Volume 0 of 12

14th Annual Edition

2021 Tech Trends Report

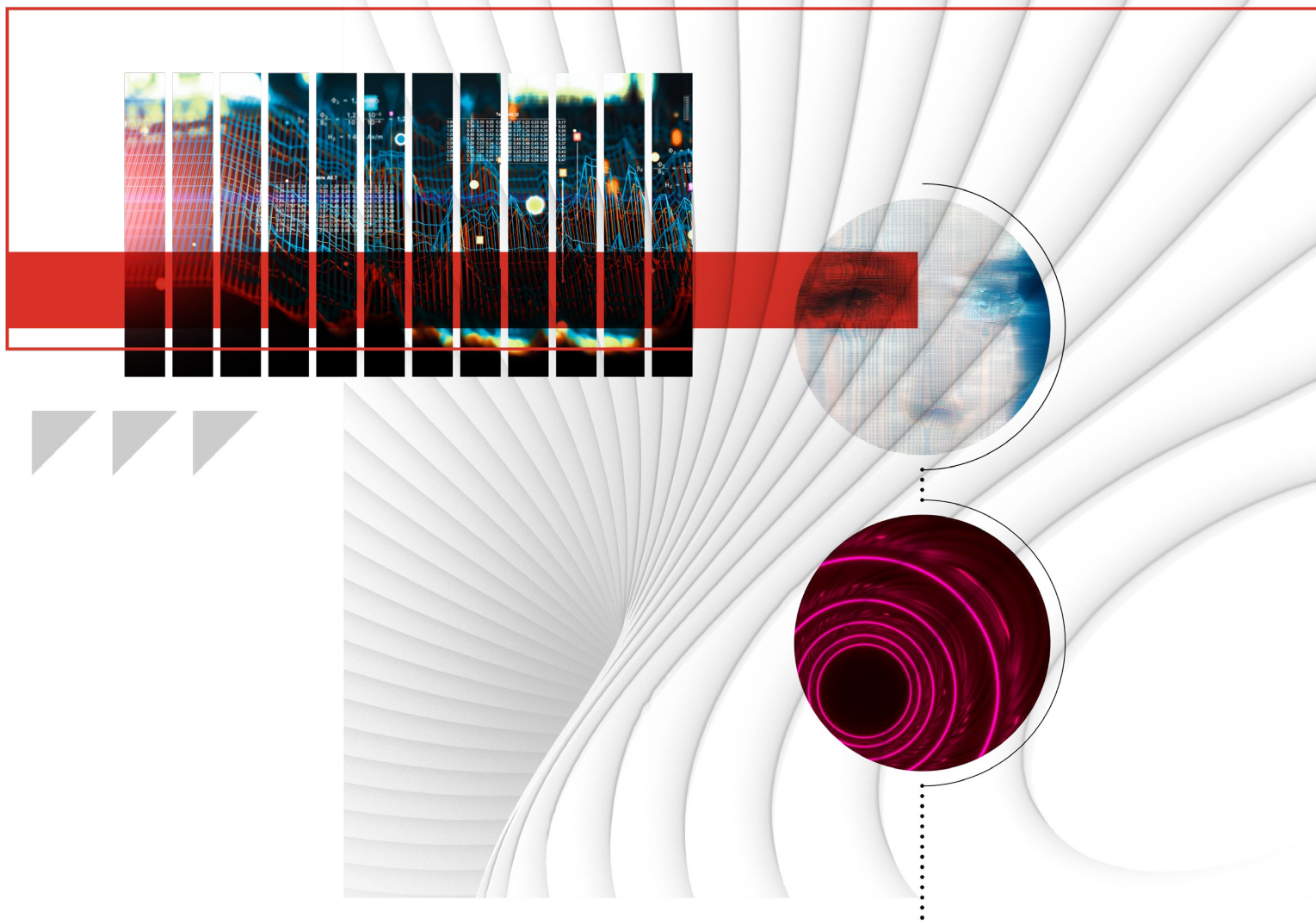
Strategic trends that will influence business, government, education, media and society in the coming year.

- Overview
- Methodology
- Frameworks

Future Today Institute

This is a companion to the Future Today Institute's 2021 Tech Trends Report. It includes the key frameworks and tools we used to develop our trends. Each volume of the 2021 Tech Trends Report covers a different set of topics.

To find additional volumes, visit **www.futuretodayinstitute.com/trends**



Overview

The 1920s began in chaos. Cataclysmic disruption resulting from the first world war and the Spanish flu shuttered businesses and provoked xenophobia. Technological marvels like the radio, refrigerator, vacuum cleaner, moving assembly line and electronic power transmission generated new growth, even as the wealth gap widened. More than two-thirds of Americans survived on wages too low to sustain everyday living. The pace of scientific innovation—the discovery of insulin, the first modern antibiotics, and insights into theoretical physics and the structure of atoms—forced people to reconsider their cherished beliefs.

The sheer scale of change, and the great uncertainty that came with it, produced two factions: those who wanted to reverse time and return the world to normal, and those who embraced the chaos, faced forward, and got busy building the future.

It's difficult not to see striking parallels to our modern world. A tumultuous U.S. election, extreme weather events and Covid-19 continue to test our resolve and our resilience. Exponential technologies—artificial intelligence, synthetic biology, exascale computing, autonomous robots, and off-planet missions to space—are challenging our assumptions about human potential. Under lockdown, we've learned how to work from our kitchen tables, lead from our spare rooms, and support each other from afar. But this disruption has only just begun.

With the benefit of both hindsight and strategic foresight, we can choose a path of reinvention. Our 2021 Tech Trends Report is designed to help you confront deep uncertainty, adapt and thrive. For this year's edition, the magnitude of new signals required us to create 12 separate volumes, and each report focuses on a cluster of related trends. In total, we've analyzed nearly 500 technology and science trends across multiple industry sectors. In each volume, we discuss the disruptive forces, opportunities and strategies that will drive your organization in the near future.

Now, more than ever, your organization should examine the potential near and long-term impact of tech trends. You must factor the trends in this report into your strategic thinking for the coming year, and adjust your planning, operations and business models accordingly. But we hope you will make time for creative exploration. From chaos, a new world will come.

Amy Webb

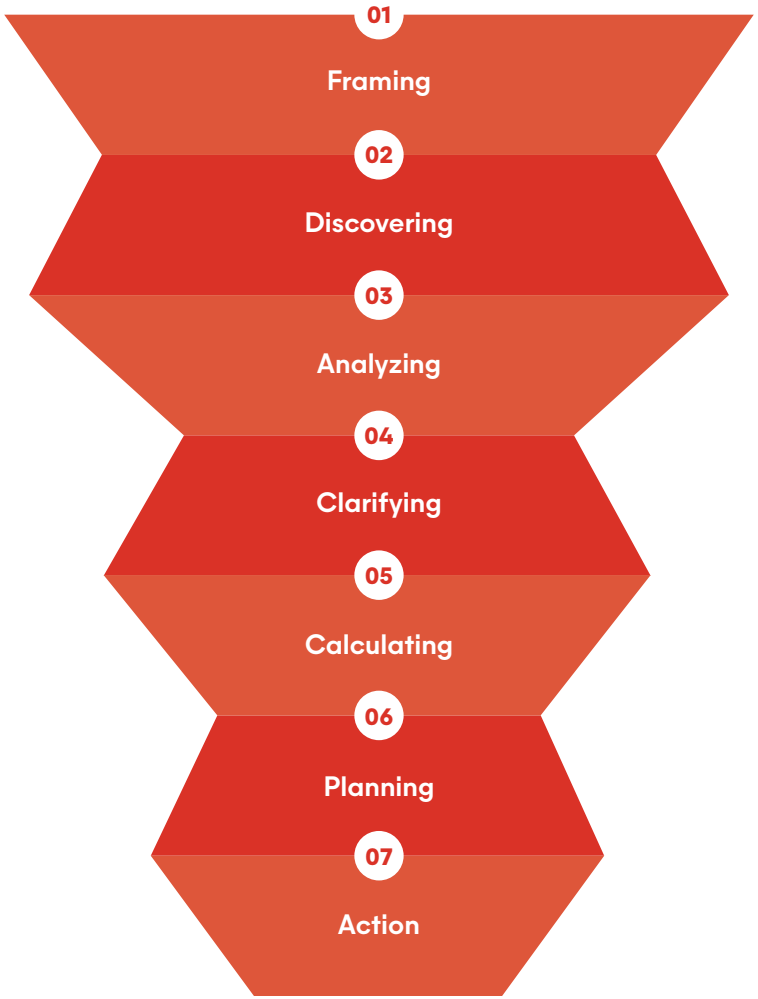
Founder
The Future Today Institute

Methodology

The Future Today Institute's Seven-Step Forecasting Funnel

The Future Today Institute's strategic forecasting model uses quantitative and qualitative data to identify weak signals and map their trajectories into tech trends. Our seven steps alternate between broad and narrow scopes, which include: framing your work, identifying weak signals at the fringe, spotting patterns, developing trend candidates, calculating a trend's velocity, developing scenarios, and finally, backcasting preferred outcomes.

