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The Science of Longevity: A Framework for Beauty to Win in the Age of Longevity

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Executive Summary

The beauty industry stands at the beginning of a transformation that may ultimately rival the impact of the anti-aging movement that reshaped the category more than two decades ago. What began as a niche scientific pursuit focused on extending lifespan has evolved into a global conversation about health span, preventative health, biological resilience, and quality of life. Advances in genomics, artificial intelligence, biomarker testing, wearable technology, and aging biology have fundamentally changed how consumers think about growing older. Increasingly, consumers no longer view aging as an inevitable process to be accepted or cosmetically concealed. Instead, they view it as a biological phenomenon that can be measured, monitored, and potentially influenced through lifestyle choices, interventions, and technology.

This shift is occurring against a backdrop of profound demographic change. By 2050, the United Nations estimates that the global population ages 65 and older will exceed 1.6 billion people, nearly doubling from 2021 levels. For the first time in human history, people ages 65 and older are projected to outnumber children under age 5 globally.

At the same time, life expectancy continues to increase across much of the world. Yet despite these gains, healthy years lived have not kept pace. According to data from the World Health Organization, populations are living longer but spending a growing proportion of those additional years managing chronic disease, disability, and declining quality of life. The gap between lifespan and health span has become one of the defining healthcare challenges of the 21st century.

As public awareness of this gap grows, longevity has emerged as a powerful cultural and commercial force. Venture capital investment in longevity-focused companies has accelerated dramatically over the past decade. Organizations ranging from biotechnology startups and pharmaceutical companies to consumer technology firms and wellness brands are competing to define the future of healthy aging. Longevity is no longer confined to scientific conferences and research laboratories. It is becoming a consumer aspiration. McKinsey estimates that products and services associated with healthy aging, wellness, prevention, and longevity already influence trillions of dollars in annual consumer spending globally, positioning longevity as one of the largest emerging opportunity spaces across consumer industries.

The beauty industry has begun responding accordingly. New products increasingly reference concepts such as cellular aging, biological age, mitochondrial health, inflammation, epigenetics, and regeneration. Major beauty conglomerates have announced partnerships, acquisitions, and investments aimed at accessing longevity-related technologies and expertise. Industry leaders are positioning longevity as a potential successor to traditional anti-aging narratives.

Yet despite growing excitement, a critical challenge remains when it comes to the role of science in true longevity breakthroughs. This paper argues that longevity in beauty is currently a translation problem rather than an innovation problem.

Contrary to common assumptions, beauty's challenge is not a shortage of scientific innovation. Research in skin biology, regenerative medicine, diagnostics, microbiome science, women's health, neurocosmetics, and biomarker measurement continues to accelerate, supported by billions of dollars in annual industry Research & Development investment. The challenge lies in translating this growing body of knowledge into consumer experiences that are credible, meaningful, and actionable.

The primary obstacle is the difficulty of translating emerging scientific knowledge into consumer-relevant experiences that are both credible and meaningful. Scientific understanding of aging is evolving rapidly, yet commercial narratives often outpace the evidence required to support them. The result is a growing disconnect between what science can currently demonstrate and what consumers are led to believe.

Three interconnected gaps define this challenge.

- 1. The Evidence Gap** refers to the distance between promising biological mechanisms and clinically validated human outcomes. Many longevity interventions demonstrate scientific plausibility without yet possessing sufficient evidence to support broad consumer claims.
- 2. The Time-Horizon Gap** emerges from the conflict between long scientific timelines and short commercial timelines. While meaningful longevity research may require decades to validate, beauty organizations often operate within annual planning cycles and quarterly performance expectations.

- 3. The Operating-Model Gap** reflects organizational structures that frequently position scientific expertise as a support function rather than a strategic driver of decision-making. As longevity becomes increasingly science-driven, this model may become insufficient.

Together, these gaps create a broader credibility challenge. Aging is measured scientifically through biomarkers, inflammation, metabolic health, cellular function, and biological resilience. Yet aging is marketed through visible appearance, perceived youthfulness, and cosmetic outcomes. The resulting tension raises an important question: Where can beauty credibly participate in longevity, and where does it risk overreach?

To explore this question, this paper examines lessons from adjacent industries that have already attempted to translate emerging science into consumer-facing offerings. Case studies including Elysium Health, 23andMe, Oura, and Timeline illustrate both the opportunities and risks associated with building businesses around rapidly evolving scientific knowledge. These examples demonstrate that scientific innovation alone is insufficient. Success depends on the ability to build trust, generate evidence, communicate uncertainty responsibly, and create meaningful consumer value.

Ultimately, this paper concludes that beauty's greatest opportunity is not to become healthcare. Rather, beauty's unique role lies in serving as a bridge between scientific discovery and everyday behavior. The industry possesses deep expertise in ritual formation, consumer engagement, sensory experience, and behavioral adherence. These capabilities position beauty to play an important role in helping consumers engage with longevity-related behaviors and interventions.

Winning in the age of longevity will require a shift from products to systems, from claims to evidence, and from quarterly thinking to long-term value creation. Organizations that successfully navigate this transition will not merely participate in the longevity economy. They will help define it.

Introduction

The Age of Longevity

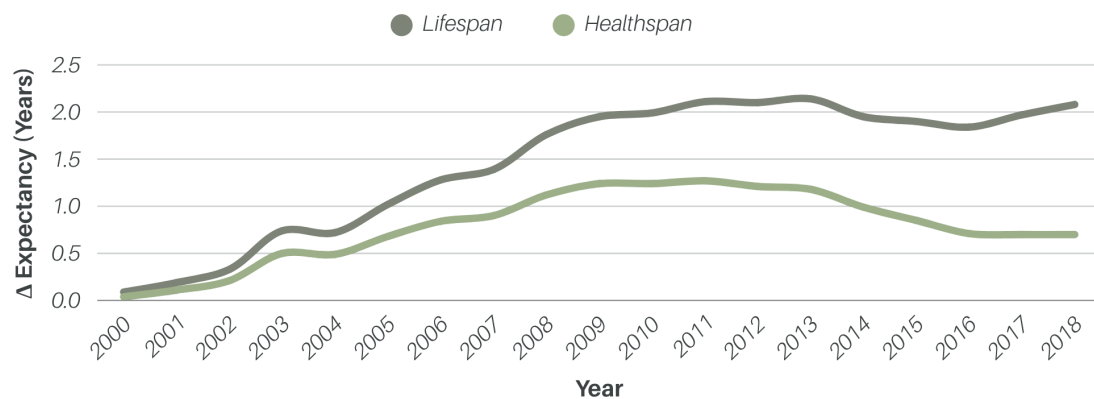
For most of modern history, conversations about aging have been dominated by a relatively simple objective: living longer. Throughout the 20th century, advances in sanitation, vaccination, antibiotics, nutrition, and medical care dramatically increased average life expectancy around the world. Public health systems succeeded in reducing infant mortality, controlling infectious disease, and extending human lifespan at a scale unprecedented in history. As a result, longevity became largely synonymous with survival. Today, however, the conversation is changing.

Increasingly, consumers, researchers, policymakers, and healthcare organizations are recognizing that living longer does not necessarily mean living better. While average lifespan has continued to increase across many developed economies, gains in healthy years lived have been considerably more modest. According to the World Health Organization, healthy life expectancy consistently trails overall life expectancy by approximately a decade or more in many countries. In practical terms, individuals may live longer than previous generations while simultaneously spending more years managing chronic disease, mobility limitations, cognitive decline, or reduced quality of life.

For the U.S. specifically, from 2000 to 2019 in the U.S., lifespan has outpaced health span by more than double. The average lifespan of Americans has grown by 2 years, while health span has grown by only 0.7 years. Put differently, only 9 months of the additional 2 years Americans gained in lifespan between 2000 and 2019 were spent in good health.

Lifespan vs Health Span: Annual Absolute Change

United States, 2000-2019 (pre-pandemic period)



This distinction between lifespan and health span has become central to the modern longevity movement.

Lifespan refers simply to the total number of years a person lives. Health span refers to the portion of those years spent in good physical, cognitive, and emotional health. While extending lifespan remains an important achievement, increasing attention is being directed toward improving health span, delaying age-related decline, and preserving function throughout life.

For consumers, longevity is no longer exclusively associated with old age. Instead, it is increasingly viewed as a lifelong process that begins decades before visible signs of aging appear. Sleep quality, nutrition, exercise, stress management, metabolic health, hormonal balance, and preventative healthcare are now understood as variables that influence long-term outcomes. Consumers are beginning to think less about adding years to life and more about adding life to years.

Technology has accelerated this transformation.

Over the past decade, the widespread adoption of wearable devices, connected health platforms, genetic testing services, and biomarker tracking has fundamentally altered consumers' relationship with their own biology. Devices such as Oura Ring, Apple Watch, Whoop, and Garmin provide continuous feedback on sleep quality, recovery, heart rate variability, activity levels, and physiological stress. Direct-to-consumer genetic testing platforms have introduced millions of consumers to concepts such as genetic predisposition and personalized risk assessment. Increasingly, individuals have access to information that was previously available only within clinical settings.

This democratization of health data has created a new form of consumer agency.

Consumers are no longer passive recipients of healthcare recommendations. They are becoming active participants in monitoring, interpreting, and managing their own health trajectories. The result

is a growing demand for products, services, and experiences that promise greater control over future well-being.

