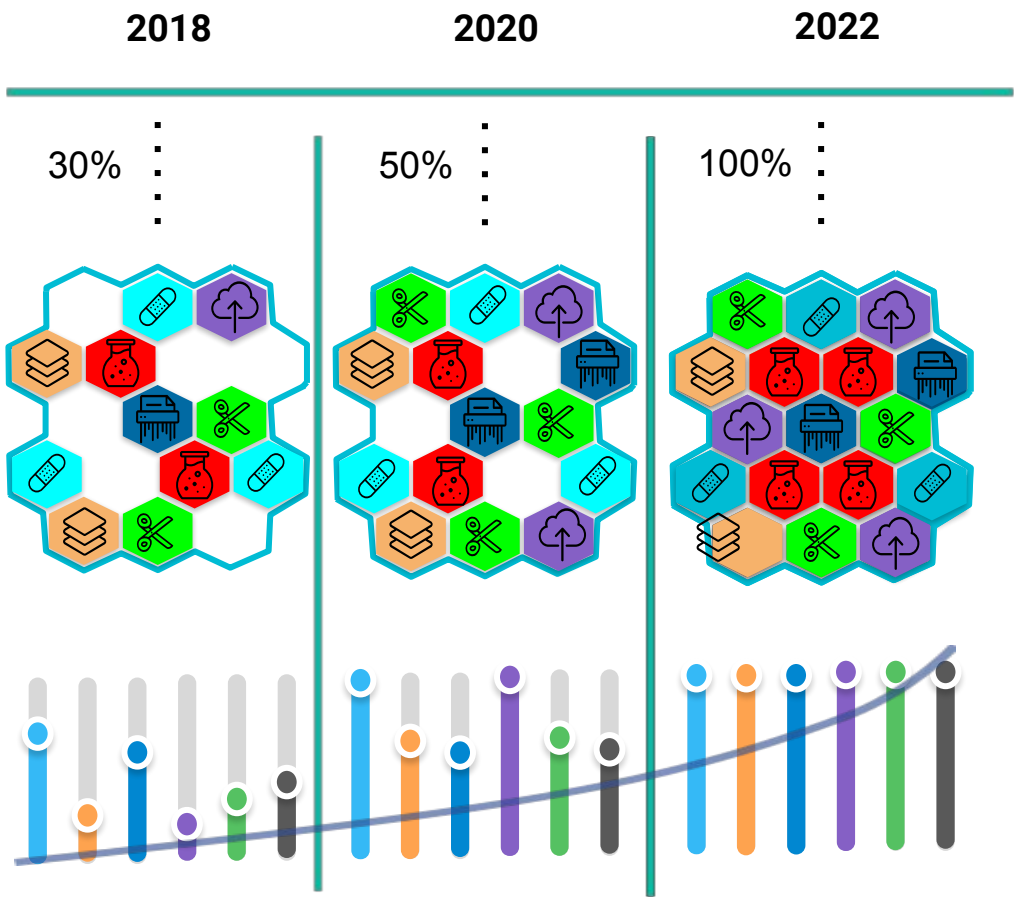
Thus, instead of relying on any single company or technology, VC funds will act as aggregators of longevity-relevant technologies. Companies within the portfolio will be able to share knowledge, technologies and expertise among themselves.

By operating as previously described, the longevity-focused venture funds of the future will act as assemblers for companies that are driving biotechnology to the point of practical application the soonest. Companies whose pipelines are optimally configured to bring about QALY and HALY as measured by biomarkers of aging, increasing the rating of P3 medicine clinics, and determined by the logic of AI, will be routinely drawn into the orbit of such funds.

We will see the rise of longevity micro index funds, each of which will invest in packages of 20-40 companies leading progress in each biomedical niche e.g. AI for Drug Discovery, Blockchain in Healthcare, P3 Medicine, Gene Therapies, Senolytics, Regenerative Medicine, etc.

These funds will use the 7 metrics described in the beginning of the chapter to select the companies in their portfolio, and when their portfolios reach a certain benchmark, the funds will be able to be acquired by larger players such as insurance companies, pension funds, novel healthcare corporations or government funds.

This approach will enable significant de-risking of the current business model of VC funds. Thus, investment into venture funds employing a micro index strategy will become more interesting and appropriate for large, conservative investors such as mutual funds and sovereign funds.



Small Molecules and Biologics

Stem Cell Therapy

Gene Therapy (CRISPR)

Next Generation Sequencing

Bioinformatics

3D Bioprinting

Let's examine a hypothetical case where a venture fund creates a portfolio related to P3 medicine clinics. Metrics in this instance will be based on the TRL of the clinic. The fund would initially invest in a number of companies with high TRL levels and MVPs ready for practical application. The strategy of such funds will be tied to the aim of creating a full assembly of the hypothetical ideal of a P3 medicine clinic, structuring and aggregating those P3 therapies and technologies required to create an ideal P3 medicine clinic, sourced from multiple portfolio companies. Such companies should have tangible MVPs ready or reasonably close to practical application. Thus the fund will be considering not just the TRL levels associated with the assets and IP of the portfolio companies, but above all else the **TRL level of the ideal P3 clinic itself**. When the portfolio is closer to deliver 70-80% of hypothetical ideal P3 clinic pipeline completeness the fund should seek to make an exit. The exit should not be made by selling the portfolio companies, but by selling equity in the fund itself, assuming that capitalization of the fund would have increased by a factor of 30 to 50 within 5 years. The idea is simple: the performance of fund managers should be tied to their capacity to structure portfolios that will perform well. Naturally, some companies will fail, but some portion of the portfolio companies will eventually deliver practical technologies to P3 clinics. The fund will act as an aggregator, assembler and supplier of knowledge and services for P3 clinics.

Case Study: Micro Index Fund “AI for Drug Discovery”

For example, there are 40 or so companies in this particular subsector, the capitalisation of which is set to multiply 10-30x in the next 2-3 years. Supposing that under the circumstances described in the previous slide, a micro index fund linked to this subsector begins small, at $40M let’s say, with $1M being invested in each company in the subsector.

After 3 years, we might still expect half of these companies to fail, or be acquired by their competitors. Some micro index funds will be capable of investing throughout the entire subsector, others only a portion. But with the subsector on the rise overall, the companies that have not yet sunk would fill the role of those that have, and the subsector would continue to rise, acquiring funds from more conservative investors who would otherwise avoid investing in start-ups due to their high-risk nature.

It is obvious that AI for drug discovery, as a sector, cannot fail, and will inevitably grow significantly. However, as a subsector it is still young, and as such it is difficult to tangibly judge which companies will come out on top, and which will fail or become acquired. For these reasons it is an ideal subsector for this kind of novel investment approach, which bets not on companies but on entire industry niches. Betting on subsectors can only be a losing strategy when an entire subsector fails. In the large scheme of things, failure of even 80% of the companies in this niche will not detrimentally impact the performance of the fund as a whole. The fund would ride on the success of the few unicorns in the subsector that do succeed at the expense of the others, which can be safely forecasted due to the increasing market capitalization of the sector as a whole. Those companies that succeed will acquire the best IP, assets and AI specialists of those startups that failed or stagnated, through mergers and acquisitions. We can estimate that 20% of existing companies will become the successors of the growing niche, with others falling by the wayside.

The strategy at the heart of a Micro Index Fund is to bet on entire subsectors (AI for Drug Discovery in this case), not specific companies within them. Some funds will be capable of investing in the majority of companies within a subsector, and others just a few, but those that can maximize the number of companies within a given subsector can provide the most stable, hedged and de-risked opportunities for limited partners (investors into the Venture Micro Index Fund). Ultimately, a Micro Index Fund can only fail if the entire subsector it is betting on fails. It is a perfect investment vehicle for companies that could previously only acquire funding from angel investors due to the riskiness of its value proposition.

AI for Drug Discovery, Biomarker Development and Advanced R&D Landscape

Companies - 70
Investors - 180
Corporations - 20

Drug Discovery

Advanced R&D

Investors

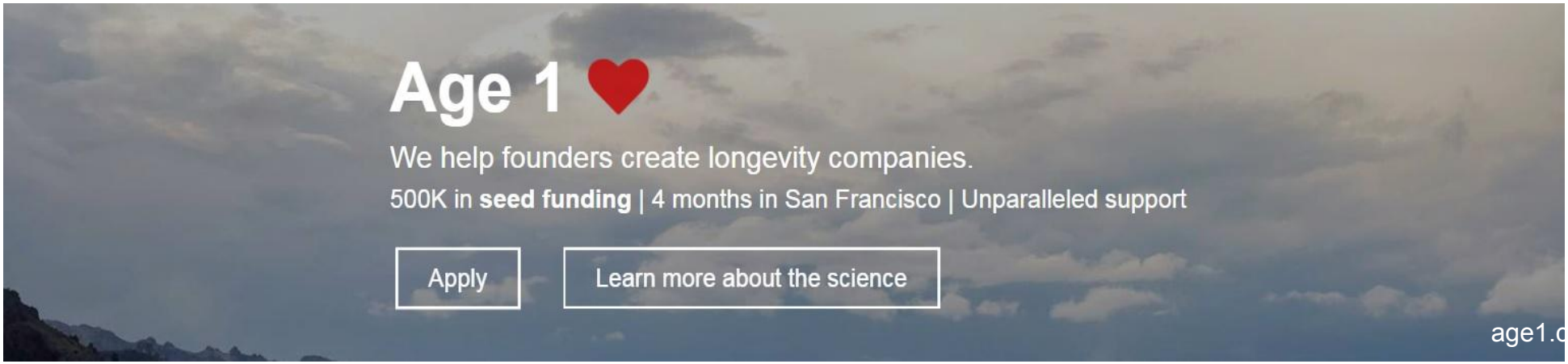
AI Companies

Corporations

DEEP KNOWLEDGE VENTURES

Longevity Accelerators

Age1 is a longevity focused accelerator with $500K seed funding that runs over 4 months in San Francisco. It was established by **Laura Deming**, one of the youngest fund managers in the world, who started her college education at the young age of 14 and surpassed all academic and professional expectations of her peers by working in the labs of **Cynthia Kenyon** and **Leonard Guarente**.



Deming founded the accelerator with Elad Gil as an advisor, who is also cofounder of Color Genomics and Mixer Labs, having completed a PhD in the genetics of ageing at MIT.

UNITY Biotechnology is a portfolio company (as well as Color Genomics) of Age1, working on therapeutics against ageing. UNITY Biotechnology has backing from multiple sources including **Peter Thiel** and **Jeff Bezos**.