The steps of our methodology can be used independently to surface new trends or to generate scenarios, or they can be used to guide your strategic planning process. To identify trends, use steps 1 – 4. To imagine future worlds, use steps 1 and 5.



1. **Converge:** Determine your questions, time horizons and stakeholders.

2. **Diverge:** Listen for weak signals at the fringe. Make observations and harness information from the broadest possible array of sources and on a wide variety of topics.

3. **Converge:** Uncover hidden patterns in the previous step. Use FTI's CIPHER framework to identify trends. Look for contradictions, inflections, practices, hacks, extremes and rarities.

4. **Diverge:** Ask questions to learn how the trends you've identified intersect with your industry and all of its parts.

5. **Converge:** Calculate the velocity and trajectory of change that are both internal and external to your organization.

6. **Diverge:** Write scenarios to describe impacts and outcomes in the future.

7. **Converge:** Backcast preferred outcomes. Define your desired future and then work backwards to identify the strategic actions connecting that future to your present.

The 11 Sources

Macro Forces

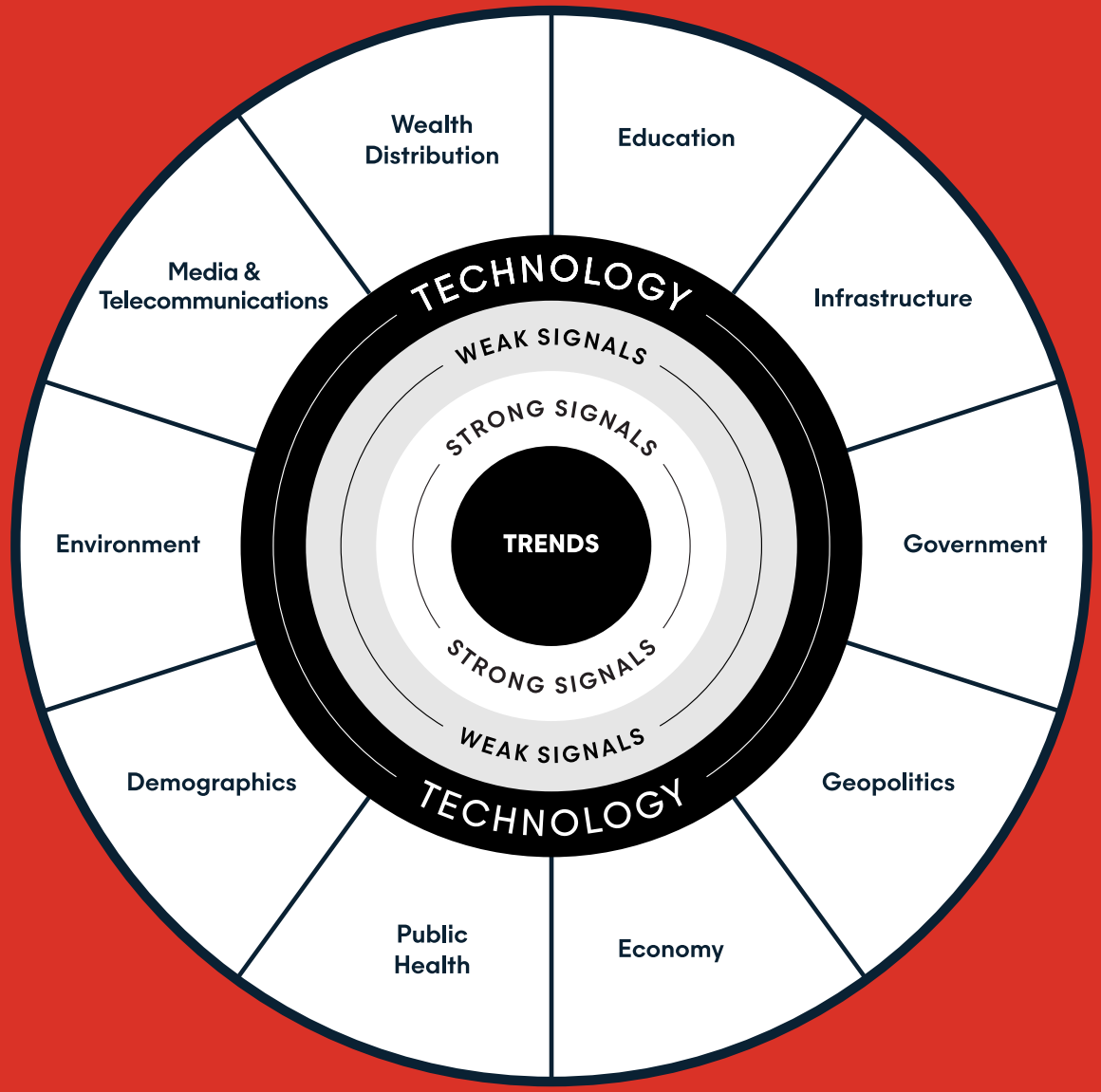
Shape our world

Signals

Indicate emerging change

Trends

Describe our futures



The 11 Sources

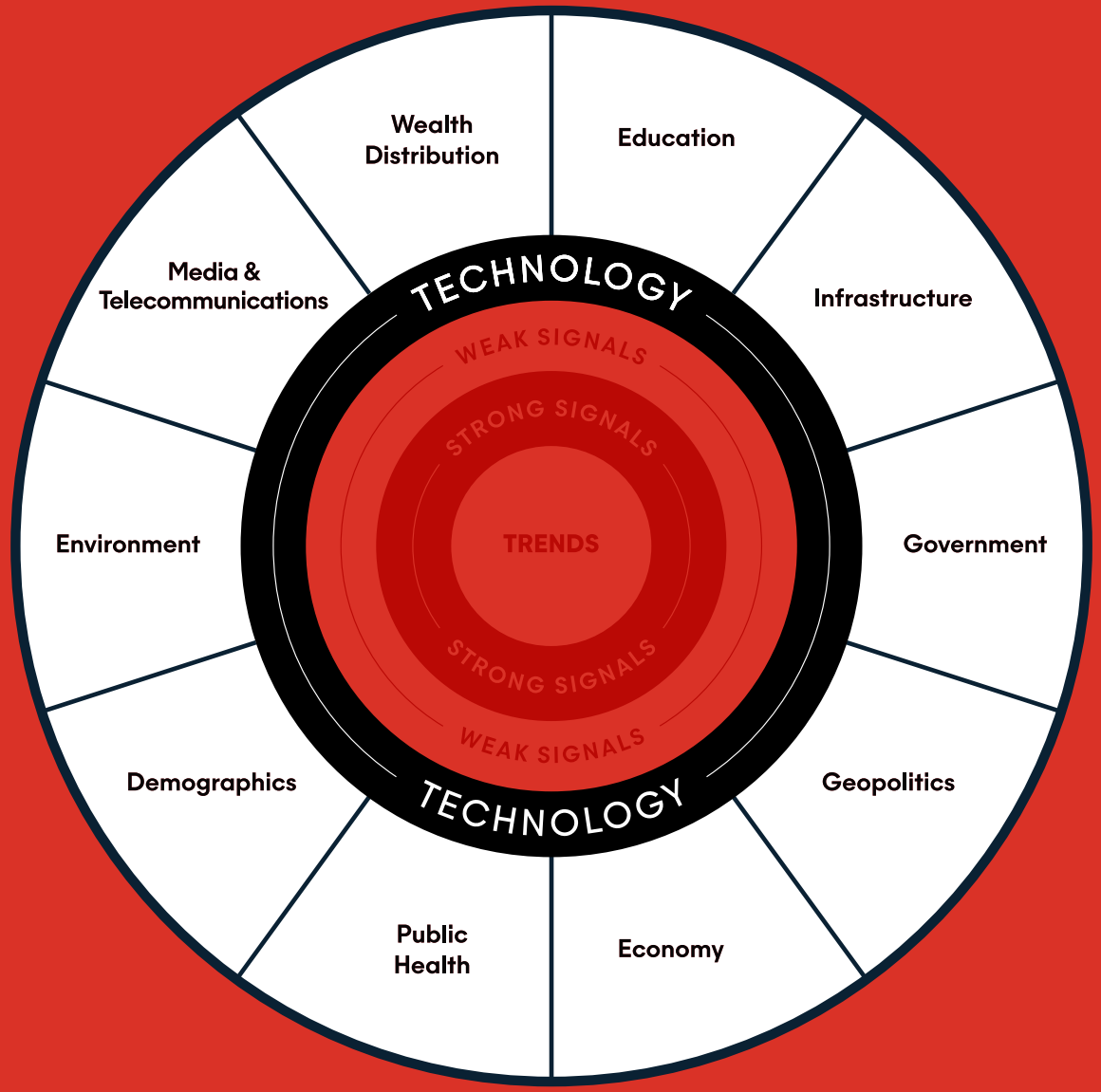
Macro Forces

Shape our world

These 11 Macro Forces represent external uncertainties that no one entity has control over but that play a critical role in how our futures develop. These factors broadly influence business, governing, and society. They can skew positive, neutral, and negative. These are primary source shifts. Developments in each of these 11 Macro Forces impact the world we live in.

FTI Senior Foresight Associate Marc Palatucci refers to this framework as our "Wheel of Disruption." This framework illustrates how disruption tends to stem from 10 major influential sources of macro change, with technology, the 11th source, underpinning all others. When we are analyzing the future of anything, we think about each area of potential disruption.

We also consider each of the macro sources to ensure that our framing includes areas beyond one industry and its direct adjacencies. The result is a diverse set of clear drivers we use to guide our research and analysis.



The 11 Sources

Macro Forces

Shape our world

Wealth Distribution:
The distribution of income across a population's households, the concentration of assets in various communities, the ability for individuals to move up from their existing financial circumstances, and the gap between the top and bottom brackets within an economy.

Education:
Access and quality of primary, secondary, and post-secondary education; workforce training; trade apprenticeships; certification programs; the ways in which people are learning and the tools they're using; and what people are interested in studying.

Infrastructure:
Physical, organizational, and digital structures needed for society to operate (bridges, power grids, roads, Wi-Fi towers, closed-circuit security cameras) and the ways an infrastructure of a city, state, or country might impact another's.

Government:
Local, state, national, and international governing bodies; their planning cycles; their elections; and their regulatory decisions.

Geopolitics:
The relationships among the leaders, militaries, and governments of different countries, and the risk faced by investors, companies, and elected leaders in response to regulatory, economic, or military actions.

Economy:
Shifts in standard macroeconomic and microeconomic factors.

Public Health:
Changes in the health and behavior of a community's population in response to lifestyles, popular culture, disease, government regulation, warfare or conflict, and religious beliefs.