The scale of this opportunity is significant. Analysts increasingly describe longevity as one of the largest emerging markets of the coming decades. Investment in longevity-related startups has expanded dramatically, spanning biotechnology, diagnostics, digital health, nutrition, supplements, fitness, and preventative medicine. At the same time, governments and healthcare systems face mounting pressure from aging populations, increasing chronic disease burden, and rising healthcare costs. The convergence of scientific progress, consumer demand, and demographic necessity has elevated longevity from a niche scientific field to a broad societal movement.

Beauty now finds itself at the center of this transformation.

Historically, beauty's relationship with aging was primarily cosmetic. Anti-aging products focused on reducing visible signs of age, including wrinkles, sagging skin, hyperpigmentation, and loss of firmness. Success was often measured through visible improvements in appearance. Scientific innovation supported these efforts, but the consumer proposition remained largely aesthetic. Longevity introduces a fundamentally different framework.

Rather than focusing exclusively on appearance, longevity emphasizes biological function. Rather than correcting damage after it appears, longevity seeks to preserve resilience before decline occurs. Rather than treating aging as a cosmetic concern, longevity frames aging as a systemic biological process. This distinction creates both opportunity and risk for the beauty industry.

On one hand, beauty companies possess significant strengths that position them well for the longevity era. They maintain trusted consumer relationships, possess deep expertise in skin biology, and have decades of experience translating complex science into accessible consumer narratives. Beauty rituals also occupy a unique place within daily consumer behavior, creating repeated touchpoints that few other industries can replicate.

On the other hand, longevity introduces scientific complexity that extends far beyond traditional cosmetic claims. Questions surrounding biological age, biomarkers, cellular function, inflammation, and preventative health often exceed the boundaries of established beauty frameworks. Without

clear standards, robust evidence, and responsible communication, the industry risks creating confusion rather than clarity.

The challenge, therefore, is not whether beauty should participate in longevity. The challenge is determining how. The organizations that succeed will not be those that simply adopt longevity language. They will be those that understand the distinction between scientific discovery and scientific translation and then build the capabilities necessary to bridge that gap responsibly.

Chapter 1

From Anti-Aging to Longevity

The beauty industry's interest in longevity did not emerge in isolation. Rather, it represents the latest chapter in a decades-long evolution of how the industry approaches aging.

For much of the late 20th and early 21st centuries, anti-aging served as one of the industry's most powerful growth engines. Anti-aging products promised to reduce wrinkles, improve firmness, restore radiance, and create a more youthful appearance. Scientific advancements in ingredients such as retinoids, peptides, antioxidants, alpha hydroxy acids, and growth factors enabled increasingly sophisticated claims and formulations. Anti-aging became one of the most commercially successful categories in beauty history.

Yet anti-aging was ultimately built upon a specific assumption: that aging itself was undesirable. The language of anti-aging positioned aging as a problem to be corrected, concealed, reversed, or fought. Marketing imagery frequently celebrated youth as the ideal state while framing aging primarily through visible decline. While this positioning resonated for decades, cultural attitudes have begun to shift.

Consumers increasingly reject narratives that frame aging solely as loss. Simultaneously, broader wellness movements have expanded the definition of health beyond the absence of disease to

include vitality, resilience, performance, and quality of life. These changes have created conditions for a new framework to emerge.

Longevity differs from anti-aging in both ambition and orientation: Anti-aging asks how consumers can look younger, longevity asks how consumers can function better for longer.

This distinction represents a fundamental philosophical shift. Appearance becomes one outcome among many rather than the sole objective. Skin quality remains important, but it exists within a broader ecosystem that includes sleep, nutrition, stress, movement, cognition, metabolic health, and emotional wellbeing.

As longevity moves into mainstream culture, beauty brands are increasingly attempting to position themselves within this broader narrative. The question is whether they can do so credibly.

Chapter 2

Longevity Is Not an Innovation Problem

A common assumption is that beauty's challenge in longevity stems from insufficient scientific investment. However, evidence suggests the opposite. The industry is already investing heavily in research and development, generating significant intellectual property, and actively exploring aging-related biological pathways.

Among major global beauty companies, L'Oréal remains the clear leader in absolute research and development spending, investing approximately \$1.6 billion annually. Other leading organizations including Beiersdorf, Kao, Estée Lauder, Shiseido, and Amorepacific collectively invest hundreds of millions of dollars each year in scientific research and product development. Such levels of investment are comparable to those of many science-driven consumer industries and reflect a longstanding commitment to innovation.

However, absolute spending alone does not fully capture strategic priorities. When research investment is evaluated as a percentage of net sales, a different picture emerges. Companies such

as Beiersdorf, Kao, and Amorepacific dedicate a greater proportion of revenue to research and development than some larger competitors, suggesting a particularly strong commitment to scientific advancement relative to organizational size. This distinction highlights an important reality: Scientific intensity cannot be measured solely through scale. Strategic commitment often becomes more visible when investment is evaluated relative to available resources.

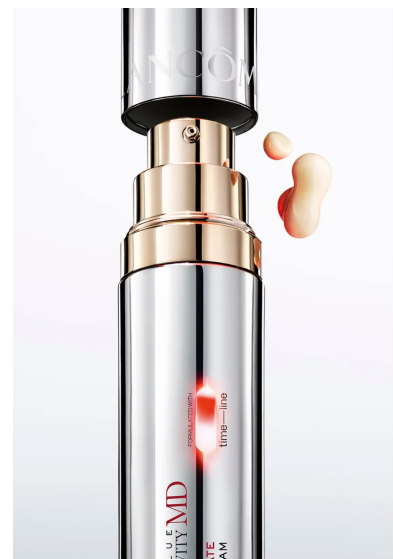
The industry's commitment to innovation is also reflected in intellectual property generation. Over the past decade, more than 7,000 cosmetic patents have been granted globally. While the vast majority relate to broader beauty and personal care innovations, approximately 240 patents are directly associated with longevity-related platforms and technologies. Although longevity patents currently represent a relatively small proportion of total beauty innovation, their existence demonstrates that the industry is already actively investing in aging-related science.

Notably, longevity-related patent activity is concentrated among a small number of organizations. More than half of identified longevity patents belong to Amorepacific, followed by significant activity from Shiseido, Beiersdorf, and Kao. These organizations have been exploring aging-related biological mechanisms for years, often long before longevity emerged as a mainstream consumer trend. Their investments suggest that many of the scientific foundations required for longevity innovation already exist within the industry.

Taken together, these findings challenge the notion that beauty lacks innovation. The industry is investing in research, generating intellectual property, and exploring longevity-related science at increasing levels. The more significant challenge lies elsewhere. Despite substantial scientific activity, relatively few consumers can clearly articulate how longevity science translates into products, routines, or outcomes that are meaningful within their daily lives. The gap is therefore not primarily scientific. It is translational.

The Longevity Translation Problem

As longevity gains momentum across healthcare, biotechnology, wellness, nutrition, and consumer technology, beauty brands are increasingly positioning themselves within the conversation.



Product launches reference biological age, cellular rejuvenation, epigenetics, senescence, mitochondrial function, and regenerative science. Industry conferences feature longevity-focused panels. Venture capital investment continues to flow toward companies promising to extend healthspan, improve resilience, or slow age-related decline.

At first glance, this activity appears to signal a flourishing innovation ecosystem. New technologies are emerging. Scientific understanding of aging continues to advance. Consumer interest is growing rapidly. Yet despite these developments, the longevity category remains characterized by confusion, inconsistent claims, and uncertainty regarding what constitutes meaningful evidence.

The central challenge is not a lack of scientific progress. Rather, it is the growing difficulty of translating rapidly evolving science into credible, consumer-relevant applications.

This distinction is important because it fundamentally changes where organizations should focus their efforts. If longevity were primarily an innovation problem, the solution would be straightforward: invest more heavily in research and development. However, evidence suggests that scientific innovation is already occurring at an extraordinary pace. The greater challenge lies in interpreting, validating, communicating, and operationalizing that science in ways that create lasting trust.

Three interconnected gaps define this translation problem: the Evidence Gap, the Time-Horizon Gap, and the Operating-Model Gap.

The Evidence Gap

The first challenge emerges from the relationship between scientific mechanisms and real-world outcomes.

Modern longevity science has generated significant insight into the biological processes associated with aging. Researchers have identified multiple “hallmarks of aging,” including genomic instability, telomere attrition, epigenetic alterations, mitochondrial dysfunction, cellular senescence, stem-cell exhaustion, and chronic inflammation. Collectively, these mechanisms provide a framework for understanding why biological systems deteriorate over time. However, understanding a mechanism is not the same as demonstrating a meaningful outcome.

Many interventions associated with longevity demonstrate what scientists refer to as mechanistic plausibility. In other words, researchers can explain why an intervention might work based on current biological understanding. Yet mechanistic plausibility alone does not prove that a meaningful improvement in human healthspan has occurred. This challenge is particularly visible within the supplement industry.

Elysium Health emerged as one of the earliest and most visible longevity companies, founded on research surrounding nicotinamide adenine dinucleotide (NAD+), a molecule involved in cellular energy production and DNA repair. Early scientific findings suggested NAD+ levels decline with age, generating excitement around compounds capable of boosting NAD+ production. Elysium's flagship supplement, Basis, was developed around this scientific premise and supported by an impressive scientific advisory board that included multiple Nobel Prize winners.