In terms of areas of focus for future Age1 companies, Deming stated that late-onset conditions including heart disease, Alzheimer's disease and diabetes would be of prime interest. Additionally, the science behind circadian rhythm or other types of biological rhythms might be an interesting avenue for further research and development through companies nurtured by Age1.

https://techcrunch.com/2018/03/21/one-of-the-youngest-fund-managers-in-the-u-s-just-launched-her-own-accelerator-too/

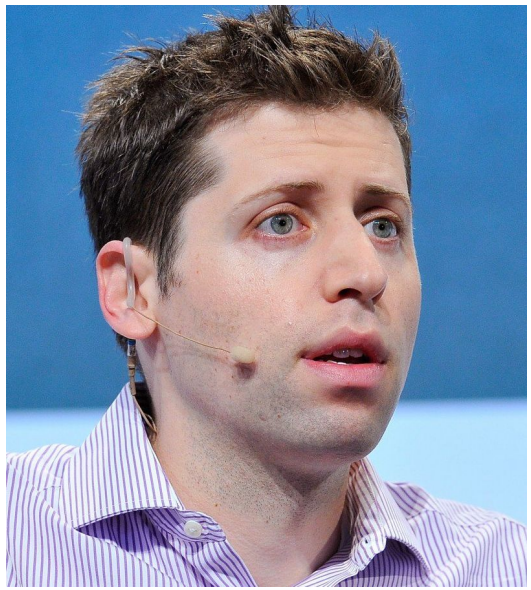
Longevity Accelerators

Y Combinator

More recently, in January of 2018, Y Combinator (one of the most reputable and well-known Silicon Valley-based disruptive technology accelerators and incubators) announced a new accelerator specifically for companies aiming to increase human longevity and healthspan.

Longevity start-ups would be given between $500k and $1M for a 20% stake in the company, as well as lab-space and mentoring services.

Those companies chosen will travel to San Francisco for a three-month accelerator program in June of 2018.



Y Combinator only began incubating life-sciences companies in 2014, and it only took them four years to see that Longevity companies backed by strong science will be the unicorn of th entire biomedical industry.

My sense is that economic incentives of drugs companies are screwed up. I don't think we have enough people saying, How can we make a lot of people a lot healthier?" - **Sam Altman, president, Y Combinator**

Novel Progressive BioPharma Corporation of the Future

The biopharma and healthcare corporations of the future will be unlike those that emerged 50 years ago, and will be chiefly operated as IT corporations focused on **healthcare**, **data science** and **AI driven** innovation. There will be no room for old bureaucratic giants lacking real time reaction. There will be no space for those unwilling to sit on the bleeding edge of biomedicine, no room for outdated management nor a lack of willingness to absorb new innovation. These new companies will resemble hedge funds totally reliant on AI and analytical quantitative methods, and measuring performance in **real time.**

Whereas the biopharma corporate valuations of yesterday were based on the number of patients and drug sales, in the future their capitalisation will depend on the overall health of the consumer population. The healthcare corporations of the future will not be entirely dedicated to the treatment of one specific disease or trying to produce another blockbuster drug. Instead they there capitalization will be related to the QALY and HALE that they deliver.

IT giants are data-analysis driven corporations. The case will be the same for healthcare companies 10 years from now. Taking into consideration the significant recent developments in understanding biomarkers of aging and the prospect of extremely advanced AI, the HALE and QALY that companies can add to their users will become a reliable basis for valuation. The biopharma companies of the future will become **mathematical corporations** driven by data science, AI and quantitative health parameters including HALE, QALY and others illustrated above, in the same way that progressive hedge funds and FinTech banks can be considered as mathematical corporations today.

And given the increasing interest of IT giants such as Google, Amazon, Apple, Tencent and Alibaba in healthcare, we can expect that in 10 years they themselves will become global healthcare corporations and their capitalization will eventually depend on the precisely measurable QALY and HALE they can provide to their users. Just as Facebook's capitalization is linked to the profit that one user can provide to the company along with the total number of users.

The development of scientifically valid biomarkers of aging will make it possible to link the capitalization of a longevity corporation to QALY and HALE along with the number of users (against the cost of producing these QALY and HALE). In addition to all of that, the projected progress of AI over the next 10 years leads us to believe that these parameters will be very precisely calculable.

But this chapter does not seek to make long-term projections, rather it seeks to give an idea of where the industry will be in 5 years' time. In 5 years, we can expect the industry to recover from a legacy of inertia, as biopharma companies are presently three years behind IT corporations in seizing the potential of AI. So there will still be significant delays, and few global longevity giants initially. But we will be able to see multiple candidates for such a role in the period between 2023 and 2027 that might potentially reach a capitalization of 10 trillion or more.

As technological megatrends converge, progress will accelerate. While currently it takes 5 to 10 years for progressing-to-nextgen startups, technologies and trends to disrupt a given industry, by 2022 we can expect that the rate of progress will accelerate, such that the sectors and industries will be disrupted by these specific megatrends within 2 to 3 years instead. We can now see that IT corporations in today's world need to run more akin to DeepTech R&D focused science corporations, but with a start-up like corporate culture, systematically modernizing themselves.

For biotech, this will become the norm as well. It is already unsustainable to just be big and stable - think of how it became impossible for big taxi companies to be big and stable with the arrival of Uber similar apps. All biotech and healthcare companies will need to mimic Google and NVIDIA's model. IBM for instance, which develops AI tech aggressively, was not capable to keep itself at the forefront of the AI industry because it failed yet to transform itself into a dynamic corporation.

BioPharma in the Age of Preventive Treatment / Rise of mHealth

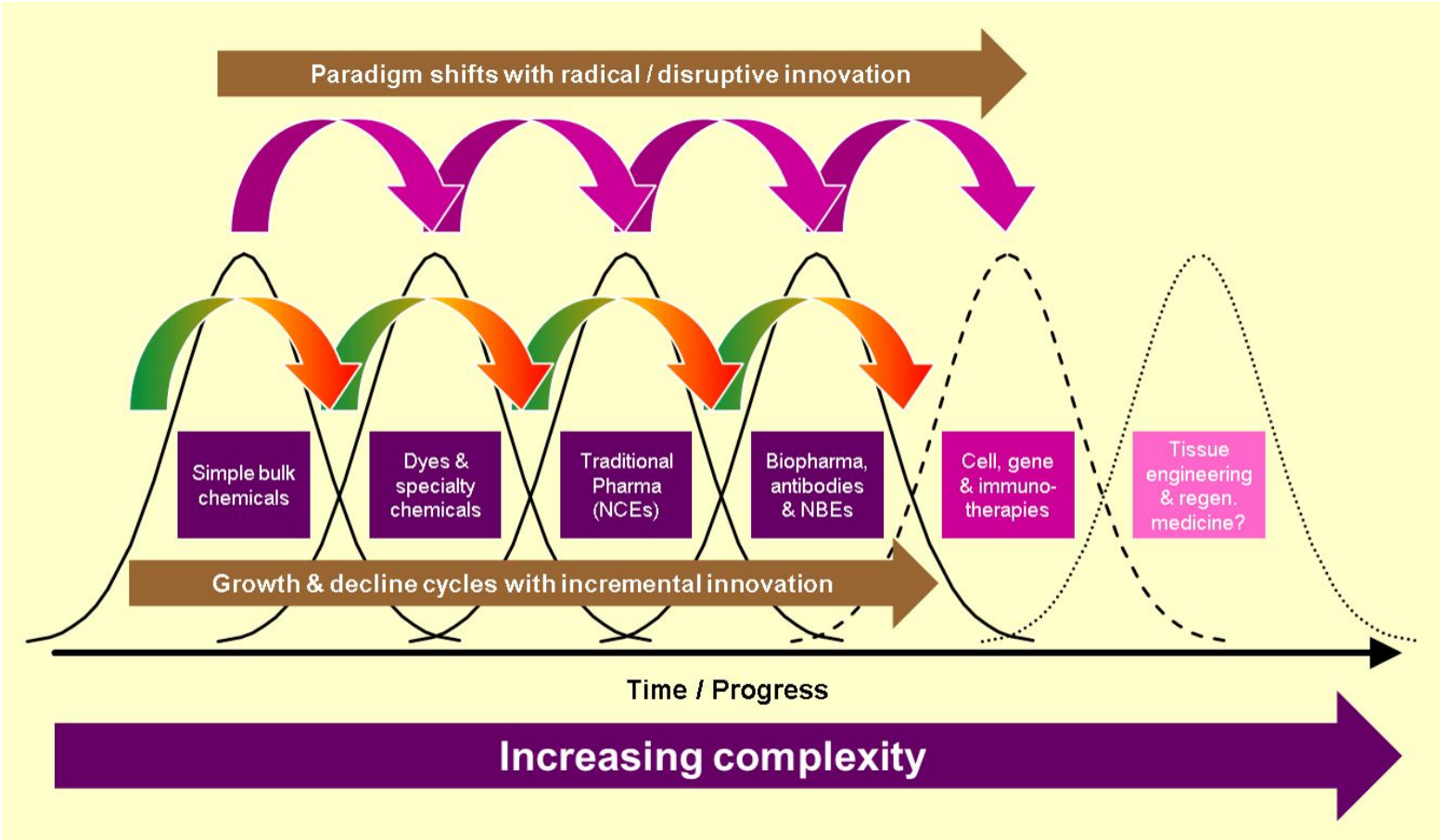
In the United States alone, nearly 900,000 deaths occur annually from preventable causes, most notably lack of physical activity, cigarette smoking and poor eating habits. This represents nearly 40% of all deaths in the US, and as such there is little wonder that nearly three-quarters of all healthcare spending goes to the treatment and management of chronic conditions. On the other side of the Atlantic, in the United Kingdom, 80% of the National Health Service's budget for diabetes treatment is spent on managing complications, which oftentimes are entirely avoidable.

This presents an interesting challenge for the biopharma industry in the ever-changing healthcare landscape, particularly when one takes into account the size of the potential market: an estimated $300 billion can be saved by the United States alone by 2023 should it reduce the prevalence of preventable non-communicable diseases. On the flipside, for some diseases, measures such as early screening can actually increase the costs rather than decrease, raising the question of how the relevant healthcare and biotechnology players can capitalize on this issue.

The answer is to harness the advancements in technology resulting in cheaper, miniaturized and more advanced devices available to all. With current technology, such as Apple Watch and Fitbits, as well as those on the horizon, such as Google Contact Lens with in-built glucose sensors, it will soon be possible to gather large amounts of real-time data on the health status of nearly everyone. With high-performance computing and AI, this technology will be able to detect and analyse discrepancies early, reducing the burden of preventable disease and transforming the healthcare outlook in the nearby future.

Biopharma Disruption & Increasing Complexity

Biopharma is in a transitional state. Just as the BioPharma industry evolved from the chemicals industry, the BioPharma industry as a whole will evolve into something quite different than its current state today, most likely continuing the historic trend of increasing complexity towards more complex biological solutions to pressing healthcare problems, such as cell & gene therapy, tissue engineering and regenerative medicine, and from reactional treatment to personalized, multi-disease preventive treatment.



http://www.goethes-farbenlehre.com/How-Pharma-can-evolve-from.html

IT-Giants & Tech corporations in Healthcare

Overall, the AI in healthcare and BioPharma subsector is growing at an exponential rate, both in terms of new companies, investments and acquisitions, and in terms of the extent with which it is disrupting the traditional modes of operation on BioPharma as a while.

What is now a subsector and niche is poised to grow into perhaps the leading subsector in BioPharma in the next 1-2 years, one that will have the greatest transformational impact on the industry, and one that will distinguish the leaders of the industry from the stagnators.

By the end of 2018, we can predict that there will be intensive competition between the largest BioPharma companies and the largest IT and tech giants for the acquisition of new AI specialists, IP and startups, in much the same way that 2014 – 2016 saw intense competition between traditional IT and tech giants to acquire the best AI assets and resources.