Demographics:
Observing how birth and death rates, income, population density, human migration, disease, and other dynamics are shifting communities.

Environment:
Changes to the natural world or to specific geographic areas, including extreme weather events, climate fluctuations, rising sea levels, drought, high or low temperatures, and more. (We include agricultural production in this category.)

Media and Telecommunications:
All of the ways we send and receive information and learn about the world. These include social networks, news organizations, digital platforms, video streaming services, gaming and eSports systems, 5G, and the boundless other methods for connecting with each other.

Technology:
We recognize technology not as an isolated source of macro change but rather as the connective tissue linking business, government, and society. For that reason, we always look for emerging tech developments, as well as tech signals within the other sources of change.

The 11 Sources

Signals

Indicate emerging change

Weak Signals are...

- A small innovation, incremental development, or R&D advancement, or other minor development that has the potential to grow as it matures
- A new technology development that has not yet entered the mainstream, or a new market strategy, product, or service entering a noncompetitive space
- Evidence of an existing thing becoming obsolete, or evidence of a novel thing emerging
- A recently revealed problem or state of affairs that does not directly or immediately impact your business

Strong Signals are...

- A bigger innovation, significant development or R&D advancement, or other big development that is maturing
- A new market technology, strategy, product, or service entering a competitive space, where others are likely to follow fast
- Factors that challenge current beliefs or assumptions and have the momentum to mature or grow fast
- Obvious advance warning indicators

The 11 Sources

Trends

Describe our futures

Trends emerge from the intersection of macro forces and signals. They are new manifestations representing the collisions of new developments, and they form steadily over many years. Importantly, they do not necessarily follow a linear path from the fringe to the mainstream.

The Four Laws of Tech Trends

1. Trends are driven by primary forces of change and our basic human needs.
2. Trends are timely, but they persist in the wake of new developments.
3. Trends are the convergence of weak and strong signals over time.
4. Trends evolve as they emerge.

The Four Laws of Tech Trends were first introduced in *The Signals Are Talking: Why Today's Fringe Is Tomorrow's Mainstream* by Amy Webb.

Trend vs. Trendy: Knowing the Difference

Sometimes it can be a challenge to distinguish between something that is trendy (i.e., a fad that comes and goes) and a genuine "longitudinal" trend that will have significant lasting impact on the world, and on your business. We can validate the latter type of trend by confirming it meets most or all of the Four Laws of Tech Trends.

Trendy phenomena (or fads) are much more transient. They appear suddenly, capture our attention, and distract us with intense possibilities—only to burn out just as quickly as they arrived. Fads move along a common cycle—insider discovery, trending on social networks, influencer bragging, media hysteria and mainstream acceptance—until we are disillusioned because the fads never meet our broader expectations.

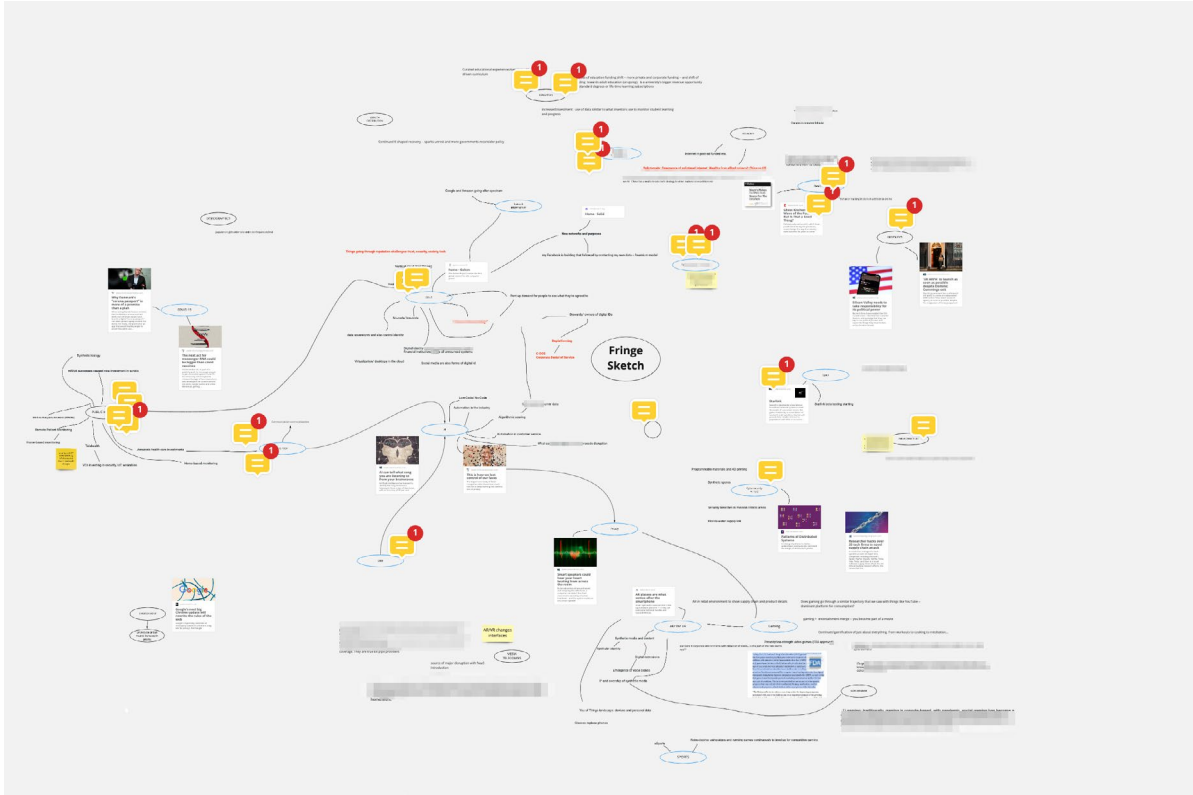
The output is a verified trend or set of trends that can then be accounted for in the strategic plans of your organization. The Four Laws can help you avoid spending time and resources adapting to what may appear to be a strong signal, only for it to prove inconsequential in the near future.