However, while evidence suggested that supplementation could influence biological markers associated with NAD+ metabolism, critics argued that evidence demonstrating meaningful improvements in lifespan, healthspan, or disease outcomes remained limited. The controversy was not necessarily whether the underlying biology was interesting. Rather, it centered on whether commercial claims were advancing faster than clinical evidence.

The Elysium case illustrates a broader challenge facing longevity businesses. Scientific excitement often originates at the level of biological mechanisms, while consumers ultimately care about outcomes. They do not purchase products because a pathway is activated or a biomarker changes. They purchase products because they hope to live healthier, longer, or more vibrant lives.

The distance between those two realities represents the Evidence Gap.

Beauty companies face a similar challenge. Emerging research on inflammation, senescence, microbiome health, and cellular repair offers compelling new possibilities for product development. Yet translating those findings into consumer-facing claims requires careful navigation. Without sufficient evidence linking mechanisms to meaningful outcomes, brands risk undermining consumer trust and contributing to scientific confusion.

The Time-Horizon Gap

The second challenge arises from a mismatch between scientific timelines and commercial timelines. Scientific understanding of aging develops slowly. Longitudinal studies often require decades to generate meaningful findings. Clinical trials can take years to complete. Scientific consensus emerges gradually through replication, critique, and refinement. Commercial organizations operate under very different constraints.

Beauty companies typically plan around annual budgets, quarterly earnings expectations, product launch calendars, and innovation pipelines measured in months rather than decades. Investors, shareholders, and executive leadership teams often require evidence of progress within comparatively short time horizons. This creates structural tension.

One of the most illustrative examples is the development of GLP-1 therapies. Research related to glucagon-like peptide-1 began in the early 1980s. More than 20 years passed before GLP-1-based therapies achieved widespread adoption in diabetes management. Additional years of research and optimization were required before semaglutide became a transformative treatment for obesity and weight management. What is now frequently described as an overnight success actually represents approximately 4 decades of scientific development.

Longevity science follows a similarly extended timeline. Many interventions currently attracting attention may require years or decades before their long-term effects are fully understood. Yet consumer demand and competitive pressures encourage organizations to participate immediately. As a result, companies often find themselves attempting to commercialize scientific possibilities before scientific certainty exists.

This dynamic is not unique to beauty. It is common across emerging technology categories. However, longevity presents a particularly acute challenge because the ultimate outcome of interest, healthy aging, unfolds over decades rather than months.

The result is an environment where narratives frequently mature faster than evidence.

Companies become incentivized to communicate future potential rather than present certainty. Scientific hypotheses are increasingly framed as commercial opportunities. Consumers,

meanwhile, struggle to distinguish between established findings and emerging possibilities. This challenge is likely to intensify as longevity receives greater investment and media attention.

The Operating-Model Gap

The third challenge is organizational. Historically, beauty companies have excelled at translating scientific advancements into consumer experiences. This capability has been one of the industry's greatest strengths. Retinoids, peptides, dermatological ingredients, microbiome science, and UV protection all benefited from the industry's ability to make complex concepts understandable and desirable. However, longevity introduces a level of scientific complexity that may exceed traditional operating models.

In many organizations, research and development functions remain separated from brand strategy, marketing, consumer insights, and innovation planning. Scientists generate knowledge. Marketers translate that knowledge into claims and narratives. While effective in many contexts, this model becomes increasingly fragile as scientific complexity increases.

Longevity demands deeper integration. The challenge is not simply generating scientific evidence. It is creating organizational structures capable of evaluating evidence quality, communicating uncertainty, identifying appropriate claims, and balancing scientific credibility against commercial objectives.

L'Oréal's investment in Timeline provides an instructive example. Rather than merely licensing an ingredient, the company invested directly in a biotechnology organization built around years of mitochondrial research. This approach provided access not only to intellectual property but also to scientific expertise, research capabilities, and a deeper understanding of the biological mechanisms underlying the technology.

Future competitive advantage may depend less on access to ingredients and more on access to scientific interpretation. Organizations capable of integrating scientific, commercial, and consumer expertise are likely to be better positioned than those relying on traditional handoffs between functions.

From Innovation Gap to Translation Gap

Taken together, these three gaps reveal a different picture of the longevity opportunity than is commonly portrayed. The beauty industry is not suffering from a shortage of scientific innovation. Research related to aging biology, regenerative medicine, diagnostics, wearables, microbiome science, and preventative health continues to accelerate. Major beauty companies collectively invest billions of dollars annually into research and development. Scientific discoveries are not the bottleneck; their translation is.

The challenge facing beauty is not whether enough science exists. The challenge is determining which science is sufficiently mature, meaningful, and relevant to translate into consumer experiences. This may ultimately define the winners and losers of the longevity era.

Organizations that focus exclusively on scientific novelty risk creating claims that exceed evidence. Organizations that wait for complete scientific certainty risk missing emerging opportunities. The most successful companies will be those capable of navigating the space between these extremes. They will develop the institutional capabilities required to evaluate evidence rigorously, communicate uncertainty responsibly, and create value without sacrificing credibility.

In the age of longevity, scientific discovery alone will not be enough. Trust will become a competitive advantage, and trust is built through translation.

Chapter 3

The Credibility Crisis

The growing interest in longevity has created a paradox. Scientific understanding of aging has advanced dramatically over the past two decades. Researchers can now measure biological processes that were previously invisible, identify cellular mechanisms associated with age-related decline, and generate increasingly sophisticated models of aging biology. Yet

despite these advances, consensus regarding what constitutes meaningful evidence for longevity remains surprisingly limited.

Consumers are presented with an expanding universe of claims related to cellular rejuvenation, biological age reversal, inflammation reduction, mitochondrial optimization, and epigenetic health. At the same time, scientists continue to debate which measurements most accurately reflect aging itself. This disconnect creates a fundamental credibility challenge.

Unlike cholesterol, blood pressure, bone density, or blood glucose, aging is not a single biological process. Aging is a complex, interconnected phenomenon involving multiple physiological systems operating simultaneously across different timescales. As a result, determining whether an intervention truly influences aging remains one of the most difficult questions in modern biology.

For beauty companies seeking to participate in longevity, this complexity creates both opportunity and risk. Scientific advances create new possibilities for innovation and differentiation. However, the absence of universally accepted measurement standards increases the likelihood that commercial narratives advance faster than scientific certainty. The result is an environment in which credibility itself becomes a strategic asset.

Aging as a Systems-Level Phenomenon

Historically, aging was viewed primarily as a chronological process. A person's age was measured by the number of years they had lived, and age-related decline was treated as an inevitable consequence of time. Modern aging research has largely abandoned this framework.

Today, aging is increasingly understood as a systems-level biological process involving the gradual accumulation of molecular and cellular damage across multiple physiological pathways. Rather than a single mechanism, aging represents the interaction of numerous interconnected processes that collectively reduce resilience, adaptability, and function over time.

One of the most influential frameworks emerged in 2013 with the publication of The Hallmarks of Aging by López-Otín and colleagues. The paper proposed nine interconnected biological hallmarks that contribute to aging:

- genomic instability
- telomere attrition
- epigenetic alterations
- loss of proteostasis
- dysregulated nutrient sensing
- mitochondrial dysfunction
- cellular senescence
- stem cell exhaustion
- altered intercellular communication

A decade later, the framework was expanded to include additional hallmarks such as chronic inflammation, microbiome disruption, and impaired autophagy.

Recent work from Mayo Clinic introduced the concept of Skinspan™, defined as the period during which skin maintains its functional integrity, resilience, and regenerative capacity. The framework is significant because it shifts discussion away from purely cosmetic indicators and toward skin as a biological organ whose health may reflect broader systemic aging processes. By linking dermatological function to longevity science, Skinspan provides one of the clearest conceptual bridges between beauty and healthspan.

The significance of this framework extends beyond academic research. It fundamentally changed how scientists think about aging. Rather than treating age-related diseases as isolated conditions, researchers increasingly view cardiovascular disease, neurodegeneration, metabolic dysfunction, frailty, and skin aging as downstream manifestations of common biological processes.

Beauty products had focused primarily on visible outcomes such as wrinkles, pigmentation, elasticity, and hydration. Longevity shifts attention toward upstream mechanisms that influence these outcomes. The emphasis moves from correcting symptoms to understanding underlying

biological drivers. However, identifying mechanisms does not automatically solve the challenge of measurement.

Chronological Age Versus Biological Age

The emergence of biological age has become one of the most influential concepts within the longevity movement.

Chronological age measures time.

Biological age attempts to measure function.

Two individuals could both be 50 years old chronologically while exhibiting dramatically different physiological profiles. One individual may demonstrate cardiovascular, metabolic, cognitive, and inflammatory markers comparable to a typical 40-year-old. Another may exhibit profiles more commonly associated with someone significantly older.

The concept of biological age attempts to capture this variation. From a scientific perspective, biological age represents an estimate of cumulative physiological deterioration relative to a reference population. It is not a direct measurement but rather a statistical construct derived from multiple biomarkers.

The appeal is obvious. If biological age can be measured accurately, then interventions can theoretically be evaluated based on whether they slow, halt, or reverse age-related decline. The challenge is that there is no universally accepted method for measuring biological age.

Multiple approaches currently exist, including the following:

- epigenetic clocks
- transcriptomic clocks
- proteomic clocks
- metabolomic clocks
- composite biomarker models

- functional performance assessments

These approaches often produce different results for the same individual. Consequently, the question is no longer whether biological age exists, but how it should be measured.