Additionally, the next 1-2 years will show that traditional tech giants and IT corporations have to major play in the exponentially-advancing AI for healthcare in general and for drug discovery in particular.

Meanwhile, within that last financial quarter (2018 Q1), Chinese IT and Tech giants, such as Alibaba, Baidu and TenCent, have made significant investments and acquisitions in the AI for Drug Discovery sector, showing that the number of IT giants committing to the sector is growing not just regionally but also globally.

IT-Giants & Tech corporations in Healthcare

One prime example of the major changes that have occurred in just the past several months is the current state of what we have referred to previously as the Big Gap, i.e., the fact that throughout 2016 and 2017 IT giants recognized and supported AI for healthcare startups, in terms of both investment and acquisitions, while BioPharma lagged behind, still skeptical of the impact that AI could make upon drug discovery, biomarker development and other BioPharma niches.

Developments over the past several months (2018 Q1) seem to indicate that this Big Gap is now to a large extend neutralized, and the BioPharma industry now has significant interest in AI, and belief in its ability to facilitate fundamental paradigm shifts in their traditional modes of operation.

Some BioPharma companies have now become actively involved in the AI for drug discovery sector, while others still lag behind, skeptical of the sector's potential for impact and disruption.

All indications point to the conclusion that 2018 will mark the year that will test the strength, resolve and foresight of BioPharma as a whole.

Those BioPharma and IT & Tech companies that commit significant will and resources to acquiring strong AI specialists, IP and acquisitions will flourish, and those that do not will stagnate, and by the time their profit margins force them to realize the disruptive potential of AI for drug discovery and other biomedical niches, they will have missed the boat, with the majority of talent, IP and companies having already been acquired by their competitors.

Hedge Funds

We are likely to see the rise of many hedge funds that will capitalize on the gaps in biotech and healthcare companies, structuring long and short positions to bet on financial instruments related to progressive medicine, while at the same time creating short positions based on mathematical models of assessing and quantifying these gaps.

Hedge funds will short outdated biopharma

During the late-2000s mortgage crisis in the US, several hedge funds such as Hayman Capital capable in strategic forecasting were able to successfully predict and effectively bet against the U.S. subprime mortgage crisis by purchasing credit default swaps on subprime securities which, in turn, increased in value when the real estate bubble burst.

The hedge funds capitalizing on these opportunities will initially make their fortunes shorting outdated biopharma companies that fail to compete with progressive companies at the forefront of biomedicine, AI and next generation technologies with the focus on preventive medicine.

Moreover, in addition to technologies for assessing the probable success of VC funds in this area, we will also see the development of related technologies that can effectively assess the “negative ratio”, that is the degree of outdatedness. So for example, if a pharma company is not using AI in its core R&D, this would add to its negative ratio. Analysis of negative ratio will play a key role in the analytical systems for investment techniques, and will be used by data and science-driven hedge funds to short those biotech and healthcare companies that are not aboard the longevity train.

The multi-trillion dollar BioTech industry is one of the most inefficient and heavily bureaucratized industries today. Therefore, we can predict that a significant portion of the industry will shrink, being replaced by the BioTech Industry 2.0 (the rising Longevity industry). Meanwhile, hedge funds will have an outstanding opportunity to thrive on this transition, shorting the stagnating partart of the industry.

Hedge Funds

2015 saw a very notable example of this approach, in which hedge fund manager Kyle Bass, founder of Hayman Capital Management, L.P., began to routinely challenge pharmaceutical patents through a process called *inter partes* review (IPR).

This is an interesting example of a hedge fund which is profiting from a combination of challenging pharmaceutical patents while simultaneously shorting the stock of the pharma company owning those patents, the logic being that, if a pharmaceutical patent is effectively and successfully invalidated, then the pharma company who owns that patent will see their stock price drop.

His efforts have succeeded in having the US patent and trademark office (USPTO) invalidate the claims of two Anacor patents, which pertain to Kerydin®; his efforts to invalidate patents held by Horizon, pertaining to Vimovo®, patents held by The University of Pennsylvania, pertaining to Juxtapid®, patents held by Acorda Therapeutics, pertaining to Amprya®, and patents held by Biogen, pertaining to Tecfidera®, were collectively thrown out by the USPTO. Nonetheless, funds profit from such strategies, even when they fail to get the majority of the patents they target overturned by the USPTO.

However, despite the remarkable efficiency of this approach, the fund was eventually closed, likely due to controversy surrounding its tacticas from a legal and ethical standpoint.

While tangible metrics for sophisticated investment strategies should and will no doubt be developed for the next generation novel VC funds, it is currently in a preliminary stage, and will only develop in a practical and actionable manner over the next few years.

Conversely, the existing metrics for quantitatively assessing the "negative value" of companies with weak IP, overhyped valuations, weak management, dead-end science and regulatory roadblocks are already strong and effective enough to be applied today, in order to short weak biomedical and BioPharma companies.

Pension Funds / Insurance Companies

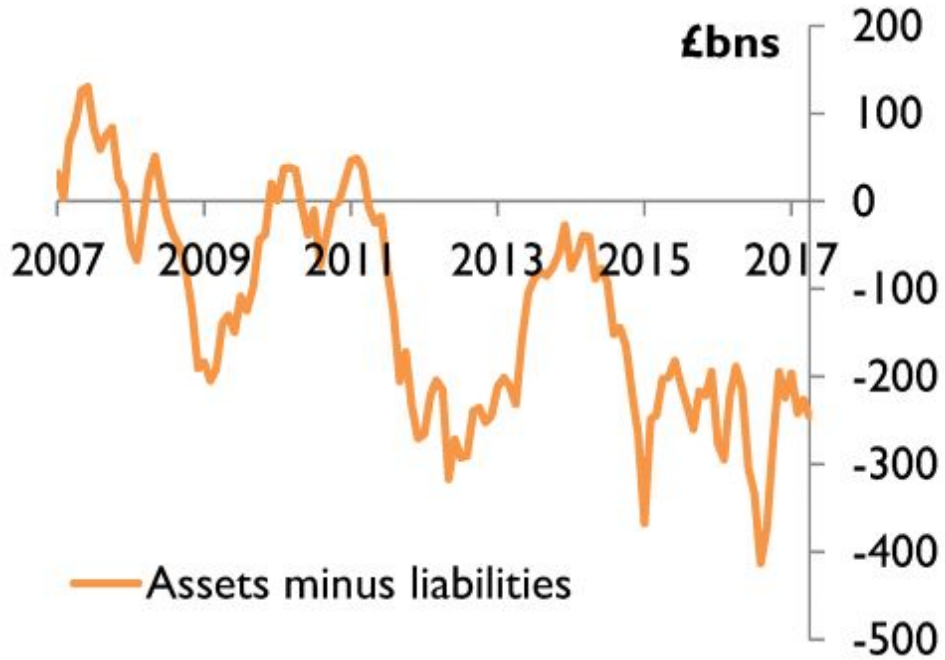
I believe the recognition of our precarious retirement position is one of the most underappreciated future crises in this country. *I think this crisis is going to be much bigger than health care. Health care is immediate. If you don't have proper health care, it is today's problem. But as you know—investing, the whole concept of compounding—if you're not building your nest egg year after year after year, you're not going to have enough savings to retire with dignity.*

- Larry Fink, BlackRock CEO

It is obvious to many experts today that certain pension funds and insurance companies are going to end up bankrupt and go the way of those in Southern Europe, which needed bailouts from governments eventually.

By 2030, pension and old-age expenses could reach up to 13-15% of world GDP - or 10-13 trillion dollars. This is slightly less than the GDP of a country like the United States and about 10 times the GDP of Russia.

UK Pension Fund Assets Minus Liabilities 2007 - 2017



BIGGEST FTSE100 PENSION DEFICITS

BT	£9.1bn	Unilever	£2.2bn
Royal Dutch Shell	£6.9bn	GlaxoSmithKline	£2.1bn
BP	£6.7bn	GKN	£2bn
Tesco	£6.6bn	AstraZeneca	£1.8bn
BAE Systems	£6.6bn	Imperial Brands	£1.5bn

The challenge will be even more pronounced in developed countries, where politicians, presently turning a blind eye, could be setting the stage for the situation to turn into a crisis within 5 years. Only then will national governments and parliaments openly acknowledge the problem.

Left standing will be only those pension funds and insurance companies that are better adapted, with business models that account for the **longevity factor**.

Pension funds are fundamentally either **Defined Benefit** (DB) or **Defined Contribution** (DC) in nature (with some hybrid models). DB funds are those that provide a pre-defined benefit at retirement based on various factors like salary at retirement, total employment period and/or contribution into the fund - and can be funded (where money is set aside in advance) or unfunded in nature. DC funds provide a benefit based on contributions into the fund by the individual combined with the investment returns achieved over the period to retirement. Differences also exist between Corporate and Government schemes.

To consider any country's pension fund system, one needs to consider the Government and Corporate Pension Systems **together**.

In the UK for example, the **Government pension fund is low**, pre-defined and unfunded so current **tax payers** pay the bill. As a result, the Government provides tax-breaks to Companies to encourage Corporate pension funds, which are backed by the Company that created it (often in Trust form to achieve the tax benefits) - this means even if the fund is currently in deficit, the **Company will need to fund this deficit** as long as the Company survives.
This means Companies will ultimately go under when they can't meet the bill to fund their fund's pension deficits. Some countries provide additional protection to members of such pension funds with failed Companies (e.g. Pension Protection Fund or PPF in the UK) - even then, this will often mean **reduced benefits for these pension fund members**.

The pension deficits can be attributed to various factors (the economy underperforming, as well as a lack of sophisticated or relevant financial products) including:

- Longevity - the longer a pension fund member lives, the longer they need to be paid their pension, and this money needs to come from somewhere.

- Underperformance of assets applying to funded schemes; this can be due to conservative investment strategies, partly driven by regulatory requirements and/or due to the overall economy underperforming and/or lack of sophisticated / relevant financial products for the p ısion fund to invest in.

The past century has seen a continued growth in both male and female life expectancies. As seen in the UK, US and the Netherlands, life expectancy has been rising from around 12 more years after age 65, to around **20+ years** by the turn of the 21st century. Current steps to address pension deficits include closure of DB funds or change of promises i.e. reduction in pension benefits where possible, the rise of DC funds, increase in taxes/contributions on current active population to meet the increasing bill where current active members meet the bill of the current pensioners or increase in retirement age.

- Ageing population - applies to underfunded, government schemes where the contributions by the current active population are not sufficient to meet the pension costs of the current non-active or pensioner population due to more pensioners compared to the active population.

- Lack of sophistication, and not being data driven - while there have been some advancements in techniques to better understand longevity risks, pension funds still do not have sufficient access to accessible techniques and appropriate technology to better model their pension cash-flow requirements, the associated investment strategy of assets and more accurately determine longevity risk.