Fringe Sketching

The Fringe Sketch is FTI's first step in looking for emerging signals and trends. It is a network map connecting signals to macro forces. We build the sketch using a digital whiteboard, and add data sources, images, videos, and other relevant bits of information as we go.

We begin by adding a wide array of relevant idea "nodes" to the sketch—these can include concisely described current events, emerging tech trends, societal phenomena, even additional questions—and drawing lines between each node and those to which it is most closely related. This process takes the form of an active brainstorm, with thoughts flowing freely and most, if not all of them, making it into the sketch. We keep at it until we have an explosive amount of ideas on the board, each forming a node and spawning its own sub-nodes in a many-layered web of information.

The result is a map of direct and orthogonal relationships between diverse technological and cultural phenomena, all with the central topic as their nucleus. This collection of structured data can then be analyzed to reveal unexpected interactions and surface overarching trends that are likely to play a role in the future.



Recognizing Patterns

CIPHER provides a tool to categorize the signals we surface during our Fringe Sketch, but we also use it for our regression models.

Six key factors indicate trends, and they are represented by the CIPHER acronym.

Contradictions, inflections, and practices are the most common. Hacks and extremes tend to be outliers or strong trends when they appear. Rarities are exactly what they sound like: rare and unusual, so when we see them we tend to pay close attention to their influence.

C	Contradictions	Examples that demonstrate opposing or incongruous forces at play simultaneously
I	Inflections	Occurrences that mark a major turning point or establish a new paradigm
P	Practices	Emerging behaviors that are becoming more pronounced or gaining in popularity
H	Hacks	Inventive, unintended uses for tools, technologies, and systems
E	Extremes	Instances of technologies, functions, or concepts being pushed to new limits that might change the nature of their use
R	Rarities	Highly unlikely or unexpected events and phenomena

Escalation Triggers

Signals and trends aren't useful within an organization unless strategic action of some kind is taken. Teams sometimes have a difficult time aligning on which trends to share with executives—and when.

We customize this Escalation Triggers matrix for our FTI clients to help them determine when they should take action, when a strategic decision is needed, and when to continue monitoring a signal or trend (or constellation of signals and trends). With each new signal discovered, they use this matrix to determine the category. If the answer in a category is predominantly yes, they know when to escalate the signal to other departments, executive teams, or boards of directors.

Action Criteria

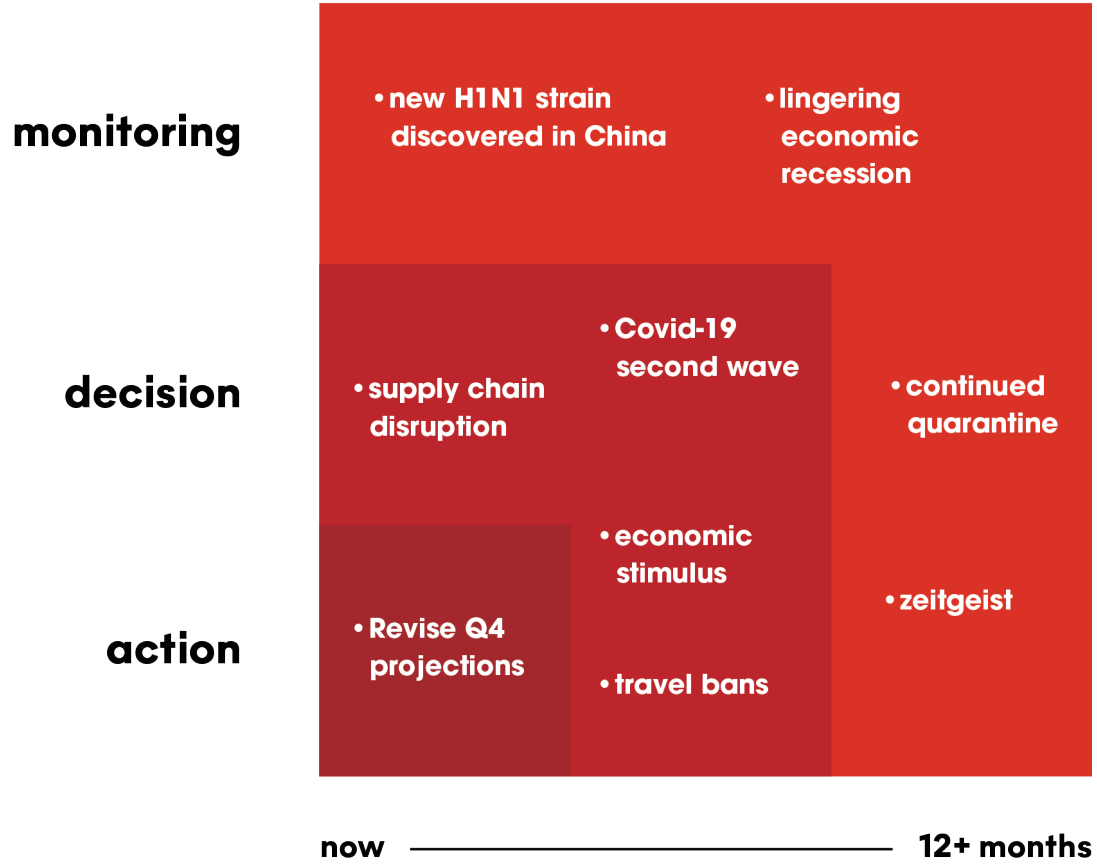
- Inflection point is imminent
- Immediate opportunity for competitor
- Impacts our partners
- Great internal momentum/support in our organization

Decision Criteria

- High importance and/ or high impact
- Could cause disruption to our model
- Financial, operational or market risk
- Meaningful impact on brand positioning
- Tied to an existing strategic initiative
- Pending regulation
- Strong interest from within our organization