The Rise of Epigenetic Clocks

Among the most influential developments in longevity science has been the emergence of epigenetic clocks.

Epigenetics refers to modifications that influence gene expression without altering underlying DNA sequences. One of the most extensively studied mechanisms involves DNA methylation, chemical tags that accumulate and change throughout life.

In 2013, Steve Horvath introduced a model capable of predicting chronological age using DNA methylation patterns across hundreds of genomic sites. Remarkably, the model could estimate age with a high degree of accuracy across multiple tissues. This discovery transformed longevity research; for the first time, researchers possessed a measurable biomarker that appeared to track biological aging processes.

Since then, increasingly sophisticated clocks have emerged, including the following:

- Horvath Clock
- Hannum Clock
- PhenoAge
- GrimAge
- DunedinPACE

Each attempts to improve prediction accuracy and better correlate with mortality, disease risk, and functional decline. However, important limitations remain.

Changes in epigenetic age do not necessarily translate directly into meaningful clinical outcomes. A reduction in epigenetic age acceleration may suggest biological improvement, but researchers

continue to debate the magnitude and significance of those changes. In other words, even some of the most advanced biomarkers in aging science remain surrogate endpoints. This is critical because many longevity claims are based on improvements in biomarkers rather than demonstrated improvements in healthspan itself.

Inflammaging and Chronic Low-Grade Inflammation

If there is one biological concept most relevant to both longevity science and beauty, it may be inflammation. Researchers increasingly describe aging as an inflammatory process.

The term “inflammaging” was introduced to describe the chronic, low-grade inflammatory state that develops with age. Unlike acute inflammation, which serves a protective function, chronic inflammation can contribute to cumulative tissue damage and dysfunction across multiple organ systems.

Elevated inflammatory signaling has been associated with the following:

- cardiovascular disease
- type 2 diabetes
- Alzheimer’s disease
- sarcopenia
- frailty
- immune dysfunction
- skin aging

Importantly, inflammation represents one of the clearest examples of convergence between internal health and visible appearance.

Skin serves as both a biological organ and a visible biomarker of systemic health. Oxidative stress, glycation, UV exposure, environmental pollution, sleep disruption, and psychosocial stress all contribute to inflammatory pathways that influence both skin quality and broader physiological aging. This creates a scientifically credible entry point for beauty brands.

Unlike some longevity narratives that require extrapolation from distant biological mechanisms, inflammation already possesses strong evidence linking internal physiology and visible outcomes.

Biomarker	Measures	Limitation
Epigenetic clocks	DNA methylation patterns	Surrogate endpoint
HRV	Recovery and autonomic function	Influenced by many variables
NAD+	Cellular metabolism	Outcome relationship unclear
Telomeres	Cellular aging marker	Weak intervention tracking
Inflammatory markers	Chronic inflammation	Non-specific

Biomarker Proliferation and Consumer Confusion

While scientific measurement capabilities continue to improve, the growing number of available biomarkers introduces a new challenge. Consumers increasingly encounter:

Each claims to provide insight into health and longevity. Yet many consumers lack the expertise necessary to evaluate their validity. The result is what might be described as biomarker inflation.

As measurement technologies become more accessible, there is increasing temptation to treat measurable variables as inherently meaningful. However, not every biomarker is equally predictive,

actionable, or clinically relevant. This challenge creates fertile conditions for exaggerated claims, oversimplification, and what critics increasingly describe as science washing.

Science Washing in the Age of Longevity

Science washing occurs when scientific language is used to create perceptions of credibility that exceed the underlying evidence. Importantly, science washing is not always intentional. In many cases, it emerges because organizations communicate emerging scientific findings without adequately communicating uncertainty.

Longevity is particularly vulnerable to this phenomenon because consumers generally lack the expertise required to distinguish between different types of evidence:

- mechanistic evidence
- animal evidence
- biomarker evidence
- clinical evidence
- longitudinal outcome evidence

These distinctions are fundamental within scientific research but often disappear within commercial communication. As longevity continues moving into mainstream consumer markets, organizations will increasingly be judged not only by the science they possess but by how responsibly they communicate that science.

Credibility as Competitive Advantage

The future of longevity may ultimately depend less on breakthrough discoveries than on trust. Consumers are entering an environment characterized by unprecedented access to biological information and unprecedented uncertainty regarding its interpretation. As this complexity increases, organizations capable of acting as trusted translators will gain strategic advantage.

For beauty companies, this represents both a challenge and an opportunity. The industry's future role in longevity will not be determined solely by scientific innovation. It will be determined by its ability to distinguish evidence from possibility, biomarkers from outcomes, and scientific credibility from scientific theater.

In the age of longevity, credibility is no longer a supporting asset. It is the product.

From Biomarkers to Meaning

One of the greatest challenges facing the longevity ecosystem is not the collection of biological data, but its interpretation. Consumers today have access to an unprecedented volume of health information. Wearable devices continuously track physiological signals such as heart rate variability, sleep architecture, resting heart rate, recovery, and physical activity. Genetic testing platforms provide insights into inherited traits and disease predispositions. Emerging biomarker platforms can measure inflammation, metabolic function, hormone levels, and biological age. Yet information alone rarely changes behavior.

Research in behavioral science consistently demonstrates that awareness does not automatically translate into action. Data becomes valuable only when it is contextualized, interpreted, and connected to meaningful decisions.

This helps explain why many early health technology platforms struggled to maintain engagement despite providing increasingly sophisticated measurements. Consumers often received large volumes of information without clear guidance regarding what those measurements meant, whether they should be concerned, or what actions they should take next.

The future of longevity may therefore depend less on generating additional data and more on creating systems capable of translating data into understanding. To have the full context, it is important to understand the difference between static and dynamic biological information.

Static data provides insight into relatively stable characteristics. Examples include genetic predispositions, ancestry information, and inherited biological traits. While valuable for

understanding long-term risk, static data often lacks immediacy. It can explain what may happen but provides limited insight into what is happening right now.

Dynamic data, by contrast, reflects the ongoing interaction between biology, environment, and behavior. Sleep quality, stress levels, physical activity, recovery patterns, and metabolic responses change continuously. Dynamic data provides visibility into how daily decisions influence health outcomes over time.

Both forms of information are valuable, but they serve different purposes. The distinction becomes increasingly important as organizations attempt to build consumer-facing longevity platforms. Genetic information may help consumers understand predispositions. Dynamic measurements may help consumers understand behaviors. Neither is inherently sufficient on its own for a holistic understanding of health.

The most successful longevity ecosystems are likely to combine both perspectives while helping consumers navigate the space between them and providing meaning.

Unlike healthcare organizations that typically engage consumers episodically, beauty brands participate in daily rituals and routines. They possess decades of experience translating complex science into accessible consumer experiences and maintaining long-term relationships through repeated engagement.

As longevity increasingly shifts from treatment toward prevention, interpretation may become as valuable as intervention.

The next chapter examines four organizations that illustrate different approaches to translating longevity science into consumer value. Together they demonstrate both the opportunities and limitations associated with scientific credibility, data utilization, and long-term trust building.

Chapter 4

Lessons from Adjacent Industries

The longevity economy is often discussed as if it were entirely new territory. While longevity may be emerging as a strategic opportunity for beauty, the broader challenge of translating complex science into consumer value has already been explored by organizations across biotechnology, diagnostics, personalized health, and wearable technology. These industries have spent the past decade confronting many of the same questions beauty now faces. How much evidence is required before commercializing an innovation? How should uncertainty be communicated to consumers? What types of biological data are most valuable? How can complex scientific information be translated into meaningful action?

Examining these organizations reveals that the future of longevity will not be determined solely by scientific discovery. Scientific innovation remains essential, but innovation alone is rarely sufficient to create lasting consumer trust. The organizations that have succeeded have generally been those capable of transforming scientific complexity into understandable, actionable experiences. Conversely, organizations that struggled often found themselves unable to bridge the gap between promising science and meaningful consumer outcomes.

Collectively, the experiences of Elysium, 23andMe, Oura, and Timeline provide a useful lens through which to evaluate beauty's future role in the longevity ecosystem. Each organization approached the challenge from a different angle, yet all confronted the same fundamental question: how can emerging science be translated into consumer value without compromising credibility?

Scientific Credibility and the Limits of Mechanistic Evidence: The Elysium Case

Few organizations better illustrate both the promise and challenges of the longevity industry than Elysium Health. Founded in 2014, Elysium emerged during the first wave of consumer-facing

longevity companies and quickly attracted attention for its scientific pedigree. The company's flagship supplement, Basis, was built around research involving nicotinamide adenine dinucleotide (NAD⁺), a molecule involved in cellular metabolism, mitochondrial function, and DNA repair. Declining NAD⁺ levels had become an area of increasing interest within aging research, leading scientists to investigate whether replenishing these levels could influence age-related biological decline.

At first glance, Elysium appeared exceptionally well positioned to succeed. Its scientific advisory board included some of the most respected names in aging research, including several Nobel Prize winners. Unlike many wellness companies, Elysium deliberately presented itself as a science-first organization, emphasizing peer-reviewed research and biological mechanisms rather than lifestyle marketing.

Yet the company's experience exposed a recurring challenge within the longevity industry: the distinction between mechanistic evidence and outcome evidence.