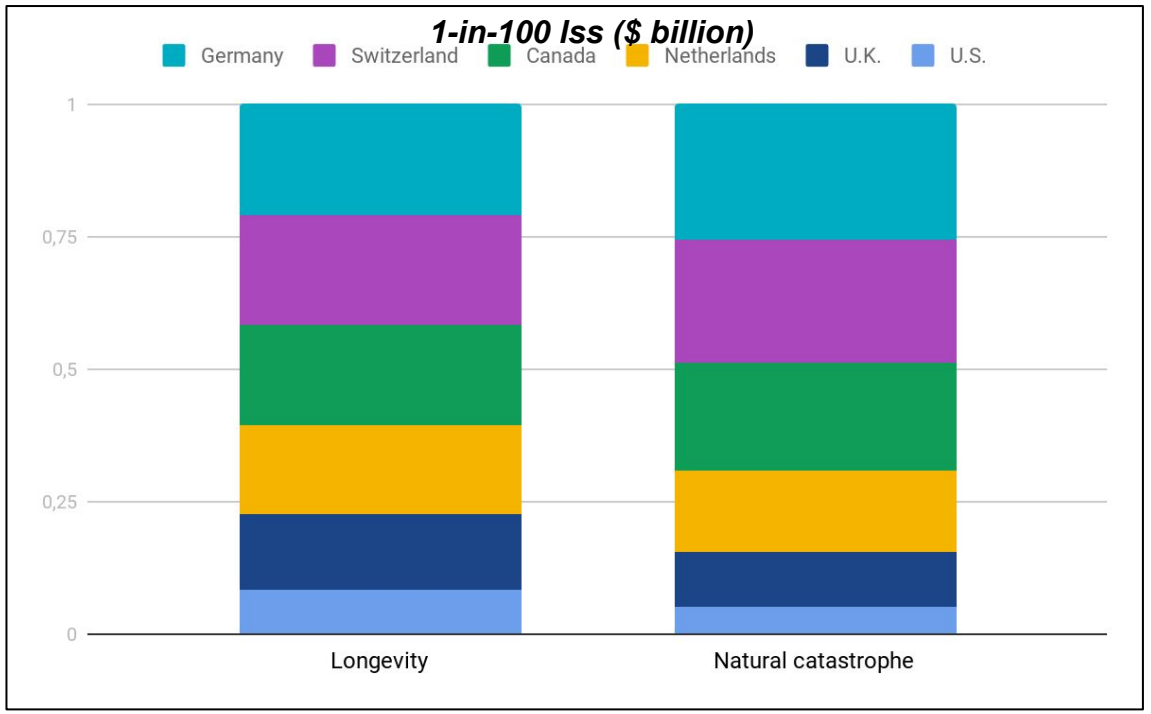
- Regulatory requirements - how pension funds measure their liabilities is based on legislative requirements. As above, this restricts the use of more sophisticated techniques driven by data, AI and technology to better analyse current risks and develop better future strategies.

However, apart from the increase in retirement age, none of these approaches are permanent solutions, due to their focus on reduction in pension costs by reduction in benefits. Even DC funds aren't a true solution as the member takes all the risks and most people retiring from DC funds aren't able to secure a decent lifestyle in retirement, and the ones that do need to be able to pay pay extra during their service years and start well in advance.

So, for countries with a focus on funded pension funds (like the UK and many other developed countries), the Companies and/or Government can invest into longevity based solutions discussed in this report e.g. investing into Companies that can increase QALY and HALE,

or for the large pension funds, create their own venture / hedge funds that either invests into such Companies directly or invests into other longevity venture funds (becoming a fund of funds) to diversify across different longevity sectors.

For smaller pension funds, the Government or a pension industry consortium can create such funds. This is when longevity will start becoming an **asset** for pension funds rather than the a key strain on them.



The price of old age
In terms of costs, longevity risk in some developed economies far outsprips natural catastrophes.

Window of Opportunity

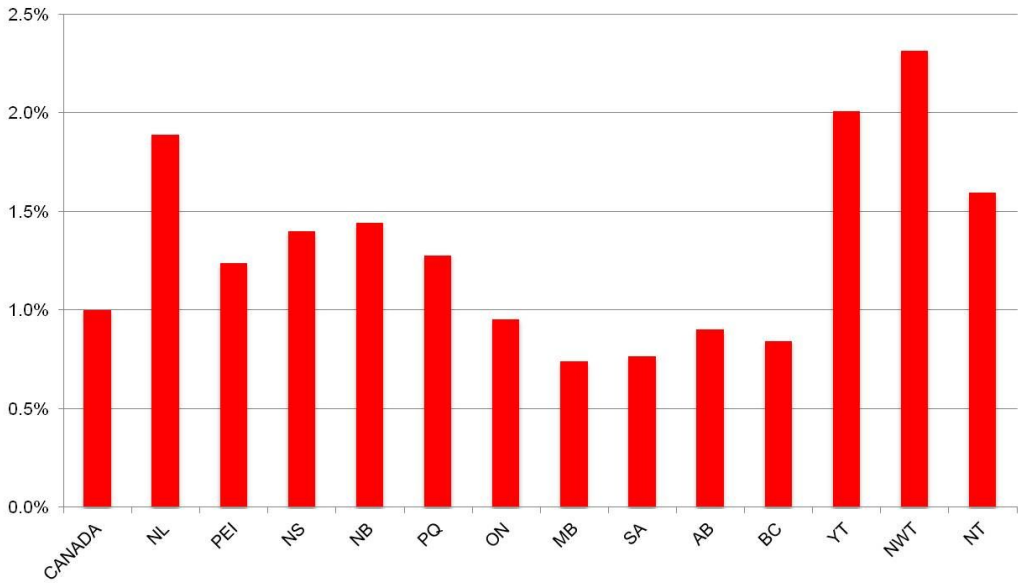
The parts of the industry left standing will be those in which the only measure of success is **QALY (quality-adjusted life years)** and **HALE (health-adjusted life years)**.

There will be a period of crisis following the tsunami landfall, and preceding the completion of first “flood defences” in the form of healthy life-extending biomedicine.

But for many, these intervening years will be a **window of opportunity** to become captains of an entirely new industry and chart a new course for humanity.

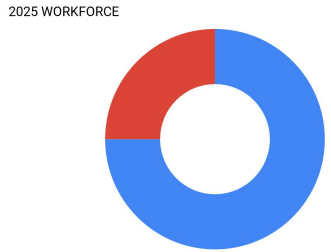
Impact of aging on health care costs - 2010 to 2036

Annual growth rate attributable to changing age composition of population



Mackenzie and Rachlis 2010. P43. Sources: Projected population by age group and sex according to three projection scenarios for 2010,2011,2016,2021,2016,2031and 2036, at July 1, Statistics Canada, Cat. No 91-520-X, June 2010, projection M4. National Health Expenditure Trends, 1975 to 2009, Canadian Institute for Health Information, Ottawa, Ont.: CIHI, 2009. Note: CIHI data gets updated on a regular basis. For the latest available information please visit website (www.cihi.ca) or contact their media team at media@cihi.ca.

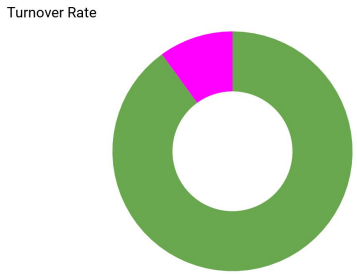
SILVER TSUNAMI



As of 2011
more than 36% of STATE level employees and more than 35% of LOCAL level employees were over the age of 50

As of 2011
more than 22% of its members report accelerating their retirement plans

75% of the workforce in 2025 will be young adults compared to the 25% who will be middle aged. This will put an anchor on leadership positions.



Turnover Rate

OLDER employees racked up to 90% of a job turnover rate

45% of companies experience a turnover rate among their YOUNGER employees.

The current business models of pension funds and insurance companies were established more than 50 years ago, in a world that had no idea about significantly increasing rising lifespans, never mind rising *healthspans*. Most of them are enormous, overfed, bureaucratic and outdated corporations, and the majority of them will prove incapable of adjusting to the Silver Tsunami and the accelerated rate of biomedical advancement which we are witnessing today. Most of them will experience their Kodak moment, and stagnate accordingly.

A select few of them will be capable of reinventing themselves in order to transform into flexible, progressive corporations capable of evolving in the face of change, but it will require them to become data science driven, mathematical corporations with much more advanced and flexible methods of management and strategy development and execution. We described this as it applies to current BioPharma giants in previous chapters, and there are many analogies to be had here. In order for pension companies and insurance companies to become interested in extension of healthy longevity, they will need to transform themselves from the ground up. This will be difficult for many, but doing so will pave the path required to enable them to become the backers of the developing P3 medicine and AgeTech industries, and the Longevity industry in general.

Life insurers' top future uses for big data and predictive analytics

53% want to increase market penetration with data and analytics.

Other planned uses	Now*	Two years
Transform business model	12%	48%
Expand customer relationships	41%	61%
Enhance customer value proposition	18%	52%
Improve internal performance management	29%	44%

*Survey fielded September 15 – October 13, 2015

Source: Willis Towers Watson's 2015 North American Life Insurance CFO Survey on big data and predictive analytics

AgeTech Banks

“ I think the industry has lost sight of what our responsibilities are. And I think through digitization and technology, it’s going to be reshaped. We need to help elevate this whole concept of financial literacy. It’s shocking to me how many people focus on their health, but so little on their money, on affording -longevity and dignity. So we need to help families—especially in this country, as we navigate away from defined benefits and contributions. We have to be leading that effort. ”

- **Larry Fink, BlackRock CEO**

The AgeTech bank will be a novel form of financial institution focused on consumers 60 years or older. It would, in most respects, resemble a traditional fintech bank, but with a focus on consumers over the age of 60.

But to attract these consumers, these banks will need to make intensive use of AgeTech technologies. Just as FinTech banks successfully appeal to young people using internet and smartphones, an AgeTech bank would involve the use of smartphones specifically configured for elderly people and AR/VR devices through which elderly people will be able to communicate.

FinTech and so-called digital banks target young populations who are steeped in the use of mobile devices, such as smartphones, while the elderly population, being less active on such devices, is rarely even considered a potential consumer market.

But it is the elderly population rather than the young who hold most of the wealth, and as such, they should be the major target demographics for such banks.

And in view of recent trends in the overall health of the elderly, the traditional approach is already outdated and will become increasingly obsolete over the next century. Even independent of any longevity-related technologies, the number of elderly people staying active for longer is increasing.

Fintech banks were made possible due to the interaction between bank and client that was made possible using smartphones and other portable devices on a massive scale.

The only current obstacle to the creation of a specialized FinTech bank for the elderly is the lack of a specific device tailored to their needs. But we should expect one to emerge in the next several years, given the continuing rate of progress in the IT sector.

But an AgeTech bank….

- Will be a novel type of fintech bank that will use novel communication devices to communicate with mentally and financially active, if not so physically active, elderly clients, using very intuitive, user-friendly front-end interfaces.

- Will have as its main attraction not interest rates, but the degree to which the bank is a community bank -- a legally recognized category of banks that are operated collectively by clients.

https://seniorsforseniors.ca/social-media-and-you

In addition to providing members of their communities with additional services to improve HALY and QALY, these AgeTech banks will use the community bank model, but instead of mutual credit, they will use their communal budget to reduce psychological aging by making these banks a centre of the community.