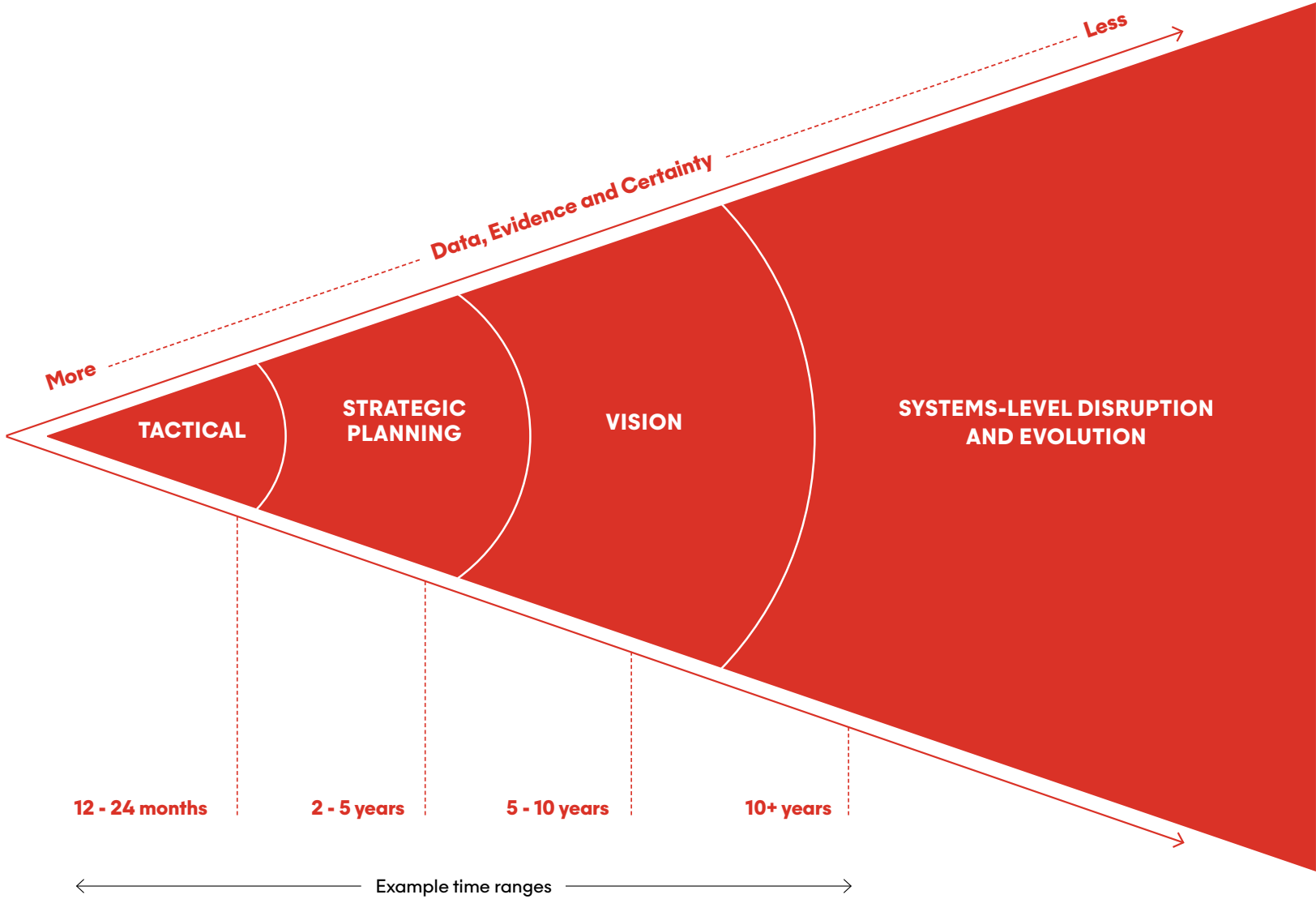
Monitoring Criteria

- Potential for financial, operational or market disruption
- Some importance and/or impact, but more time is needed
- Interest from within our organization



Time Cone

The Future Today Institute's Time Cone shows how the range of possible paths forward expands as we look further into the future and the availability of current, reliable, and actionable data decreases. Timelines are useful for tracking the progress of a project toward a finite goal, but for an organization faced with a broad range of potential futures, you need to factor in uncertainty. The time span of the cone (Tactics, Strategic Planning, Vision, and Systems-Level Evolution) are modulated to suit different foresight projects, and foreseeable waypoints can be plotted directly on the framework. We also map trends on the Time Cone to gain deeper insights into how they could impact organizations.



How to Do Strategic Planning Like a Futurist

For any given uncertainty about the future—whether that's risk, opportunity, or growth—it's best to think in the short and long term simultaneously. As we think about the future, we build a cone with four distinct categories: (1) tactics, (2) strategic planning, (3) vision, and (4) systems-level evolution.

We start by defining the cone's edge using highly probable events for which there is already data or evidence. The amount of time varies for every project, organization, and industry. In the Time Cone graphic in this book, we've used 12–24 months as a place to start. Because we can identify trends and probable events (both within a company and external to it), the kind of planning that can be done is tactical in nature, and the corresponding actions could include things like redesigning products or identifying and targeting a new customer segment.

Tactical decisions must fit into an organization's strategy. At this point in the cone, we are a little less certain of outcomes, because we're looking at the next 24 months to five years. This area should be most familiar to strategy officers and their teams: We're describing traditional strategy and the direction the organization will take. Our actions include defining priorities, setting resource allocation, making any personnel changes needed, and the like.

Lots of teams get stuck cycling between strategy and tactics, and that makes their organizations vulnerable to disruption. If you aren't simultaneously articulating your vision and a systems-level evolution, another organization will drag you into its version of the future.

Think exponentially.

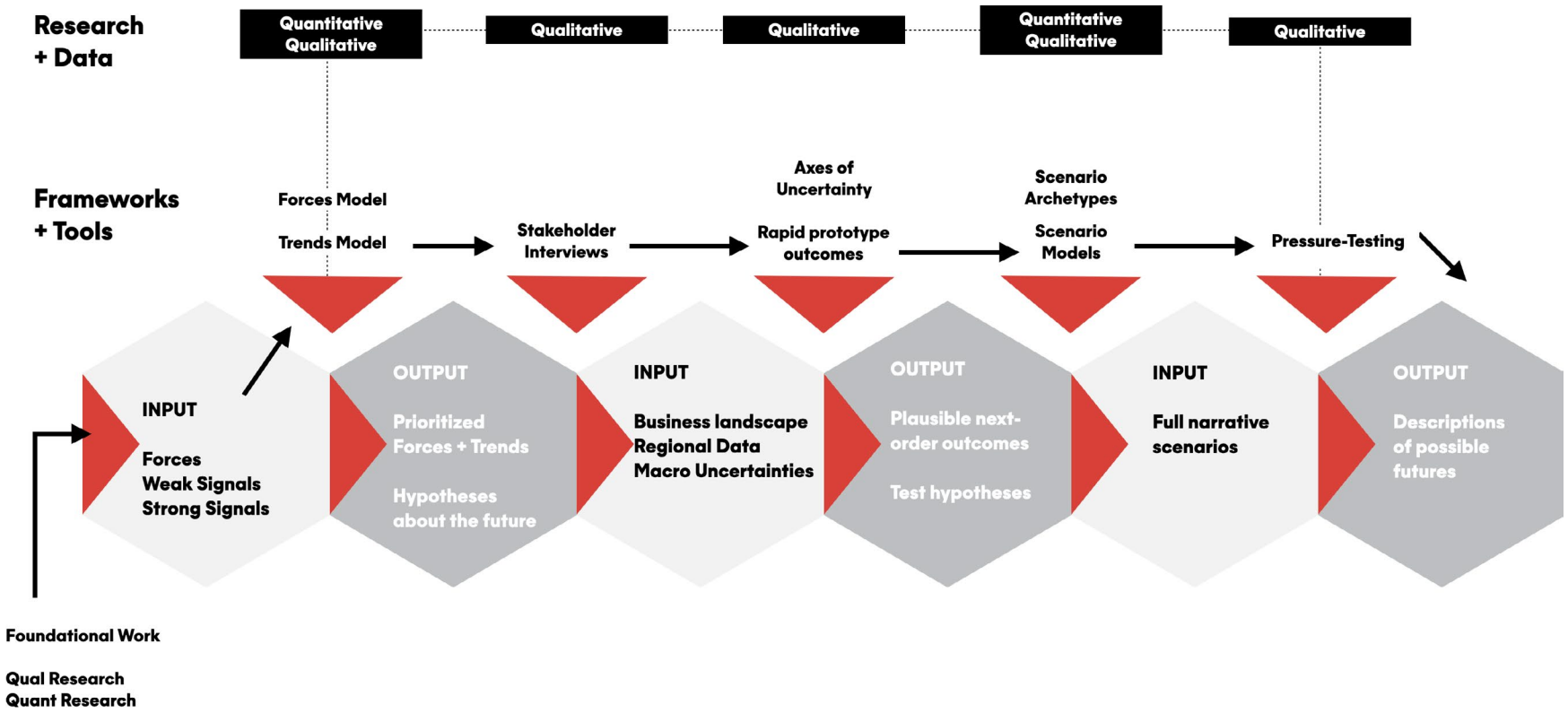
Act incrementally.