Mechanistic evidence explains why an intervention may work. Outcome evidence demonstrates whether that intervention actually improves meaningful human health outcomes. While research suggested that NAD⁺ precursors could influence biological pathways associated with aging, evidence demonstrating substantial improvements in lifespan, healthspan, or disease outcomes remained limited. Critics argued that commercial enthusiasm was advancing faster than scientific certainty.

The resulting controversy was not necessarily a rejection of the underlying science. Rather, it reflected growing concern regarding how scientific findings were being translated into consumer expectations. Consumers were being asked to purchase products based on biological plausibility rather than proven outcomes. The challenge was not that the science lacked merit, but that the pathway between mechanism and meaningful human benefit remained incompletely understood.

This distinction has important implications for beauty. Many of the biological pathways currently attracting attention within longevity, including cellular senescence, autophagy, mitochondrial function, and epigenetic regulation, are scientifically compelling. However, scientific interest in a mechanism does not automatically justify broad consumer claims. As longevity continues to evolve,

beauty companies will increasingly face pressure to determine when emerging science has matured sufficiently to support commercialization.

The Elysium case highlights the importance of restraint. In emerging scientific categories, credibility is not built through access to cutting-edge biology alone. Credibility is built through disciplined translation that acknowledges uncertainty, distinguishes mechanisms from outcomes, and avoids overstating what the evidence can currently support.

From Static Data to Dynamic Understanding: Lessons from 23andMe and Oura

If Elysium provides lessons regarding evidence, 23andMe and Oura provide lessons regarding data. Together, these organizations illustrate how consumers engage with biological information and reveal important insights about the future role of personalization within longevity.

When 23andMe launched in 2006, it fundamentally changed public access to genetic information. For the first time, consumers could gain direct insight into ancestry, inherited traits, and genetic predispositions without requiring physician mediation. The company successfully transformed personal genomics from an academic discipline into a consumer category.

Perhaps the most important lesson from 23andMe was not technological but behavioral. The company's success demonstrated that consumers are willing to share highly personal biological information when they perceive meaningful value in return. Genetic data, despite its sensitivity, became increasingly normalized as consumers sought greater understanding of their own biology.

At the same time, 23andMe exposed important limitations. Genetic information is fundamentally static. With few exceptions, an individual's genome remains relatively unchanged throughout life. While genetic testing can provide insight into predispositions and probabilities, it offers limited visibility into how lifestyle, environment, stress, nutrition, sleep, and daily behavior interact with those predispositions over time. Genetics can explain potential risk, but it often struggles to explain current reality.

This limitation is particularly important within longevity. Aging is not determined solely by inherited biology. Rather, it emerges through continuous interactions between genes, environment, and behavior. As a result, static biological data provides only a partial picture of long-term health.

Oura represents a fundamentally different approach. Rather than focusing on fixed biological characteristics, Oura centers on continuously changing physiological signals. Through metrics such as heart rate variability, resting heart rate, sleep architecture, body temperature trends, and recovery patterns, Oura provides users with an ongoing view of how their behaviors influence their biology.

The significance of this model extends beyond measurement. Oura's value is not derived solely from collecting data. Many physiological metrics can be measured by competing devices. Its competitive advantage lies in interpretation. The platform translates complex physiological signals into accessible guidance that helps users understand the relationship between behavior and outcomes. Sleep becomes more than sleep duration. Recovery becomes more than a numerical score. Data becomes a mechanism for behavior change.

This distinction between static and dynamic data has important implications for beauty. Findings from our quantitative research suggest consumers are increasingly willing to share health-related information when they perceive a clear value exchange. Respondents expressed greater willingness to share biological and lifestyle data when doing so resulted in personalized recommendations, more relevant product experiences, or improved outcomes. The findings suggest that consumer resistance may not stem from data collection itself, but rather from situations in which data is collected without generating meaningful value.

Together, 23andMe and Oura reveal an important insight. The future of personalization may not depend on collecting more data. It may depend on helping consumers make sense of the data they already have. Static information provides context. Dynamic information provides feedback. Neither is sufficient on its own. The greatest value emerges when organizations can integrate both forms of information into coherent, actionable experiences.

For beauty, this represents a significant opportunity. As consumers become increasingly comfortable sharing biological information, brands may gain access to richer sources of insight

than traditional demographic or psychographic segmentation alone. However, the ultimate value will not come from possessing data. It will come from translating data into understanding.

Long-Horizon Innovation and Scientific Ecosystems: The Timeline Case

While Elysium highlights the risks of premature translation and Oura demonstrates the value of continuous interpretation, Timeline offers perhaps the most compelling example of responsible longevity innovation.

Founded on more than a decade of research conducted at the Swiss Federal Institute of Technology Lausanne (EPFL), Timeline focuses on urolithin A, a postbiotic compound associated with mitochondrial health and cellular recycling processes known as mitophagy. Unlike many longevity startups that emerged primarily through consumer marketing narratives, Timeline was built upon a long-term scientific development pathway characterized by extensive preclinical and clinical research.

The company's development model reflects an important difference in philosophy. Rather than beginning with a commercial opportunity and subsequently seeking scientific support, Timeline's commercialization efforts followed years of scientific investigation. Research generated the foundation upon which the business was later constructed.

This distinction matters because longevity operates within an environment where scientific uncertainty remains high. In such environments, organizations that invest in evidence generation may ultimately develop more durable competitive advantages than those relying primarily on marketing differentiation. Timeline's Mitopure technology is valuable not simply because it is proprietary but also because it is supported by an expanding body of research connecting biological mechanisms to measurable outcomes.

The significance of this approach became particularly apparent when L'Oréal announced its investment in Timeline. While the transaction provided access to a promising technology platform, it

also reflected something broader. Increasingly, beauty companies are recognizing that participation in longevity may require access not only to ingredients but also to scientific ecosystems.

Historically, competitive advantage in beauty has often been built through formulation expertise, brand equity, distribution, or marketing execution. Longevity introduces a new dimension. Scientific interpretation itself becomes strategically important. Access to researchers, clinical evidence, intellectual property, and specialized expertise may become increasingly valuable sources of differentiation.

Timeline, therefore, represents more than an investment opportunity. It provides a blueprint for how beauty companies might engage with longevity responsibly. Rather than attempting to become biotechnology companies themselves, beauty organizations may be better positioned by partnering with scientific ecosystems capable of generating credible evidence and long-term innovation.

What These Cases Reveal About Beauty's Future Role in Longevity

Taken together, these case studies reveal a consistent pattern. Success within the longevity economy depends less on the discovery of novel science than on the ability to translate science into meaningful consumer value. Elysium demonstrates the risks associated with allowing mechanistic excitement to outpace outcome evidence. 23andMe highlights both the potential and limitations of static biological data. Oura illustrates how dynamic data can create continuous engagement when paired with effective interpretation. Timeline demonstrates the power of long-horizon scientific investment and evidence-based commercialization.

Importantly, none of these organizations succeeded solely because of the science they possessed. Their experiences were shaped by how effectively they interpreted, communicated, and operationalized that science.

This observation has profound implications for beauty. The industry is unlikely to compete directly with pharmaceutical companies, diagnostics firms, or biotechnology startups on scientific discovery alone. Nor does it need to. Beauty possesses a different set of capabilities that may

prove equally valuable within the longevity ecosystem. Beauty companies maintain daily consumer relationships, influence habitual behavior, and possess decades of experience translating complex science into culturally accessible narratives.

As longevity increasingly shifts from treatment toward prevention, these capabilities become strategically significant. Consumers do not simply need more biological information. They need help understanding what that information means, how it relates to their lives, and what actions they should take as a result.

This insight suggests that beauty's greatest opportunity may not be to become a healthcare provider or biotechnology company. Instead, its opportunity may lie in becoming a trusted translator of longevity science. The organizations best positioned to succeed will likely be those capable of bridging the gap between biological complexity and everyday behavior, transforming scientific knowledge into experiences that are both credible and actionable.

The question, then, is not whether beauty can participate in longevity. The question is where beauty can create unique value within the broader longevity ecosystem. It is this question that forms the foundation of the next chapter.

Chapter 5

Beauty's Right to Win in the Longevity Ecosystem

Beyond Healthcare, Beyond Beauty

Throughout this paper, we have argued that longevity represents a translation challenge rather than an innovation challenge. Advances in aging biology continue to accelerate. Researchers are generating unprecedented insights into the mechanisms that influence health span, resilience, and age-related decline. New technologies are making it possible to measure biological processes that were previously invisible. Consumers have greater access to personal health information than at any point in history. Yet despite this progress, confusion surrounding longevity remains widespread.

Scientific complexity has increased faster than consumer understanding, creating a growing need for organizations capable of translating emerging science into meaningful action.

This observation raises an important strategic question for the beauty industry. If biotechnology companies are generating the science, diagnostic companies are generating the measurements, and healthcare providers are generating the clinical expertise, what unique role remains for beauty?

The answer cannot simply be that beauty should participate because longevity is commercially attractive. Nearly every industry can make that claim. Nor is it sufficient to suggest that beauty should compete directly with healthcare, pharmaceuticals, or biotechnology. Those sectors possess scientific capabilities, regulatory frameworks, and evidence-generation infrastructures that beauty companies are unlikely to replicate successfully. The more important question is where beauty possesses distinctive advantages that other participants in the longevity ecosystem do not.