As these elderly-run community banks compete with each other, this will offer a sense of purpose, a constructive environment and even a spirit of enterprise for their clients.

"Every company should articulate and adopt a longevity strategy." — Paul Irving

-Milken Institute, *Silver to Gold*

This will be brought to fruition by a range of products and services which will flow from the convergence of next-generation elderly care IT services, MedTech services and P3 medicine. A subsequent development would be in the form of entertainment experiences focused on reversing cognitive decline and fostering a sense of community. This will possibly involve VR and AR.

The elderly demographic in particular will be able to infuse a lot of money into the VR and AR industries because they hold a considerable amount of wealth and because it would play a central role in their lives (socializing, community building, traveling, and so on). If so, we should not be surprised if AgeTech becomes a bigger industry than modern fintech.

The first AgeTech bank is estimated to appear in early 2019. But we can expect that even this year there will be further progress in AgeTech accelerators, hubs and VC funds. A big missing factor is smartphones tailored for the elderly, so this will need to be solved by 2019 in order for this industry to take off in 2020.

https://www.economist.com/news/business-and-finance/21716598-banks-need-strategies-helping-vulnerable-elderly-customers-elderly

Longevity Trust

In the history of humanity, there have been several examples of specific cases where management of health and longevity of several specific people (there were specific social models on how to maintain health of specific people, in particular the example of Indian Tzars; all the slaves and servants were buried with the Tzar). They were brutal rituals but the idea was simple: to ensure that everyone surrounding the Tzar was incentivized to make them live as long as possible.

The same rationale should be employed with novel business entities and models, where managers of financial corporations will be extremely interested in providing **the best options** to extend and maintain the longest period of healthy longevity for their clients and employees. At the same time, this could be applied for extension of the healthy period of life, measured via biomarkers of aging.

Examples:

1. A client is appointed to a longevity trust at the age of 100 years, and they deliver a % of their wealth into the trust; managers of the trust will incur penalties if the client fails to reach the age of 110. At the same time, benefits are received with each extra added year of life the client enjoys. These benefits will be awarded to the trust linearly to the client's longevity. Most benefits will result from those clients that surpass 115 and especially from those who achieve 120. When clients reach these higher numbers, the growth in benefits will start to increase exponentially.

2. In the previous case, the managers of the fund acquire benefits due to the extension of life regardless of healthspan. A different scenario involves fund managers benefiting from extension of healthspan, not just lifespan. Clients would have access to specific products related to AgeTech and precision medicine. If the fund succeeds in providing very good solutions and products, measured by HALY, QALY and other tangible metrics, but in short provides an extension of the clients' healthy period of life and an increase in client quality of life, then the fund manager is rewarded with significant benefits.

By applying forecasting we can predict these scenarios and we can also optimize the trajectory and evolution of such corporations, and maybe try to make it in **the most ethical way** ahead of time.

So, back to the example. A client enters, goes through advanced diagnostics, and their **actual biological age** is identified. This could turn out to be 75 years old. After 1 year, managers of the trust would get benefits if the client's biological age remains 75. Essentially, no further ageing has occurred biologically. If the age actually goes down, the level of benefits to the trust would increase even higher, as part of the incentivised model.

In the same way, benefits would decrease with every year of advanced ageing over time. If after 10 years the client's biological age has been preserved at 75 years old, managers will enjoy exponentially increasing benefits.

Generally speaking, the purpose of pension funds was the preservation of **money rather than health**. Some insurers do encourage their clients to stay healthy, but this remains an approach still in its innovation stage.

Pension funds and life insurance companies could probably be **merged** to create a new entity that has a self-inducing mechanism, where the longevity trust will be the vehicle for preservation of wealth *and* health, and to preserve healthy longevity of clients; some could be focused on extension of the healthy period of life as measured by **biomarkers**, while others could focus on extension of life in general (lifespan rather than healthspan).

The personal benefits of managers should be specifically tied to the performance of client health; just as in hedge funds, where exact benefits (profits and salary) of managers are precisely proportional to financial returns. Here, manager benefits will be **precisely proportional** to the performance of clients health.

These organisations should be able to deliver their clients the technologies combined under their longevity venture funds and AgeTech banks; they will efficiently use the money of these trust and will keep it in AgeTech banks and place it in the longevity index fund (composite index) to preserve and generate profit. Meanwhile, they will also invest in some entities which will be aggregators of AgeTech and preventive medicine health technologies or companies.

Derivatives

Novel longevity VC funds, hedge funds, AgeTech banks, novel pension funds, insurance companies, longevity-driven legal and financial frameworks will together provide multiple sources for multiple types of longevity-associated derivatives.

This will spawn a whole new industry, the capitalization of which could exceed anything ever considered by financial markets. It will also produce a large quantity and diversity of derivatives, which in turn will support a second and third layers of derivatives, which in turn will give rise to the biggest possible market for derivatives imaginable.

The current system of derivatives linked to the so called **longevity risk** was created roughly 50 years ago when, as it happens, the system of current pension funds started to rise; the pension funds since that time have grown from startups to trillion dollar entities. The typical value of all pension funds is around $1T in developed countries. These funds were created in an age when maximum **life expectancy** was around 85 years.

Since that time, life expectancy has grown and demographic aging has increased (some extreme examples like Japan, and now Italy). Pension funds have a certain amount of clients who are paying into the fund. If the clients live longer than 85, the fund will lose money and have a deficit.

This unexpected rise of life expectancy, named **longevity risk**, has insurance companies insuring pension funds against this risk, which was previously considered an extremely low probability event. At the same time, other insurance companies (reinsurance companies) will protect against this risk for those insurance companies.

Reinsurance companies were producing derivatives and financial instruments, and were trading with hedge funds using these instruments; and investment banks were creating so called “special synthetic financial vehicles” to create some system of hedging this risk.

During the last 50 years, this system of derivatives (including secondary and third stage derivatives), which related to this extremely complex system of pension funds, insurance companies and hedge funds, grew to an enormous scale. There are no numbers or estimates capable of calculating the entire size of this industry.

For pension funds purchasing a longevity derivative, e.g. a longevity swap, the longevity risk pricing is done by the provider of the derivative, e.g. banks or insurance companies at the outset, where the pension fund in the future will receive variable payments by the provider based on the surviving population in exchange for fixed payments paid by the fund to the provider agreed upfront. So if the pricing is done correctly by the bank or insurance company, the pension fund will ultimately have to pay for the longevity risk along with the costs and profit loading incorporated by the provider. And if the pricing isn’t done accurately, then the provider ends up funding the longevity risk, unless they have further reinsured.

Moreover, because pension funds have all the aforementioned gaps, the organizations dealing in such derivatives (including governments affected by longevity risk) will need to either apply specific methods of “financial engineering” to create all options available to postpone the crisis or somehow meet the bill.

One option is for governments to bail out such pension funds where it is affordable to do so but this cost will again need to be passed onto the current active population and so will not be popular with these people. As a result, governments are likely to covertly and instinctively support postponing the pension crisis, in order to transfer it to the next officials, government or fund managers.

This is possible by increasing national debt (in the case of Japan) or by increasing internal debt (as is the case of USA). External debt is a well known number, but it is not known to the average public that the USA internal debt exceeds 40 trillion dollars, half of it relating to the health care and pension system economic burden due to **demographic aging**.

The situation in other countries is similar, differing slightly in proportion but the same in general. Countries increase taxes and national debt, and all this suppresses the younger population and the development of the country. This is the pathway to a dead end, and all countries that will not apply extreme measures to solve this problem will suffer from the outcomes of these non-proactive, reactive solutions that simply delay the problem.

As of 2008, the mortgage bubble burst, and all derivatives built upon mortgage loans were diluted in one second. The same type of event is inevitable and imminent in the next 5-10 years in the case of these pension related derivatives. Japan and countries similar to Italy will be the first to experience this.

The bubble related to these topics could cost $100 - 200 trillion. Again, there is no clear method of calculating it because a lot of these issues are hidden within synthetic financial engineering supported by governments. This can become clear after national bankruptcy, and the “economic pathology” is investigated.

Autopsy of the bankrupt nation then reveals the size of the bubble, much like a body autopsy following a complex, unexplained pathology and death eventually sheds light upon the cause of death and the gravity of the situation that led to it for the patient.

All this was created in an age when no one considered that life expectancy could grow so much. At the same time, it is inevitable that new financial entities, systems and strategies will be created from the scratch in a way that allows for life expectancy to grow significantly. For the health of this new financial system - created with the opposite approach to the original version - it will be ensured that it will not suffer, but thrive with the growth of life expectancy and metrics created in such a way that the longer patients live, the better it will be. They will be created and will grow, and the peak of their growth will occur when the crisis and failure of previous entities will happen - so they will be especially successful in the times of crisis and failure of old pension funds, and will absorb and buy out those old structured derivatives at a fraction of their normal cost.

According to that, it is quite reasonable to predict that there will be an entire novel system of derivatives which will be added in the reverse way to the previous system. The deeper analysis of all this subject will be made in the upcoming **Volume 4 - Novel Longevity Financial System**.

Figure 01. Breakdown of tipical scheme risk profile through time

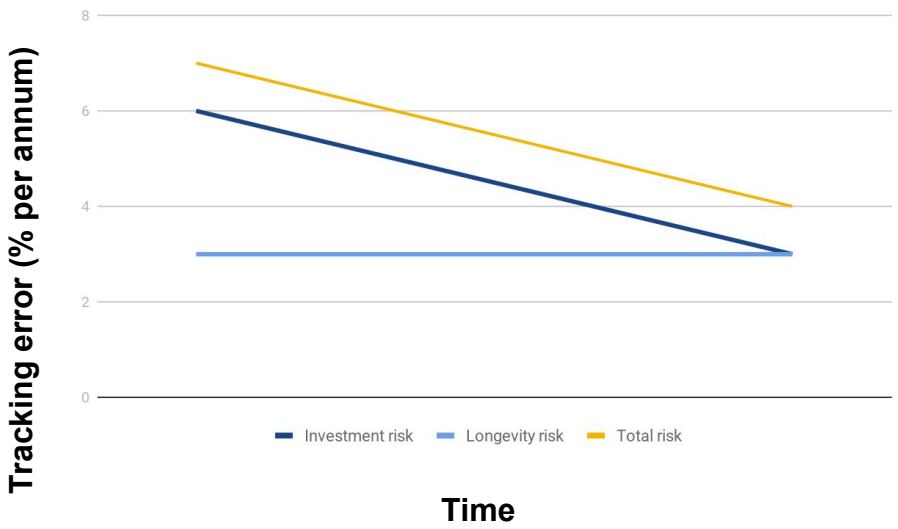
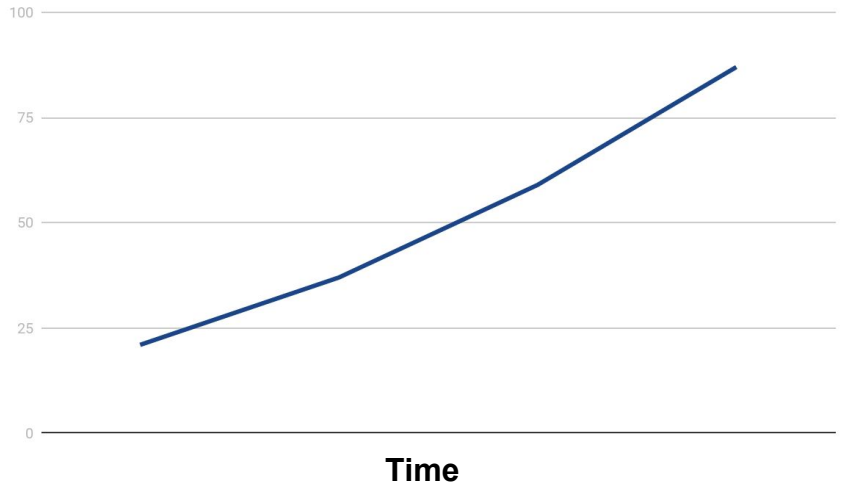


Figure 02. Longevity as a proportion f total risk



https://www.towerswatson.com/en/Services/Services/managing-longevity-risk

Furthermore, companies that come out on top in this industry will become trillion dollar corporations.