Scenarios

Scenarios are narrative snapshots describing possible futures. Scenarios are strategic tools designed to catalyze what-if conversations. They require teams to confront their cherished beliefs, develop shared visions, and sharpen their focus, and refine their expectations. Scenarios do not predict the future. They reduce uncertainty so that better decisions can be made in the present. Done well, scenarios inform what actions must be taken to shape the future.

The Future Today Institute's scenario modeling process relies on many rounds of research, analysis, and writing.

Our Scenario Modeling Process



Axes of Uncertainty

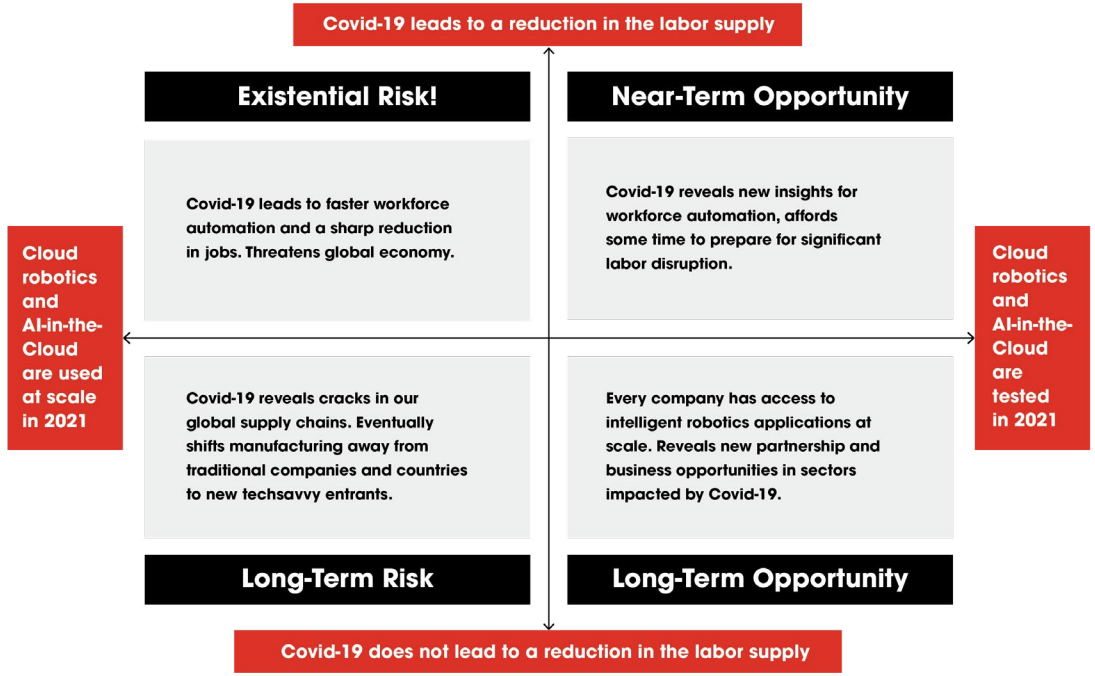
We tend to underpredict or overpredict change. The reason: Imagining plausible outcomes forces us to confront our expectations and cherished beliefs.

We use a 2x2 matrix to rapidly prototype scenarios. They are short but detailed narratives describing plausible outcomes of high-impact, high-uncertainty events.

We begin with a prioritized list of signals and trends. Then we generate an additional list of uncertainties using STEEPLE factors: Social/Demographic, Technological, Economic, Environmental, Political, Legal, and Ethical. We add in additional uncertainties that intrigue us and relate to our current project.

We write uncertainties along opposite axes to explore what scenario might emerge. Quadrants reflect the signals, trends, STEEPLE factors, and other curiosities we're exploring. In each quadrant, we answer "What if these two factors are present?" and continue probing until we have a short but deep story. We finish with a headline describing that future state.

As a last step, we label each quadrant using one of six categories: near-term opportunity, long-term opportunity, near-term risk, long-term risk, neutral, and existential risk to help us prioritize the quadrant for the next phase of our scenarios work.



S-SWOT Analysis

We adapted the traditional SWOT analysis as a way to frame scenarios for organizations new to foresight. (Hence, Scenarios-SWOT.) Because this framework is already known to most organizations, it reduces some of the frustration that can sometimes be associated with data-rich scenarios.

SWOT stands for Strengths, Weaknesses, Opportunities, and Threats, each of which occupies a quadrant, and the quadrants are further classified as internal versus external to the organization, and as favorable or adverse.

In the context of foresight, we use this tool with teams new to scenario writing. It helps them prepare to write scenarios with optimistic and catastrophic framings. A completed SWOT matrix helps teams develop the components to include in narratives. The optimistic scenario will describe a future in which teams capitalize on their strengths and seize the opportunities identified, while a catastrophic scenario will describe a future in which the weaknesses they identified are exploited or prevent them from succeeding, and the threats they surfaced are actualized.

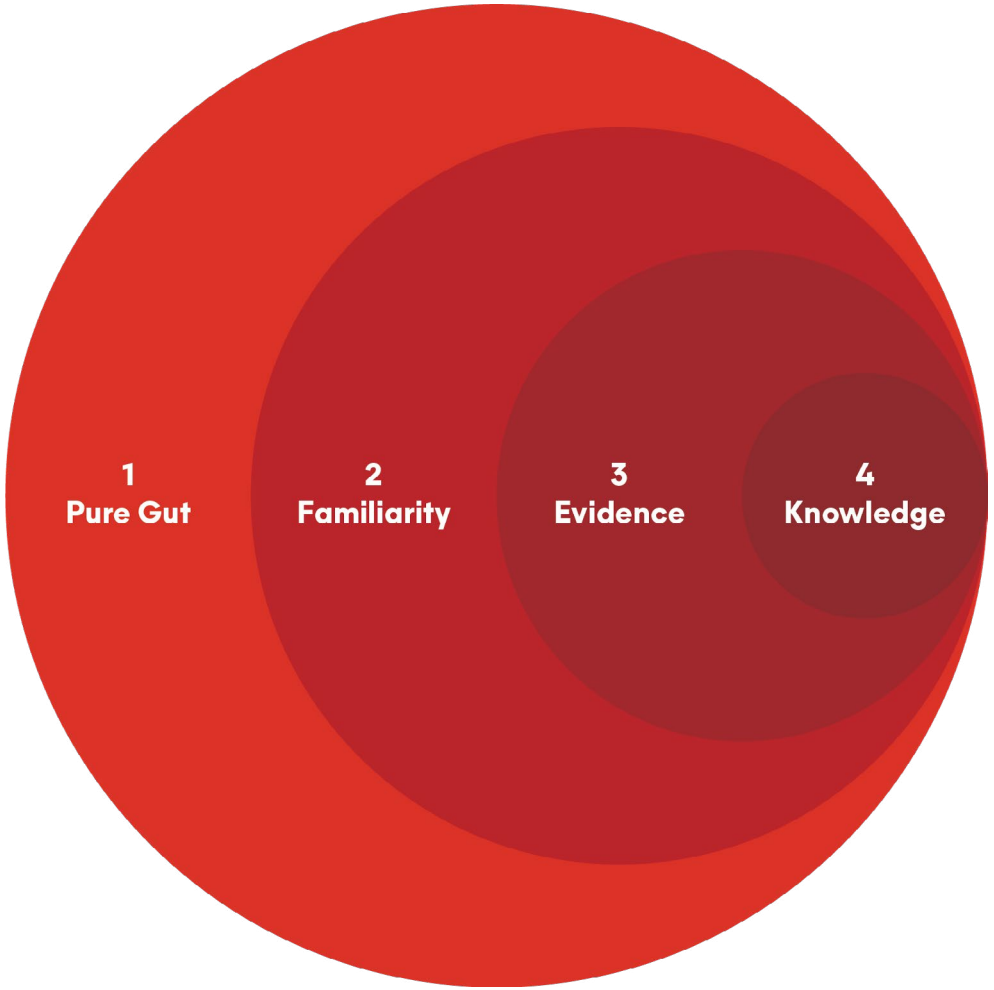
Future States

As we develop scenarios, we first determine the time horizon, the types of data we'll use to support the narrative, and the strategic purpose they will serve.