Understanding this distinction requires reframing how the industry thinks about competitive advantage. Historically, beauty's success has depended on its ability to transform scientific complexity into consumer relevance. Throughout the 20th and early 21st centuries, advances in dermatology, chemistry, materials science, and biology repeatedly entered the consumer market through beauty. Retinoids, peptides, antioxidants, ceramides, alpha hydroxy acids, microbiome science, and sun protection technologies all required extensive translation before they became widely understood and adopted. Consumers rarely engage directly with scientific mechanisms. Instead, they engage with stories, rituals, outcomes, and aspirations. Beauty's competitive advantage has therefore never been science alone. Rather, it has been the ability to make science culturally legible

Longevity presents a continuation of this historical role, albeit at a significantly greater level of complexity. Consumers are increasingly exposed to biological age assessments, genetic risk profiles, microbiome analyses, sleep metrics, inflammatory biomarkers, metabolic tracking, and wearable health data. The quantity of information available to consumers continues to expand rapidly. However, access to information does not automatically create understanding. Research in behavioral science consistently demonstrates that information alone rarely produces sustained behavior change. Individuals require context, interpretation, and actionable guidance if information

is to influence decision-making. As longevity technologies become more sophisticated, the need for trusted interpreters is likely to increase rather than diminish.

The Biological Connection

Beauty occupies a unique position within the longevity ecosystem because it maintains relationships with consumers that are simultaneously biological, behavioral, and emotional. Few industries possess all three characteristics. Healthcare providers possess scientific authority but typically engage consumers episodically, often after a problem has already emerged. Diagnostic companies generate valuable information but frequently struggle to translate data into sustained behavioral engagement. Wearable technology platforms create continuous streams of physiological information but often face challenges maintaining long-term consumer adherence. Beauty brands, by contrast, maintain regular presence within consumers' lives while possessing decades of experience translating scientific concepts into accessible experiences.

The first component of this advantage stems from beauty's relationship with biology itself. While longevity is often discussed as a systemic phenomenon affecting the entire body, the skin occupies a uniquely visible position within the aging process. Skin is not merely an aesthetic surface. It is the body's largest organ, serving critical immunological, protective, sensory, and regulatory functions. Increasingly, research suggests that skin may also serve as a valuable indicator of broader physiological processes associated with aging.

The biological pathways that influence skin aging overlap significantly with those being studied within longevity science. Chronic inflammation, oxidative stress, mitochondrial dysfunction, glycation, cellular senescence, impaired autophagy, and declining regenerative capacity have all been implicated in both visible skin aging and broader age-related physiological decline. While beauty companies should be cautious about extending claims beyond the available evidence, these overlaps provide a scientifically credible point of entry into longevity-related conversations.

Importantly, this opportunity does not require beauty to become healthcare. The industry's role is not to diagnose disease, manage chronic conditions, or make claims that exceed cosmetic or wellness-oriented applications. Rather, beauty's opportunity lies in understanding how biological processes associated with aging influence skin health, appearance, and function. The most credible beauty brands will likely be those that remain anchored in areas where biological relevance and consumer relevance intersect.

The Behavioral Advantage

However, biology alone is insufficient to explain beauty's potential role in longevity. If scientific relevance were the only requirement, healthcare organizations would possess a clear advantage. Beauty's second advantage stems from its relationship with behavior.

One of the most consistent findings across longevity research is that long-term health outcomes are profoundly influenced by behavior. Sleep quality, physical activity, nutrition, stress management, environmental exposures, and social relationships all contribute to health span. While genetic predispositions influence risk, daily behaviors often determine how those risks manifest over time. Consequently, many of the interventions most strongly associated with healthy aging are not episodic treatments but rather habits sustained consistently over decades.

This reality creates a challenge for traditional healthcare systems. Medical interventions are often designed around discrete moments of care. Longevity, by contrast, depends upon repeated actions performed over long periods of time. The difficulty is rarely knowing what behaviors are beneficial. Rather, it is maintaining those behaviors consistently enough to generate meaningful outcomes.

Beauty possesses an unusual advantage within this context because its products are embedded within daily rituals. Consumers engage with skincare, personal care, fragrance, and wellness routines repeatedly, often every day, for years at a time. These rituals create recurring moments of engagement that are relatively rare within other industries. While a skincare routine may appear unrelated to health span at first glance, the broader behavioral architecture surrounding beauty is highly relevant. Beauty companies have decades of experience encouraging routine formation, reinforcing habits, and maintaining consumer engagement over long periods of time.

This capability may become increasingly important as longevity shifts from intervention toward prevention. Future opportunities may extend beyond products alone and into broader ecosystems designed to support healthy behaviors. Such ecosystems could integrate education, personalized guidance, digital experiences, community engagement, and data-driven recommendations. In this context, the value of beauty would not derive solely from what consumers purchase, but from how effectively brands help consumers sustain beneficial behaviors over time.

The Translation Opportunity

Yet even behavioral influence does not fully explain beauty's potential role in the longevity ecosystem. The industry's most significant opportunity may lie in its ability to function as a translator.

As discussed in previous chapters, the modern longevity landscape is characterized by growing scientific complexity. Consumers increasingly encounter genetic data, biomarker assessments, wearable metrics, biological age estimates, microbiome analyses, and personalized health recommendations. While these tools generate valuable information, they also create confusion. Most consumers lack the scientific training required to evaluate evidence quality, distinguish between established findings and emerging hypotheses, or determine which signals are genuinely meaningful.

This challenge creates an opportunity for trusted intermediaries.

Historically, beauty has functioned as a translation industry. Scientific discoveries rarely enter mainstream consumer culture directly from academic journals or research institutions. Instead, they are interpreted, contextualized, simplified, and integrated into experiences that consumers can understand and adopt. The industry's success with ingredients such as retinol, niacinamide, peptides, and probiotics demonstrates that consumers often rely on brands to help navigate scientific complexity.

Longevity may require this capability on an even larger scale. As biological data becomes increasingly accessible, consumers will not necessarily need more information. They will need help understanding what information matters, how different pieces of information relate to one another, and what actions should follow. The organizations that succeed in longevity may therefore be those that provide interpretation rather than simply information.

This possibility is supported by findings from our quantitative research. Consumers demonstrated a willingness to share personal health and lifestyle information when they believed doing so would result in more personalized recommendations, improved outcomes, or more relevant experiences. These findings suggest that the primary barrier may not be data-sharing itself but rather the

absence of a meaningful value exchange. Consumers appear increasingly willing to participate when information is transformed into guidance that feels actionable and personally relevant.

Toward a Longevity Ecosystem

Viewed collectively, these observations suggest that beauty's greatest opportunity within longevity is not to become a pharmaceutical company, diagnostic platform, or healthcare provider. Rather, its opportunity lies in connecting these domains. Beauty can serve as a bridge between biological science and everyday behavior, helping consumers navigate increasingly complex information ecosystems while remaining grounded in daily rituals and routines.

This role is both ambitious and constrained. It is ambitious because it positions beauty as an active participant in the future of health span rather than a passive observer of broader industry trends. It is constrained because it acknowledges the limits of the industry's expertise and avoids overextending into areas where scientific credibility would be difficult to sustain. The organizations best positioned for the longevity era will likely be those capable of balancing these two realities simultaneously.

Ultimately, beauty's right to win in longevity does not stem from its ability to generate the most sophisticated science or collect the most comprehensive data. It stems from its ability to translate complexity into understanding, understanding into behavior, and behavior into long-term consumer value. As longevity continues to evolve, this translational capability may prove to be one of the industry's most important strategic assets.

The question that remains is how organizations must evolve to fulfill this role. If beauty's future competitive advantage lies in scientific translation rather than scientific discovery alone, then traditional operating models may no longer be sufficient. The next chapter examines the organizational capabilities, structures, and strategic investments required to build a longevity-ready beauty company.

The Rise of Holistic Longevity Solutions

A final implication of beauty's emerging role in longevity is a shift in how value itself is delivered. Historically, beauty has largely operated through individual products. Consumers purchased cleansers, serums, moisturizers, treatments, and supplements as discrete solutions designed to address specific concerns. This model aligns well with traditional beauty categories because many visible outcomes can be linked to relatively narrow interventions.

Longevity introduces a different reality. Aging is increasingly understood as a systems-level process influenced by the interaction of biological, behavioral, environmental, and psychosocial factors. Sleep quality influences inflammation. Stress influences hormonal regulation and immune function. Nutrition influences metabolic health. Physical activity influences mitochondrial function and insulin sensitivity. Social connection influences psychological well-being and even mortality risk. These factors operate as interconnected systems rather than isolated variables.

As a result, the future of longevity is unlikely to be defined by individual products alone. Instead, value may increasingly emerge through integrated regimens that combine products, services, diagnostics, education, behavioral support, and personalized recommendations into a cohesive consumer experience.

Early signals of this transition are already visible across adjacent industries. Oura has expanded beyond a wearable device into a behavioral platform that combines physiological monitoring with personalized recommendations designed to improve sleep, recovery, and long-term health outcomes. 23andMe demonstrated consumer willingness to share deeply personal biological information in exchange for greater self-understanding while simultaneously revealing the limitations of static genetic information when disconnected from ongoing behavioral feedback. Together, these models point toward a future in which static biological data and dynamic physiological data converge to create increasingly personalized health experiences.