In fact, all derivatives, insurance and pension funds considered, the total market capitalization might be somewhere between 100-200 trillion, rivalling that of the real estate industry. We are aiming to produce a 4th volume entitled ‘Novel Financial System’ later this year. We already have a team of experts working on this, however we expect that publication of the preceding volumes will generate enough interest to attract further expertise which will be able provide independent unbiased work on this topic.

The projections made in previous chapters will be considered too optimistic by some, but we remind readers that just three years ago the present hot topic of life extension by technological means was seldom discussed seriously.

It is practically impossible to determine the size of the longevity-associated derivatives market due to the highly complex nature of the system. But key to the market’s success will be accurately figuring out the pricing of derivatives, which should take into account the price of the associated risk. Failing to do so will result in losses to the provider of the derivative. But if done properly, pension funds purchasing those derivatives will have to pay that price. In this instance, the government can step in and bail the pension funds, but that will be most likely done in a way that only postpones the looming crisis.

One treads a narrow path making predictions in this area. One’s stated prognostications must be bold enough to accommodate a futuristic vision but serious enough and data driven to be correct and by extension taken seriously. Our overall expectation is that a confluence of AI and advanced biomedicine will accelerate progress in some regions while government inertia and broken healthcare frameworks will stall progress in others.

The global financial derivatives industry is vastly complex and multifarious, and as such requires very particular backgrounds and specialized knowledge to sensibly analyze and forecast. Therefor, we are aiming to produce in subsequent volumes special case studies analyzing this topic of novel financial longevity derivatives, sourcing contributors with specific expertise and experience in this complex financial arena.

Longevity Stock Exchange

In Volumes I and II we charted the development of techniques into science, science into technology, and technology into industry.

A **Longevity stock exchange** is the culmination of this journey: **a fully-fledged, multifarious global commercial industry**.

As soon as HALY and QALY become quantifiable products, platforms for the various types of longevity and P3 medicine companies have been established, and a longevity stock exchange is set up, we will see the emergence of new types of digital assets stock exchange platforms.

Specialized stock exchanges already exist. Currently, investors can dig into about 50 major commodity markets worldwide for example. Those include markets for soft commodities such as wheat, coffee, cocoa and other agricultural products, and ones for commodities that are mined, such as gold and oil. NASDAQ fits that profile as well; it was created as a stock exchange for IT companies and is currently the home of tech-oriented stocks.

Such a specialized Longevity Stock Exchange might first appear in countries such as Japan, Hong Kong, Singapore and the UK, which will come to be known as ‘longevity-progressive’ countries due to having taken on the challenge of fostering longevity-friendly environments with longevity stock exchanges, attracting P3 medicine and longevity companies and all and any financial entities compatible with that market. A longevity progressive country will be one with a technocratic government whose pragmatic approach makes it likely to implement advanced technologies into government level frameworks. Such countries are inherently poised to provide a favorable environment for the longevity industry. As we mentioned earlier, longevity progressive countries such as the UK, Hong Kong, Singapore and Japan are prime sites for such a fund to emerge, but out of the four, it is the latter (Japan) that is best suited since the country will suffer hardest from the silver tsunami. Consequently, it will be the best place to attract the best companies and investors with something relevant to offer the longevity industry.

Longevity Stock Exchange

Specialized stock exchanges typically form when an industry grows by a sufficient amount. A longevity stock exchange feels inevitable. Estimates for the growth of the longevity industry - spurred by the will of progressive companies to become financial and technological hubs and havens for the longevity industry.

We estimate that between 2020 and 2022, a Longevity Stock Exchange will be created.

Given that timeline, one should taken into account the fact that specific other industries and technologies will have grown significantly by that time. Given that it is a stock exchange designed to house the companies making up the next generation biomedicine industry, it is reasonable that it will employ next generation RegTech, LegalTech and InvestTech as well, and that it should aim to be on the very forefront of the financial industry.

It should also employ simplified framework for assessing companies and listing them on the xchange. The Longevity companies should be focused on R&D rather than the commitment of significant resources to investment relations and paperwork; meanwhile, investors should be insured that companies listed on the exchange have been subjected to thorough technological and scientific due diligence, to avoid the selection of companies whose success is based solely on successful “financial engineering” rather than scientific breakthroughs.

Given the possibility for large financial institutions such as pension funds to invest in these companies (given that they will be traded publicly), the exchange will require an advanced yet simplified approach for due diligence, assessment and company listing, which will be discussed in detail over the next few pages.

Setting up this exchange will require the public listing of 100 longevity companies as well as acquiring Moody’s and S&P 500’s ratings for the Longevity ETF Fund and transitioning it to the Longevity Index Fund. The increased liquidity that the exchange will provide will also enable greater flexibility and greater leverage for the further growth of the companies listed on the exchange, and as such greater opportunities for advancement of the Longevity industry as a whole, for the betterment of society on a global scale.

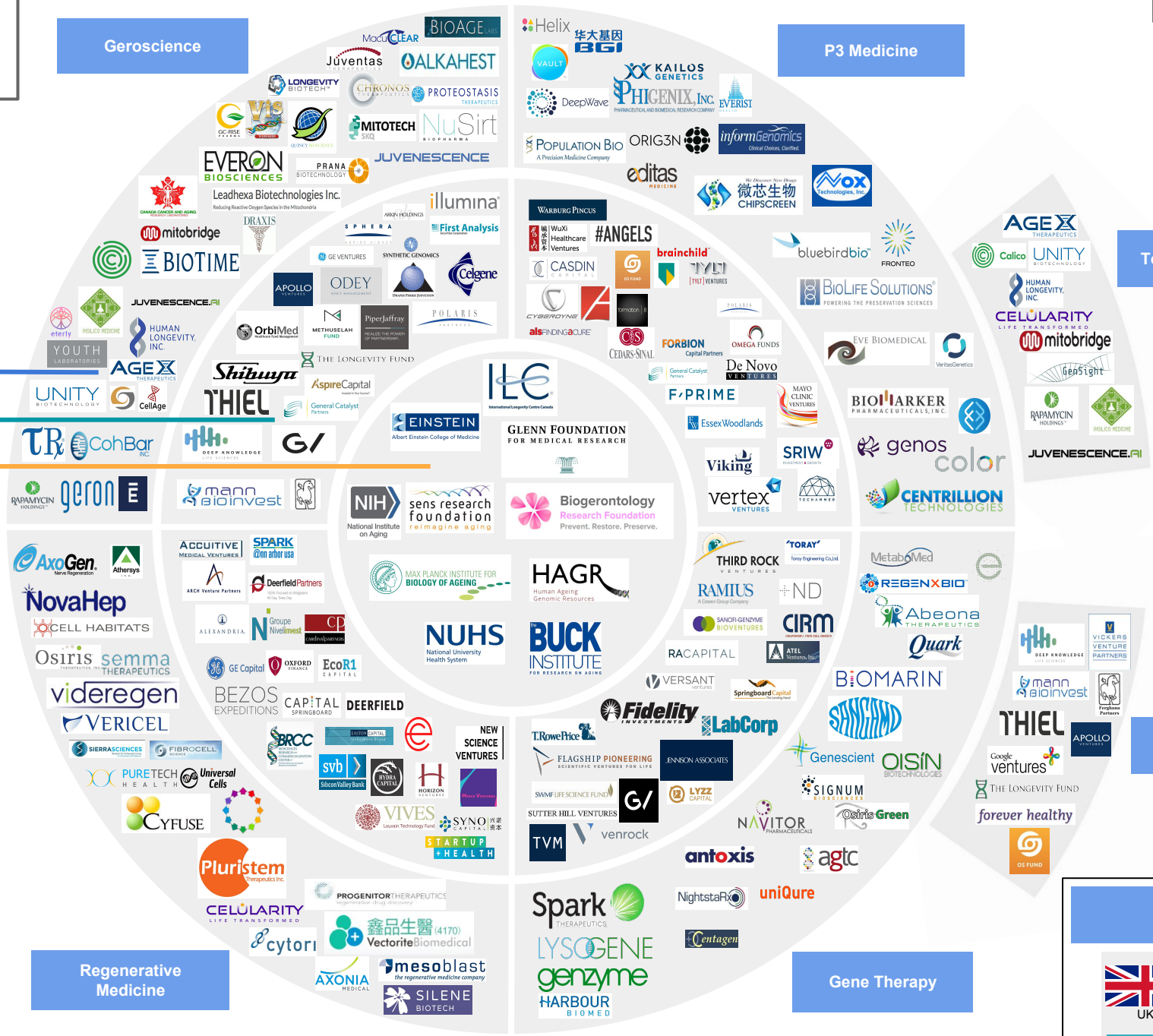
GLOBAL LONGEVITY INDUSTRY LANDSCAPE 2017

LONGEVITY.INTERNATIONAL

COMPANIES

INVESTORS

SCIENCE HUBS



AGING ANALYTICS AGENCY
Invest for life

Biogerontology Research Foundation
Prevent. Restore. Preserve.