	Time Horizon	Characteristics	Strategic Purpose
Probable	Near-future now - 5 years	Ample quantitative data Limited unknown variables Limited volatility	Making near-term tactical decisions
Plausible	Mid-future 5 - 15 years	Limited data Many unknown variables Follows laws of governing/ society/ physics	Building strategic direction/ vision Looking for investments
Possible	Farther-future 15+ years	Little or no data May not follow laws of governing/ society/ physics	Long-term planning Systems-level evolution

Assumptions vs. Knowledge

This is a tool we use to check our instinctive biases—a scale we call AvK, short for Assumptions vs. Knowledge. It can be used any time an assertion is made to determine whether it's based on fact or feeling. On one end of the spectrum are Assumptions (1), pure hunches that are not supported by any substantial data, and on the other is Knowledge (4), declarations made with ample evidence from multiple sources to back them up. With two intermediate steps—limited evidence or insight but still significant uncertainty (2), and meaningful corroborating data or models but still some doubt (3)—the scale is a great way to keep sentimental bias from clouding our strategy.



1. Pure Gut

- No evidence affirming or negating
- Hopeful thinking
- Intuition

2. Familiarity

- Some evidence
- Some insights
- Lots of remaining questions

3. Evidence

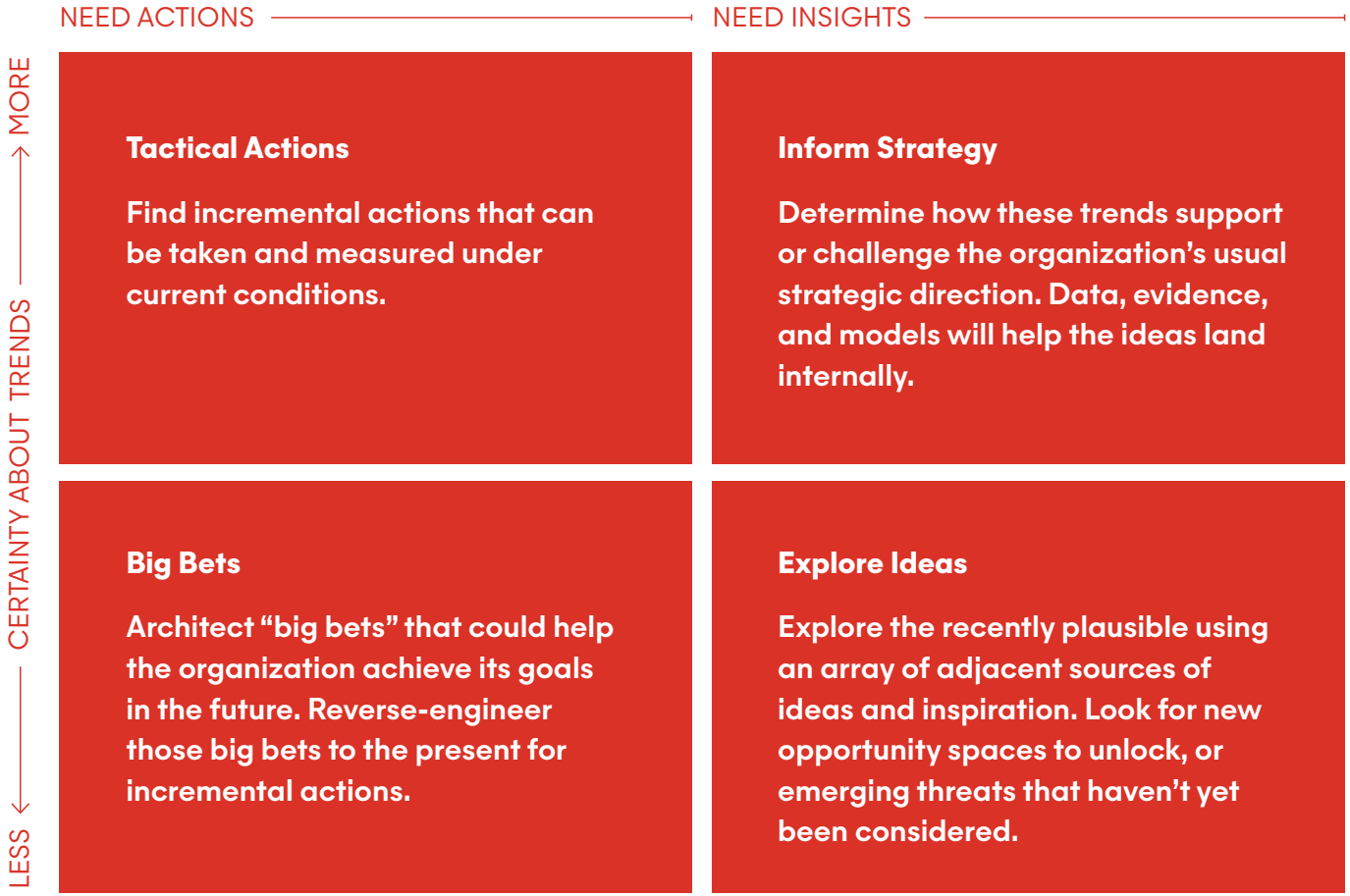
- Mounting evidence
- Models are built
- A few remaining questions

4. Knowledge

- Extensive evidence
- Established models
- Questions answered

Scoping and Refining

We ask clients whether they need actions or insights. We also assess their tolerance for risk and uncertainty. This strategic assessment is used to scope our work with clients at the beginning of projects and to refine the questions organizations are seeking to answer.



Foresight

What is Strategic Foresight?

Strategic foresight reduces uncertainty about the future. It's about preparation, not predictions.

Foresight is a strategic activity that uses quantitative and qualitative data, frameworks and tools to build plausible visions of the future so that management can make informed decisions today.

Accounting data, competitor intelligence, market share, the success or failure of past initiatives, campaigns or products, and consumer research covering near-term supply needs can be accurate in the present, however they are often unreliable predictors of the future. Likewise, presumptions that the future will merely be a continuation of the present does not accommodate the chaos, uncertainty and disequilibrium that develop during periods of rapid change.

Foresight

Foresight Creates Value

33% Higher Profitability

Companies with a dedicated strategic foresight methodology and resources outperformed the average by a 33% higher profitability.