The same pattern is beginning to emerge within longevity-focused healthcare organizations. Clinics such as LNGVTY Health have moved beyond traditional medical interventions toward integrated programs that combine diagnostics, education, coaching, and lifestyle guidance to help consumers make informed decisions about long-term well-being. Rather than treating longevity as a single intervention, these models frame it as an ongoing practice supported by multiple interconnected touchpoints.

For beauty, this suggests a fundamentally different model of value creation. Rather than positioning a serum, supplement, or device as the solution, brands may increasingly participate in broader longevity regimens. A future consumer journey could begin with biological assessment, incorporating static data such as genetic predispositions alongside dynamic data collected through wearable technologies. These insights could then inform personalized product recommendations, behavioral interventions, stress-management practices, sleep-support protocols, nutritional guidance, and women's health considerations. Product becomes only one component within a larger ecosystem designed to support health span.

Several of the opportunity spaces identified throughout this research align naturally with this model. Active biological interfaces provide opportunities to engage with scientifically relevant manifestations of aging through skin, scalp, and sensory biology. Data convergence enables personalization through the integration of biomarkers, wearable data, and consumer behavior. Women's health represents a significant opportunity given the profound influence of hormonal transitions on aging trajectories. Neuroscience and fragrance introduce new possibilities for addressing stress, mood, sleep, and emotional well-being through the skin-brain axis and sensory experience. Taken together, these domains suggest that the future longevity offering may resemble a personalized regimen rather than a standalone product.

Importantly, our quantitative research suggests consumers may be receptive to this evolution. Respondents demonstrated willingness to share health and lifestyle information when doing so resulted in more personalized recommendations and improved outcomes. This finding suggests that consumers are not necessarily seeking more products. Rather, they are seeking greater relevance, greater personalization, and greater confidence that recommended actions are aligned with their individual needs.

In the anti-aging era, value was often created through claims attached to individual products. In the longevity era, value may increasingly be created through the effectiveness of the overall regimen. The organizations that succeed will likely be those capable of orchestrating diagnostics, products, services, data, and behavioral guidance into coherent systems that support measurable health span outcomes. In this model, beauty's role is not merely to sell products. It is to help consumers navigate the increasingly complex journey of aging itself.

Chapter 6

Building a Longevity-Ready Organization

If longevity represents a translation challenge rather than an innovation challenge, then the implications extend far beyond product development. The transition into longevity requires organizations to rethink how they generate evidence, evaluate emerging science, build partnerships, allocate resources, and define success. Many of the operating models that have historically served the beauty industry well were designed for a market in which innovation was primarily measured through ingredients, formulations, packaging, and claims. Longevity introduces a different set of requirements. Success increasingly depends upon scientific interpretation, evidence generation, long-term thinking, and the ability to navigate rapidly evolving knowledge systems.

This shift suggests that longevity should not be viewed as a trend, product category, or marketing platform. Rather, it represents an organizational capability challenge. The companies best positioned to succeed will likely be those capable of building structures that allow scientific credibility and commercial execution to evolve together. This requires changes in how organizations approach research and development, partnerships, measurement, and strategic planning.

Rethinking Research and Development

Historically, research and development has often functioned as a supporting capability within beauty organizations. Scientific teams generate innovations, validate claims, and support product development, while strategic direction is frequently determined elsewhere within the organization. This model has proven highly effective for categories where the scientific foundations are relatively established and innovation cycles are measured in months or years.

Longevity introduces a different dynamic. Scientific understanding is still evolving. New biomarkers continue to emerge. Biological mechanisms are being continuously refined. Consensus regarding evidence standards remains incomplete. Under these conditions, research and development can

no longer function solely as a validation function. It must increasingly operate as a strategic capability.

This distinction is important because longevity requires organizations to make decisions in environments characterized by uncertainty. Scientific findings frequently emerge before commercial implications are fully understood. New technologies may appear promising long before outcome data becomes available. Brands must therefore determine not only what is scientifically possible, but also what is scientifically credible.

The companies most likely to succeed will be those that integrate scientific expertise earlier into strategic decision-making. Rather than asking scientists to validate claims after concepts have already been developed, organizations may need scientific teams involved in identifying opportunities, evaluating evidence quality, and shaping innovation priorities from the outset. In this model, scientific literacy becomes a strategic asset rather than a technical requirement.

This evolution may also require different forms of talent. Expertise in dermatology and formulation science remains essential, but longevity increasingly draws upon disciplines such as systems biology, bioinformatics, genomics, data science, aging biology, behavioral science, and preventive health. Building longevity capabilities may therefore require organizations to expand beyond traditional beauty expertise and cultivate more interdisciplinary teams.

From Products to Scientific Ecosystems

The case studies explored in the previous chapter suggest that future competitive advantage may depend less on proprietary products and more on access to scientific ecosystems.

Historically, beauty innovation has often been organized around ingredients. Organizations sought access to novel actives, proprietary formulations, or exclusive technologies capable of creating differentiation. While these capabilities remain important, longevity introduces a level of complexity that extends beyond any single ingredient or mechanism.

The Timeline case provides a useful illustration. L'Oréal's investment was not simply an investment in Mitopure. It was also an investment in years of mitochondrial research, scientific expertise,

intellectual property, clinical evidence, and institutional knowledge. The value extended beyond the molecule itself to the broader ecosystem supporting it.

This distinction may become increasingly important as longevity evolves. Scientific breakthroughs are unlikely to emerge from isolated disciplines. Instead, progress will likely occur through collaboration across biotechnology, diagnostics, healthcare, data science, wearable technology, nutrition, and behavioral science. Beauty companies attempting to build all of these capabilities internally may face significant challenges.

Partnerships, therefore, become strategically important. Rather than viewing collaboration as a mechanism for accessing individual technologies, organizations may need to view partnerships as a means of accessing complementary expertise. Universities, research institutions, biotechnology firms, digital health companies, and diagnostic platforms may all play important roles within future longevity ecosystems.

The organizations best positioned for the future may not be those with the largest internal research budgets. Instead, they may be those most capable of identifying, integrating, and translating insights generated across broader scientific networks.

Evidence as Competitive Advantage

As longevity becomes increasingly crowded, evidence is likely to become one of the most important sources of differentiation.

Many beauty categories have historically competed through branding, storytelling, sensory experience, and emotional connection. These capabilities will remain important. However, longevity introduces a level of scientific scrutiny that may elevate evidence itself into a strategic asset.

This observation does not imply that every beauty company must conduct pharmaceutical-scale clinical trials. Rather, it suggests that organizations will need more sophisticated approaches to evidence generation and evidence communication.

One challenge is that traditional beauty metrics may prove insufficient. Historically, efficacy has often been demonstrated through visible outcomes such as wrinkle reduction, hydration

improvement, or changes in skin texture. Longevity increasingly introduces questions related to resilience, recovery, biological function, and long-term outcomes that may not be immediately visible.

As a result, organizations may need to develop broader evidence frameworks that integrate clinical studies, biomarker research, consumer outcomes, and longitudinal data. Equally important is the ability to communicate evidence responsibly. Consumers are increasingly exposed to scientific terminology but often struggle to distinguish between established findings and emerging hypotheses. Organizations that communicate uncertainty transparently may ultimately build greater trust than those making more aggressive claims.

In this environment, evidence becomes more than a regulatory requirement. It becomes a mechanism for establishing credibility.

Developing Long-Term Strategic Horizons

Perhaps the most significant challenge facing beauty organizations is time. The previous chapters demonstrated that longevity science operates on fundamentally different timelines than most commercial organizations. Biological aging unfolds across decades. Meaningful health outcomes often require years to observe. Scientific consensus develops gradually through accumulation of evidence rather than through individual breakthroughs.

Most organizations, however, operate on significantly shorter horizons. Quarterly earnings expectations, annual planning cycles, and near-term performance targets frequently dominate decision-making. While these structures are necessary for managing current operations, they can create challenges when organizations attempt to participate in fields characterized by long-term uncertainty.

This tension suggests that longevity requires a different approach to strategic planning.

One useful framework comes from the Three Horizons model, which argues that organizations must simultaneously manage present performance, emerging opportunities, and long-term

transformation. Applied to longevity, this framework suggests that companies should think across multiple time horizons simultaneously.

The first horizon focuses on current business performance. Within longevity, this may include improvements to existing products, claims, and consumer education efforts that can be implemented immediately.

The second horizon focuses on emerging opportunities. Examples might include partnerships, new service models, personalization capabilities, data integration initiatives, or investments in new scientific platforms.

The third horizon focuses on transformational possibilities that may not generate returns for many years. These could include investments in aging biology research, advanced diagnostics, regenerative technologies, or entirely new business models.

The challenge is not choosing between these horizons. It is managing all three simultaneously.

Organizations that focus exclusively on short-term opportunities may struggle to build long-term credibility. Organizations focused exclusively on long-term possibilities may fail to create meaningful value in the present. Longevity, therefore, requires strategic balance.

Toward 100-Year Thinking

Underlying all of these shifts is a broader change in mindset. Much of modern business is optimized around short-term performance. Product launches are measured in quarters. Marketing campaigns are measured in weeks. Corporate strategies are frequently measured in years. Longevity, by contrast, asks organizations to engage with a biological process that unfolds across entire lifetimes.

This perspective invites what might be described as 100-year thinking. 100-year thinking does not imply that organizations should attempt to predict the future with certainty. Rather, it encourages leaders to consider how today's decisions influence long-term resilience, trust, and relevance. It shifts focus from extracting immediate value toward creating enduring value.