DEEP KNOWLEDGE LIFE SCIENCES

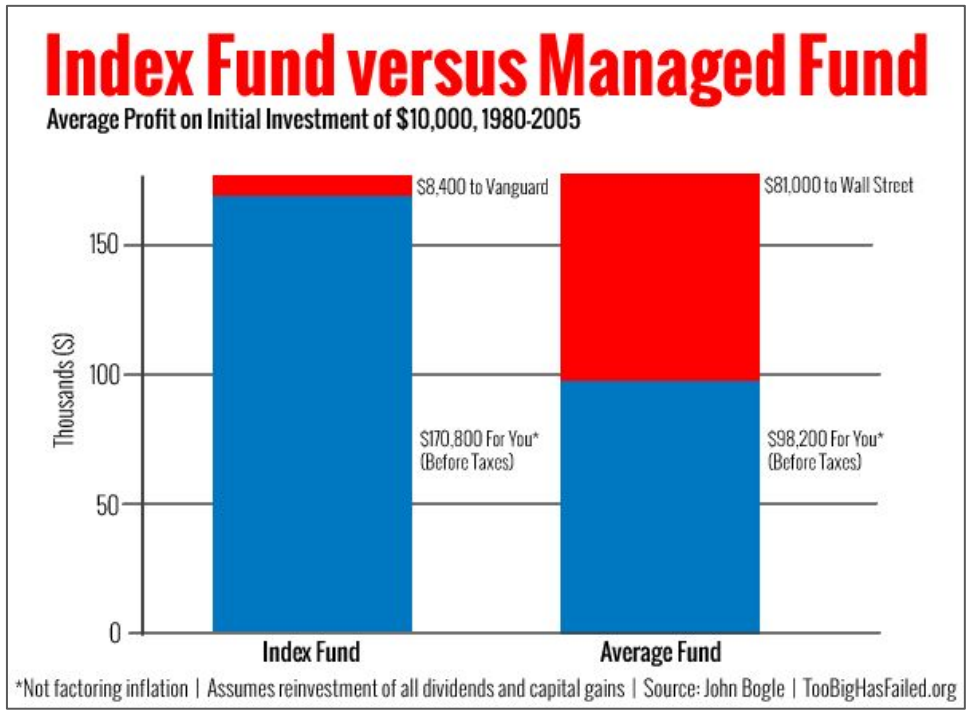
LONGEVITY.INTERNATIONAL

Longevity Index Fund

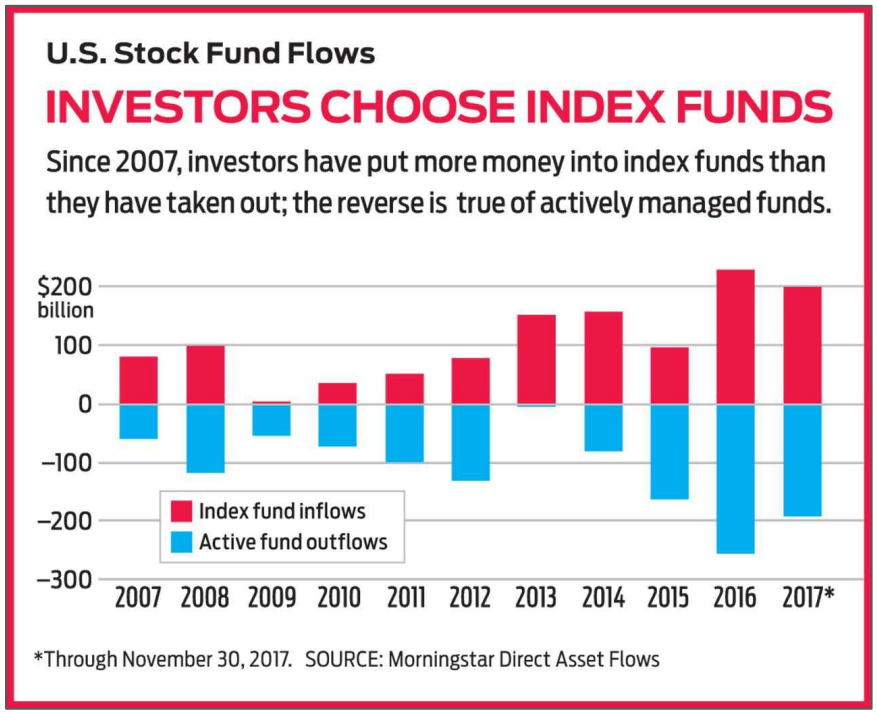
Similar to how the NASDAQ Composite is structured, once a longevity stock exchange succeeds in having its first 100 companies listed, the index would be tied to the capitalization of a well-diversified pool of top 100 companies - the diversity will be determined based on the area of specialization of each company.

The more companies are listed, the more the index will be diversified, and this will lead to more specialized sub-indexes similar to the NASDAQ 100 and the NASDAQ 100 Financial Index - think of a gene therapy sub-index for the longevity industry for example.

Those sub indexes could form the framework for attracting money from conservative investors and institutions, such as pension funds, mutual funds, insurance companies and sovereign funds.



http://www.bankers-anonymous.com/blog/more-on-actively-managed-equity-mutual-funds/



https://www.kiplinger.com/article/investing/T041-C009-S002-the-perils-of-investing-in-index-funds.html

Uniting the Fragmented Longevity Industry through Longevity.International platform

LONGEVITY.INTERNATIONAL

Similar to most industries in their nascent state, the longevity landscape remains highly fragmented. With all the innovation pouring in from startups, scientists, researchers, tech titans, thinkers and writers, the possible synergies and consequently full potential of the industry are yet to be fulfilled.

Longevity.International was setup to mitigate that problem, providing longevity industry services crucial to its functioning on every level.

The online portal will serve primarily as a meeting point for all stakeholders in the business of longevity. The platform will have matching system and networking tools, allowing the different stakeholders from companies to investors to scientists to activists, to connect with one another and collaborate.

The platform also hosts the latest Longevity Industry Reports which offer a comprehensive overview of the current longevity landscape; from the most successful investors and disruptive startups, to the most recent advancements in science, technology and regulation.

An interactive database section armed with automated data filtering and visualization tools for longevity companies and investor tools will provide vital information to the industry, and will present new opportunities.

Longevity.International also acts as a space where consensus over scientific methods and discoveries, decentralized scoring and ranking of entities - such as companies, technologies, and countries will be assembled.

Novel Approaches for Assessing Longevity Companies via Decentralized Due Diligence System Longevity.International as a Collective Intelligence Assessment System

Venture investors have so far been hesitant to invest in the longevity industry and advanced biomedicine in general as a result of the difficulty in conducting biomedical due diligence. For that, they have had to resort to hiring expensive consultants, and, more often than not, those consultants are biased towards their own specialization.

This is where the longevity.international platform, a non-profit framework with the purpose of generating knowledge, comes into play.

Hundreds of science consultants will be present on the platform, diversified according to geography and specialization, allowing for crowdsourced, unbiased scientific and technical due diligence. The platform will store the info using blockchain technology, ensuring trust, transparency and accountability.

Due diligence will be conducted according to tangible metrics such as TRL, both applied to research and development and practical applications, HALE and QALY, a P3 innovation score, biological age versus chronological age.

As such, the platform will lay down the framework for a scoring and rating system that takes into account the most modern and comprehensive tangible metrics to date.

The platform for crowdsourced due diligence and collective intelligence will be used by third parties such as Longevity venture funds, Longevity micro-index funds, Longevity exchanges, and other financial and scientific entities.

Longevity.International Future Roadmap

The long term goal of Longevity.International consortium is to enable the Longevity industry to emerge, mature and thrive.

2019 - Longevity Fund of Funds (Portfolio of Micro Index Funds - AI for Drug Discovery, Blockchain in Healthcare, P3 medicine, Longevity)

2019-2020 - AgeTech Bank / Longevity Hedge Fund / Longevity ETF Fund

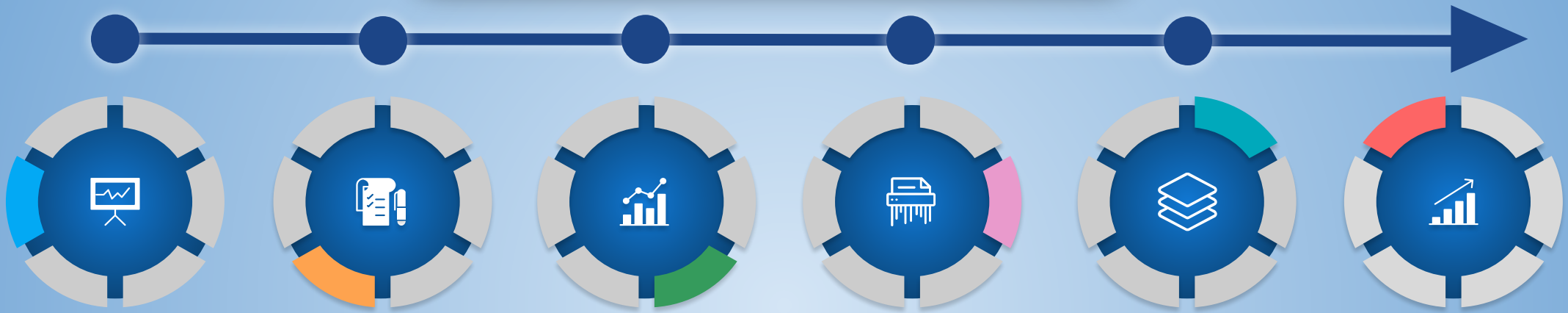
2021 - Establishment of Longevity Stock Exchange (Tokyo or London), have 100 Longevity companies listed on the exchange, acquire Moody's and SNP 500 rating for the Longevity ETF Fund, and subsequently transition it to the Longevity Index Fund

2022 - Longevity Index Fund / Longevity Composite Index (index related to composition of combined capitalization of all companies listed on the Longevity stock exchange)
https://en.wikipedia.org/wiki/Nasdaq_Composite

2022 - 2025

- List 1000 longevity companies at the Longevity stock exchange
- Attract 5 trillion dollars into Longevity Composite index
- Attract 1 trillion dollars into Longevity Index Fund
- Attract 5 trillion dollars into 1000 Longevity companies
- Acquire AAA rating for the Longevity Composite Index
- Acquire AAA rating for the Longevity Index Fund
- To enable the distribution of P3 Medicine and Longevity technologies to 7.5 billion people globally

Roadmap Toward Longevity Finance Industry



Longevity VC Fund:

VC Fund focused on longevity startups, with deep scientific expertise in geroscience

AgeTech Bank:

New generation of a bank focused on the elderly people applying combination of Fintech and care solutions to improve quality of life of its clients

Longevity Hedge Fund:

Hedge fund that shorts risky and non-scientific life science and outdated BioTech companies

Longevity Trust:

Trust optimized to manage clients' wealth and assets across an extended period of healthy longevity

Longevity Stock Exchange:

Specialized longevity stock exchange will form a fully-fledged, multifarious global Longevity commercial industry

Longevity Index Fund:

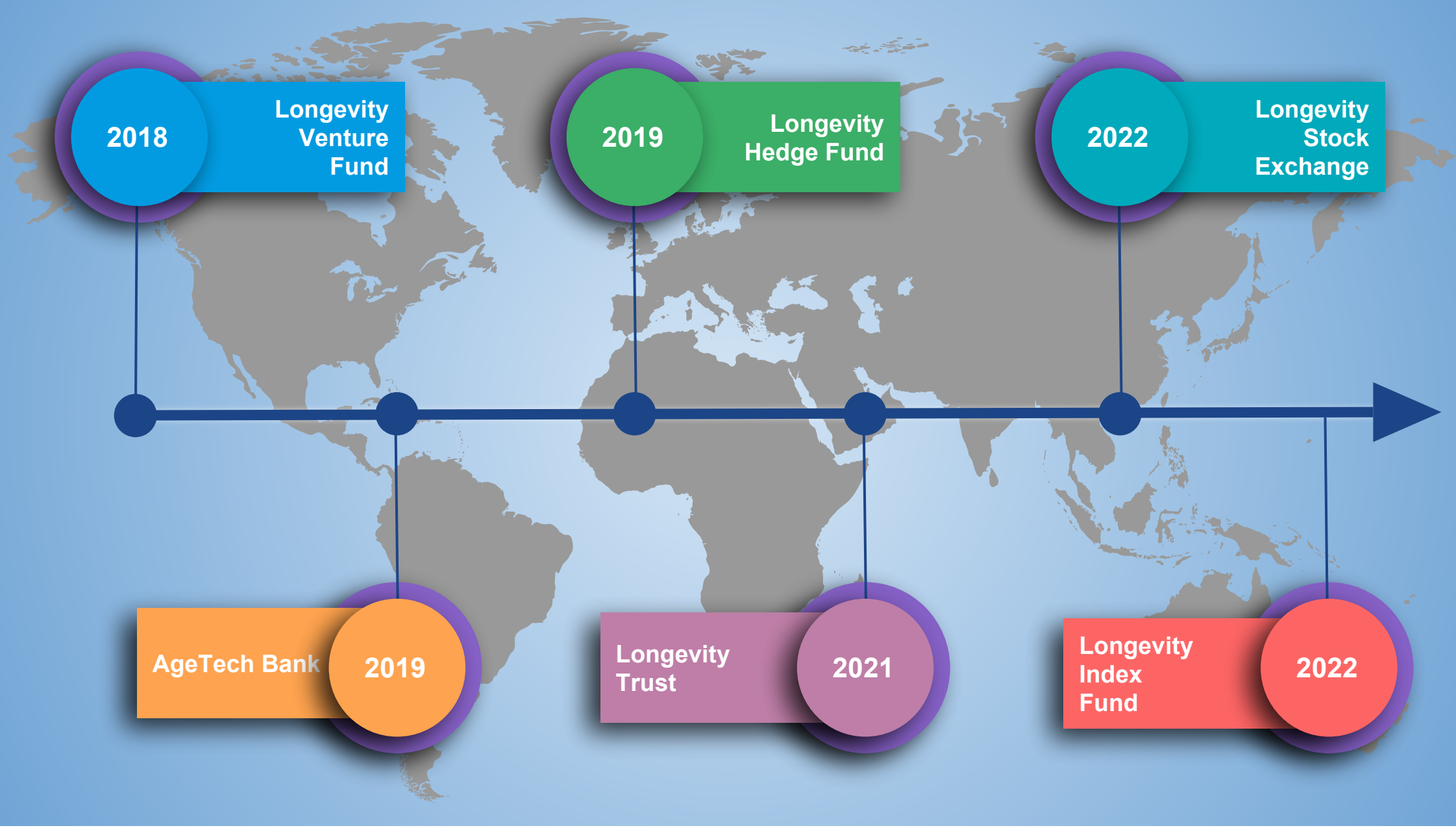
Tied to the capitalization of a well-diversified pool of top 100 companies that operate within the longevity industry

AGING ANALYTICS AGENCY
Invest for life

Biogerontology Research Foundation
Prevent. Restore. Preserve.

DEEP KNOWLEDGE LIFE SCIENCES

LONGEVITY.INTERNATIONAL

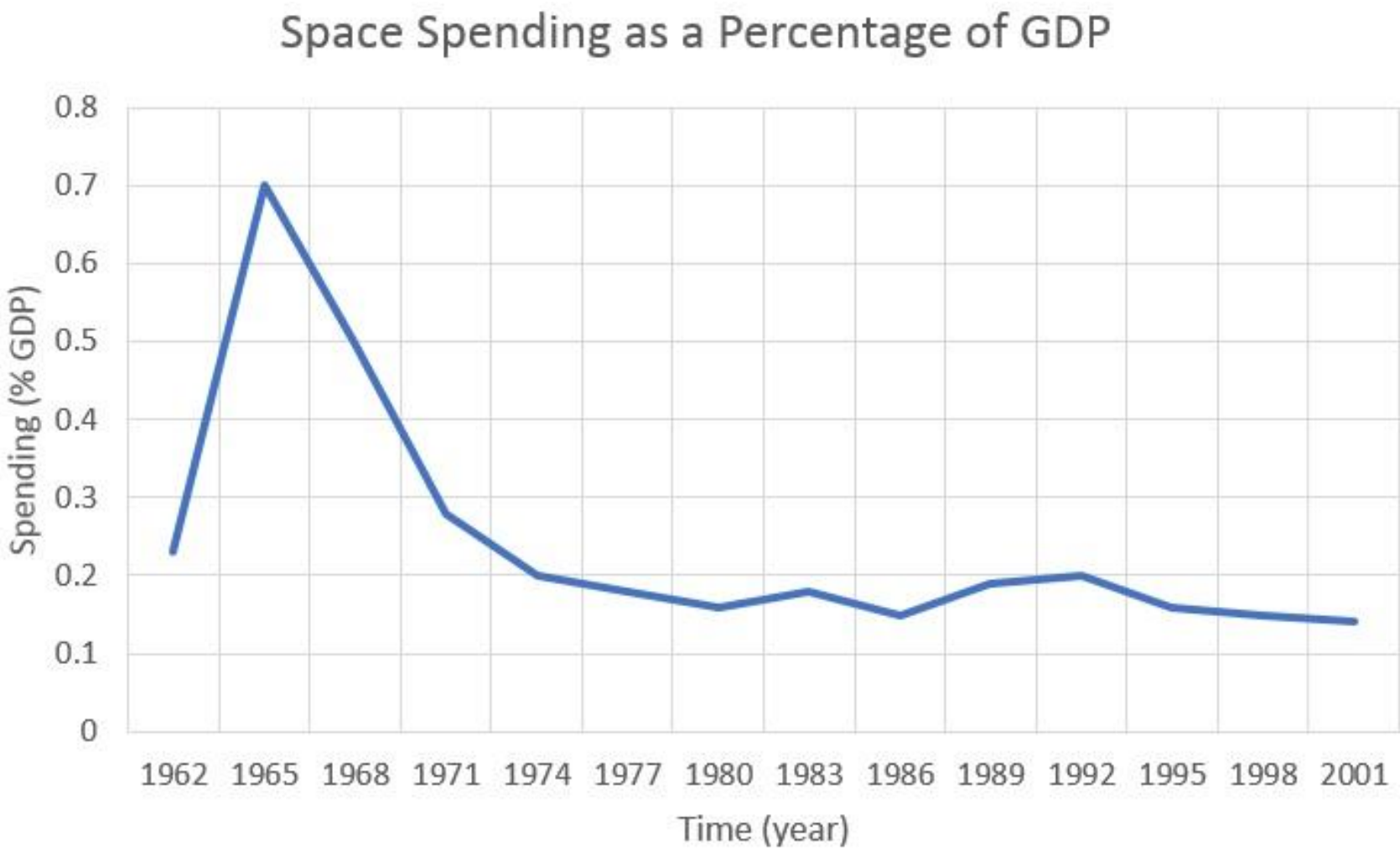


AGING ANALYTICS AGENCY
Invest for life

Biogerontology Research Foundation
Prevent. Restore. Preserve.

DEEP KNOWLEDGE LIFE SCIENCES

LONGEVITY.INTERNATIONAL



The proportion of GDP allocated to space spending with the approach of the race to the Moon skyrocketed in the ‘60s, only to then deflate with no sign of revival for the following several decades. Investment in deep tech and science must be adequate if we are to reap the benefits they promise. If the same approach will be applied to aging research and the Longevity industry, the outcome for the US economy, and humanity at large, will be much more significant than the rewards reaped by the space race.

Chapter VII Conclusion

Future progress in the Longevity industry depends on multiple factors, but support from Longevity-progressive countries can substantially accelerate the dynamic of further industry development, and in particular the *rate* of future progress can be significantly impacted by the efficiency of those countries' national development programs.

Consider the United States' Apollo Program, on which 4.5% of GDP was spent over 11 years, or the Manhattan Project, on which The USA spent a significant portion of the nation's resources over 6 years, but which yielded unprecedented strategic advantages. What would happen if one progressive country would launch a Longevity Manhattan project? And what would happen if five progressive countries would unite to create a joint global Longevity Initiative on the same scale as the joint International Space Station program?

Fully igniting the longevity industry and getting it off the ground some time between 2025-2030 would require bringing about the paradigm shift described in previous chapters, which in turn would require mobilising some 5 trillion dollars in 5 years.

The national debts of developed countries are managed quite efficiently, applying special "financial engineering" techniques of their central banks, but at the expense of younger populations economic futures. Such enormous resources, if instead spent on the neutralization the Silver Tsunami via development of the Longevity industry, would be a much more relevant and pragmatic use of nations' capital. It all depends on how seriously we consider the looming Silver Tsunami and how much we value longevity as a dividend. Countries most likely to take the coming threats and opportunities seriously are those with the greatest life expectancies: Japan, Germany, Hong Kong, Singapore, the UK, and so on.

The Longevity industry from a science and technology perspective is one of the most complex and multifarious industries today. Nonetheless, when it will emerge in full maturity and will be transitioned into practical applications, the Novel Longevity Financial Industry and associated financial derivatives will grow to become one of the largest industries ever, and simultaneously one of the most important for global society, as well as one of the most ethical sphere of business activity.

Biogerontology Research Foundation

Prevent. Restore. Preserve.

Website: http://bg-rf.org.uk

Contact: info@bg-rf.org.uk

The Biogerontology Research Foundation (BGRF) is the UK's oldest longevity non-profit organization founded by leading geroscientists. **The BGRF** funds and conducts research which aims to develop biotechnological interventions to remediate the molecular and cellular deficits which accumulate with age and which underlie the ill-health of old age. **The BGRF's** Board of Trustees include British billionaire Jim Mellon, prominent longevity investor Dmitry Kaminskiy, renowned geroscientists Dr. Alex Zhavoronkov, João Pedro De Magalhães and Dr. Richard Faragher, as well as Jim Plante and Franco Cortese.

DEEP KNOWLEDGE LIFE SCIENCES

Website: http://deepknowledge.life

Contact: info@deepknowledge.life

Deep Knowledge Life Sciences is a London based investment fund focused on ground- breaking research in life sciences and aging. **DKLS** strategically invests in mission-driven companies and supports founders who will bridge the gap between basic biological research and real-world healthcare products that extend healthy lifespan. **Insilico Medicine**, a company applying the latest advances in deep learning to biomarker development, drug discovery and aging research, is **the DKLS flagship investment.**

LONGEVITY.INTERNATIONAL

Website: http://longevity.international

Contact: info@longevity.international

Longevity.International is an online interactive database of longevity scientists, companies, and investors. This platform allows different stakeholders in the longevity industry to connect, network, research and analyze.

On the next stage this platform will also employ *cutting-edge data visualization software and a networking section* where various stakeholders within the longevity industry can connect and collaborate, where longevity companies are matched with the right investors, and where scientists can make contributions.

AGING ANALYTICS AGENCY

Invest for life

Website: http://aginganalytics.com

Contact: info@aginganalytics.com

Aging Analytics Agency aims to use its knowledge of anti-aging technologies and current research paradigms to create invaluable databases and provide a supporting **Aging Analytics Agency** aims to use its knowledge of anti-aging technologies and current research paradigms to create invaluable databases and provide a supporting framework for financial decision making. The goal of **the Agency** is to promote the growth of biogerontology, enhance international collaboration, and increase interaction and cooperation between companies to benefit the field as a whole.