200% Growth

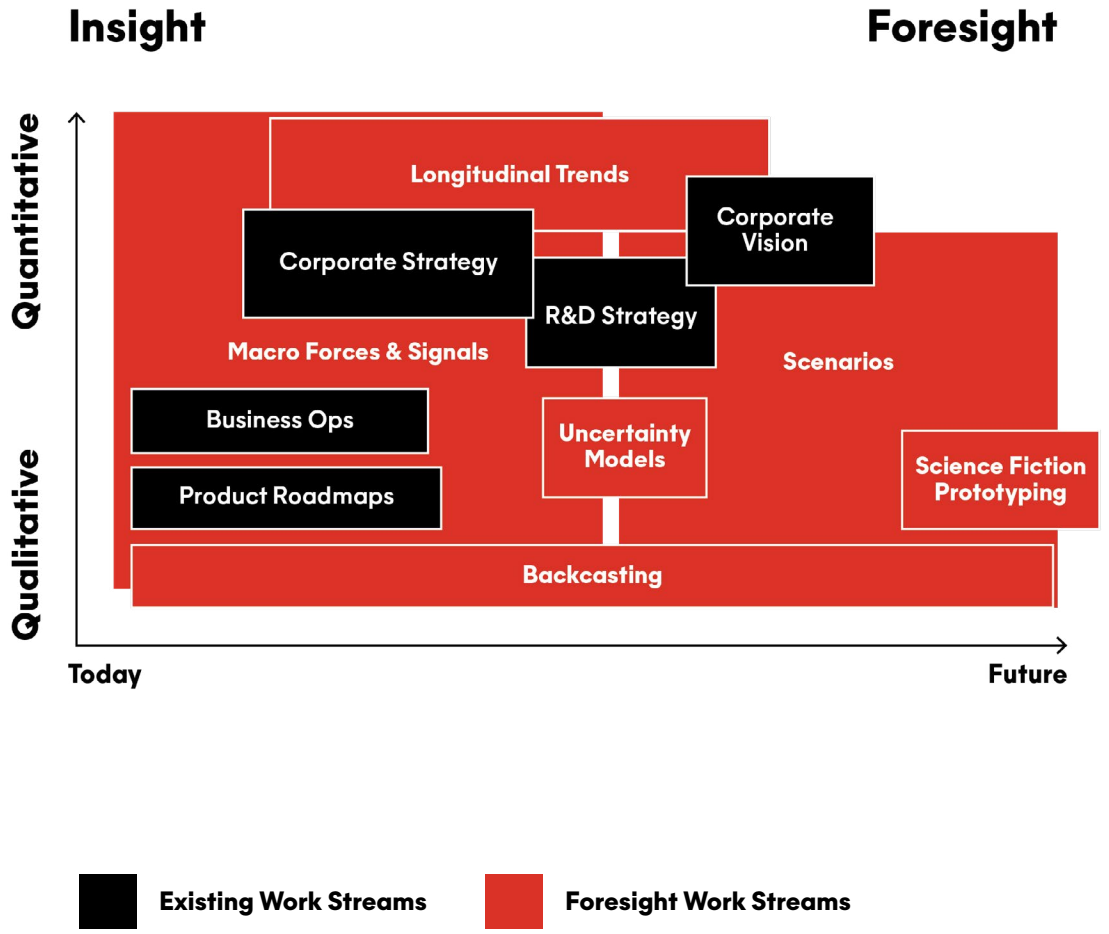
Companies with a dedicated strategic foresight methodology and resources outgrew their competitors 200%.

25% Improvement

Companies say that strategic foresight improves business objectives and planning, helps define new markets, and builds flexible mindsets among executives, even in times of deep uncertainty

Foresight

Foresight Compliments Existing Work Streams



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Amy Webb pioneered FTI's data-driven foresight methodology that is used within hundreds of organizations globally. Her focus is to transform organizations as they prepare for complex futures. She advises CEOs of the world's most-admired companies, three-star admirals and generals, and the senior leadership of central banks and intergovernmental organizations. She leads FTI's technology research initiatives on AI, synthetic biology and genetic engineering, next-generation networks, and quantum technologies. Webb is a professor of strategic foresight at the New York University Stern School of Business, where she developed and teaches the MBA course on strategic foresight. She is a Visiting Fellow at Oxford University's Säid School of Business, was elected a life member to the Council on Foreign Relations and is a member of the Bretton Woods Committee. She is a member of the World Economic Forum where she serves on the Global Future Council on Media, Entertainment and Culture and the Stewardship Board of the Forum's Platform for Shaping the Future of Media, Entertainment and Culture. Webb is the bestselling author of several books about strategic foresight and emerging technologies. A lifelong science fiction fan, she collaborates closely with writers and producers on films, TV shows and commercials about science, technology and the future.

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Why FTI

We answer your most challenging questions using data, creative inquiry, and strategic foresight.

- What are plausible deep (20+ years), long-range (10+ years), and near-term (2+ years) futures?
- What scenarios describe our futures?
- What's happening outside my industry that I should know?
- What companies, startups, and partners make up our future value network?
- What new products, services, or businesses should we build?
- Which tech trends should we monitor? When should we act?
- How can we build an early warning system to see the next disruptive event?
- How do we reduce uncertainty about our futures?

We support executive leaders and their teams.

The Future Today Institute works closely with executive leadership and management teams to transform their strategic thinking on the future. Advisory services include signal mapping, trend identification, scenario development, risk modeling, visioning, and strategic planning.

About the Future Today Institute

Founded in 2006, the Future Today Institute researches, models, and prototypes future risk and opportunity. As the leading strategic foresight and futures management consultants to executive leadership teams worldwide, FTI's data-driven applied research reveals trends and calculates how they will disrupt business, government, and society.

Together with our clients and partners, FTI is helping leaders achieve their preferred futures. Our pioneering, data-driven forecasting methodology and tools empower leaders to make better decisions about the future, today.

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Appendix

Value of Foresight: Sources

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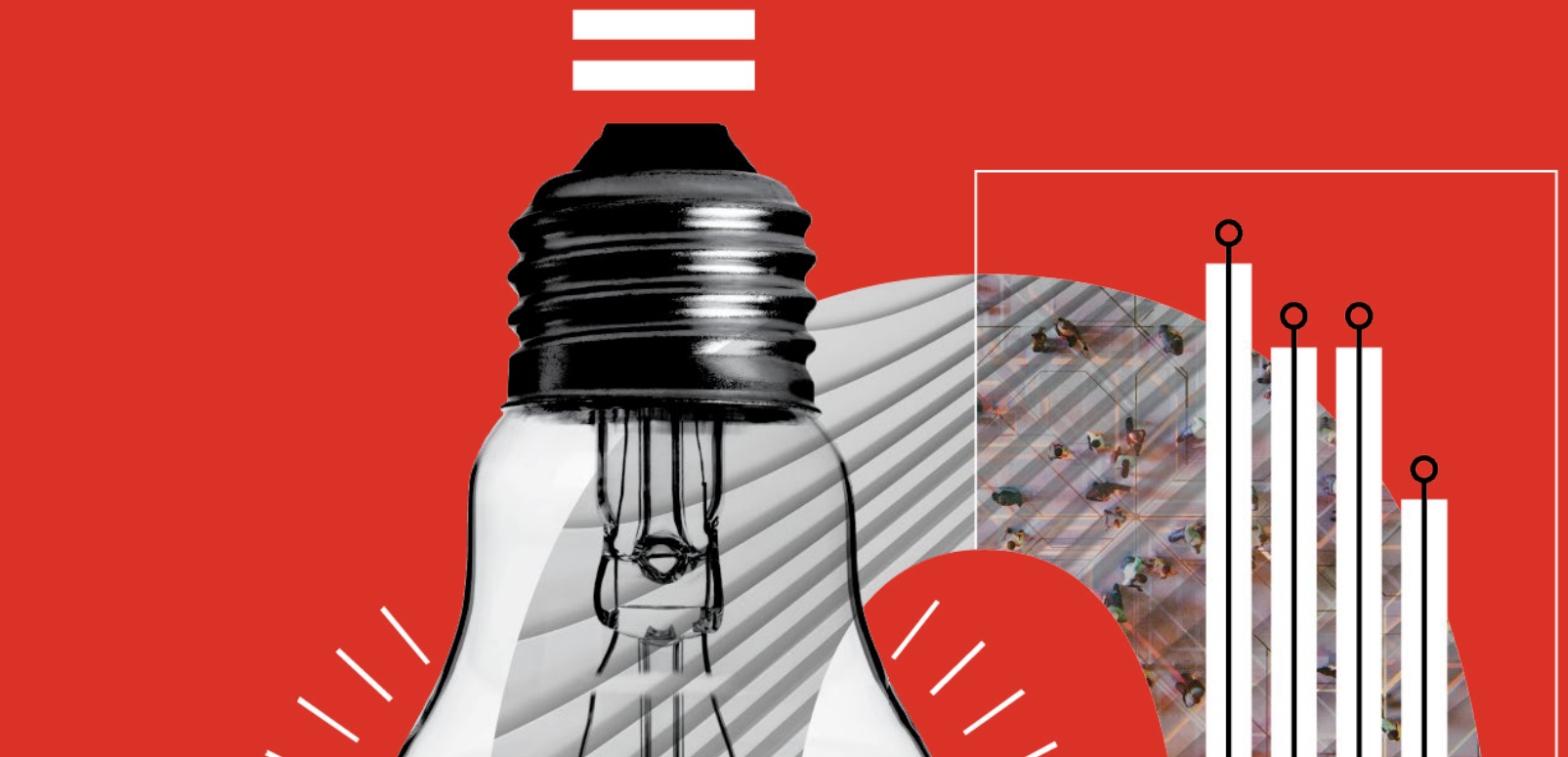

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