For beauty companies, this may require asking different questions. Instead of asking which claims will generate the strongest short-term response, organizations might ask which claims will remain credible 10 years from now. Instead of asking which ingredients are currently trending, they might ask which scientific platforms are likely to remain relevant as knowledge evolves. Instead of asking how longevity can support existing products, they might ask how the organization itself must evolve to support longevity.

The companies that ultimately define beauty's role in the longevity era will not necessarily be those with the most products, the largest portfolios, or the most aggressive claims. They will be those capable of building organizations designed for learning, adaptation, and scientific credibility.

Longevity is not merely a new market opportunity. It is a test of whether organizations can successfully operate at the intersection of uncertainty, evidence, and long-term value creation.

The final question, then, is how leaders can translate these ideas into action. The next chapter introduces a practical framework for evaluating organizational readiness and identifying the short-, medium-, and long-term actions required to compete in the age of longevity.

Chapter 7

From Claims to Credibility: A Longevity Readiness Framework

For decades, competitive advantage in beauty was largely determined by a company's ability to identify consumer trends, develop compelling products, and communicate persuasive narratives. Longevity introduces a different set of requirements. As biological science becomes increasingly visible within consumer culture, organizations will face growing pressure to demonstrate not only innovation but also credibility. Scientific legitimacy, evidence generation, data interpretation, and long-term strategic thinking are likely to become increasingly important determinants of success.

The central argument of this paper has been that longevity in beauty is not fundamentally an innovation problem. The industry already has access to a growing body of scientific research,

emerging technologies, and potential partnership opportunities. The more significant challenge lies in translating those resources into systems that consumers can trust. As a result, readiness for the longevity era should be evaluated not by the number of longevity products a company launches, but by its ability to create credible, evidence-based, and consumer-relevant experiences.

This chapter proposes a Longevity Readiness Framework to help organizations evaluate their preparedness for this transition. The framework is not intended to predict which companies will win. Rather, it identifies the capabilities most likely to distinguish organizations that successfully participate in the longevity ecosystem from those that simply adopt longevity language.

Dimension 1: Scientific Capability

The first dimension concerns an organization's ability to engage meaningfully with evolving science. Historically, many beauty companies have relied on external suppliers, ingredient manufacturers, and contract research organizations to provide scientific expertise. While this model remains effective for many categories, longevity introduces a level of complexity that increasingly requires internal scientific literacy.

Scientific capability extends beyond laboratory research. It includes the ability to evaluate evidence quality, understand biological mechanisms, identify emerging areas of relevance, and distinguish between promising hypotheses and validated findings. Organizations with strong scientific capability are better positioned to navigate uncertainty and avoid overreliance on marketing narratives that outpace available evidence.

Indicators of strength may include dedicated longevity research initiatives, interdisciplinary scientific teams, active participation in academic collaborations, publication activity, patent generation, and long-term investment in biological research.

Dimension 2: Evidence Generation

The second dimension evaluates how organizations create, validate, and communicate evidence. One of the recurring themes throughout this paper has been the distinction between scientific plausibility and demonstrated outcomes. Longevity-related claims often emerge from promising

mechanistic research long before meaningful human outcomes can be established. Organizations that rely solely on theoretical mechanisms may struggle to maintain credibility as consumer expectations evolve.

Evidence generation, therefore, becomes a strategic capability rather than a regulatory obligation. This includes investment in clinical research, longitudinal studies, biomarker validation, consumer outcome tracking, and transparent communication regarding limitations and uncertainties.

In the longevity era, trust may increasingly be built not by claiming certainty, but by demonstrating intellectual honesty regarding what is known, what is unknown, and what remains under investigation.

Dimension 3: Data and Personalization Readiness

The future of longevity is likely to be increasingly personalized. Biological age, recovery capacity, hormonal status, genetic predispositions, microbiome composition, sleep quality, and metabolic health all vary significantly between individuals. Consequently, standardized approaches may become less effective as consumers increasingly expect personalized experiences.

Organizations must therefore consider their readiness to leverage both static and dynamic forms of biological information. Static data, such as genetic testing, provides insight into predispositions and baseline characteristics. Dynamic data, including wearable-device metrics and biomarker monitoring, provides insight into how biology changes over time. As demonstrated through the 23andMe and Oura case studies, the greatest opportunity may emerge not from either category independently, but from their integration into more comprehensive consumer profiles.

Importantly, success in this domain depends not only on data collection but also on interpretation. Organizations must determine how data will be translated into meaningful recommendations, behavioral guidance, and consumer value.

Dimension 4: Ecosystem Development

Longevity is unlikely to be won through products alone. Throughout this paper, we have argued that aging functions as a systems-level phenomenon influenced by interconnected biological,

behavioral, environmental, and psychosocial factors. As a result, the future of longevity may increasingly shift from standalone products toward integrated solutions that combine diagnostics, products, services, education, coaching, and personalized guidance.

Organizations should therefore evaluate their ability to participate in broader ecosystems rather than isolated categories. This includes partnership strategies, interoperability with external platforms, access to scientific expertise, and the ability to connect multiple consumer touchpoints into cohesive experiences.

The most successful organizations may not be those that own every component of the ecosystem. Rather, they may be those that orchestrate ecosystems most effectively.

Dimension 5: Organizational Alignment

Perhaps the most overlooked dimension of readiness is organizational structure. Many beauty companies remain optimized for short product-development cycles, annual planning horizons, and marketing-led decision-making. Longevity introduces challenges that do not align naturally with these structures. Scientific validation often requires years rather than months. Partnerships may generate value gradually rather than immediately. Biological outcomes may take significant time to emerge.

Organizations must therefore evaluate whether decision rights, incentives, governance structures, and resource allocation processes support long-term scientific initiatives. This includes examining the relationship between marketing and R&D, mechanisms for claim substantiation, and leadership commitment to evidence-based decision-making.

Without organizational alignment, even the strongest scientific opportunities may struggle to translate into sustainable competitive advantage.

The Three Horizons of Longevity

While readiness provides a snapshot of current capabilities, leaders must also determine how to prioritize future action. One useful approach is to organize initiatives across multiple time horizons.

In the short term, organizations should focus on credibility. This includes strengthening scientific literacy, improving evidence standards, auditing longevity-related claims, and identifying areas where existing products can be more accurately connected to emerging longevity narratives. The objective is not to launch entirely new businesses, but to establish a trustworthy foundation. For example, upgrade existing anti-aging products with evidence-based longevity claims

In the medium term, organizations should focus on capability-building. Priority areas may include partnerships with scientific institutions, investments in personalization infrastructure, experimentation with data-enabled experiences, and development of holistic longevity regimens that combine products with services, education, and behavioral support. Opportunities lie in partnerships with Oura, Timeline, and other diagnostic companies

In the long term, organizations should focus on transformation. This includes exploring new business models, developing integrated longevity ecosystems, participating in emerging scientific platforms, and positioning the organization to compete in a future where health span rather than appearance becomes the dominant consumer outcome. This means building health span ecosystems, biological age platforms, or women's longevity platforms.

These horizons should not be viewed as sequential stages. Organizations must manage all three simultaneously, balancing present performance with future opportunity.

A New Definition of Success

Ultimately, longevity challenges the beauty industry to reconsider how success is defined. For much of the industry's history, success was measured through product performance, brand awareness, market share, and consumer perception. While these metrics remain important, longevity introduces additional considerations. Scientific credibility, consumer trust, evidence quality, behavioral impact, and long-term outcomes may become equally important indicators of value creation.

This transition requires a shift from short-term claims toward long-term credibility. It requires organizations to think beyond individual products and toward systems that support health span.

Most importantly, it requires recognizing that consumers are increasingly seeking guidance rather than promises.

The companies that thrive in the longevity era will not necessarily be those with the most sophisticated technologies or the most aggressive marketing campaigns. They will be those capable of translating scientific complexity into meaningful consumer value while maintaining the trust required to guide individuals through increasingly personal aspects of health and aging.

Conclusion: The Science of Longevity and the Future of Beauty

Longevity is often discussed as the next frontier for beauty. This paper has argued that such a framing is incomplete. Longevity is not simply a new category, ingredient trend, or product opportunity. It represents a broader shift in how consumers understand aging, health, prevention, and well-being.

The beauty industry enters this transition with significant strengths. It understands rituals, aspiration, behavior, and consumer engagement. It possesses decades of experience translating complex science into accessible experiences. Yet it also faces substantial challenges. Scientific timelines move more slowly than marketing cycles. Biological outcomes are more difficult to measure than cosmetic outcomes. Credibility requires evidence that many organizations are not yet structured to generate.

The Evidence Gap, the Time-Horizon Gap, and the Operating-Model Gap are not independent challenges. They reinforce one another. Limited evidence encourages premature commercialization. Short commercial timelines discourage long-term evidence generation. Traditional operating models make it difficult to integrate scientific uncertainty into strategic decision-making. Together, these forces create the translation challenge that sits at the center of the longevity opportunity.

The future of longevity in beauty will therefore be determined less by who adopts the language first and more by who builds the capabilities required to support it. The organizations that succeed will likely be those that trade narrative for evidence, products for systems, and short-term optimization for long-term resilience.

In doing so, beauty has the opportunity to become more than an industry focused on appearance. It can become a trusted partner helping consumers navigate one of the most complex and consequential challenges they face: how to live longer, healthier, and more meaningful lives.

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