



17TH EDITION • 2024 TECH TRENDS REPORT

EXECUTIVE SUMMARY



THE YEAR AHEAD: TECH SUPERCYCLE

The theme for our 2024 report is Supercycle. In economics, a “supercycle” refers to an extended period of booming demand, elevating the prices of commodities and assets to unprecedented heights. It stretches across years, even decades, and is driven by substantial and sustained structural changes in the economy.

We believe we have entered a technology supercycle. This wave of innovation is so potent and pervasive that it promises to reshape the very fabric of our existence, from the intricacies of global supply chains to the minutiae of daily habits, from the corridors of power in global politics to the unspoken norms that govern our social interactions.

Driving this seismic shift are the titans of technology and three of their inventions: artificial intelligence, biotechnology, and a burgeoning ecosystem of interconnected wearable devices for people, pets, and objects. As they converge, these three macro tech segments will redefine our relationship with everything, from our pharmacists to our animals, from banks to our own bodies. Future Today

Institute's analysis shows that every technology—AR/ VR/ XR, autonomous vehicles, low Earth orbit satellites, to name a few—connects to the supercycle in some way.

The ramifications are stark and undeniable. As this tech supercycle unfurls, there will be victors and vanquished, those who seize the reins of this epochal change, and those who are swallowed whole. For business leaders, investors, and policymakers, understanding this tech supercycle is paramount.

In this 17th edition of FTI's annual Tech Trends report, we've connected the supercycle to the nearly 700 trends we've developed. Our research is presented across 16 technology and industry-specific reports that reveal the current state of play and lists of influencers to watch, along with detailed examples and recommendations designed to help executives and their teams develop their strategic positioning. The trends span evolutionary advancements in well-established technologies to groundbreaking developments at the forefront of technological and scientific exploration. You'll see emerging epicenters of innovation and risk, along with a preview into their transformative effects across various industries.

We've visually represented the tech supercycle on the report's cover, which is an undulating image reminiscent of a storm radar. Vertical and horizontal lines mark the edges of each section's cover. When all 16 section covers converge, the trends reveal a compounding effect as reverberating aftershocks influence every other area of technology and science, as well as all industries.

It's the convergence that matters. In isolation, trends offer limited foresight into the future. Instead, the interplay of these trends is what reveals long-term change. For that reason, organizations must not only remain vigilant in monitoring these evolving trends but also in cultivating strategic foresight—the ability to anticipate future changes and plan for various scenarios.

Our world is changing at an unprecedented rate, and this supercycle has only just begun.

A handwritten signature in black ink that reads "Amy Webb".

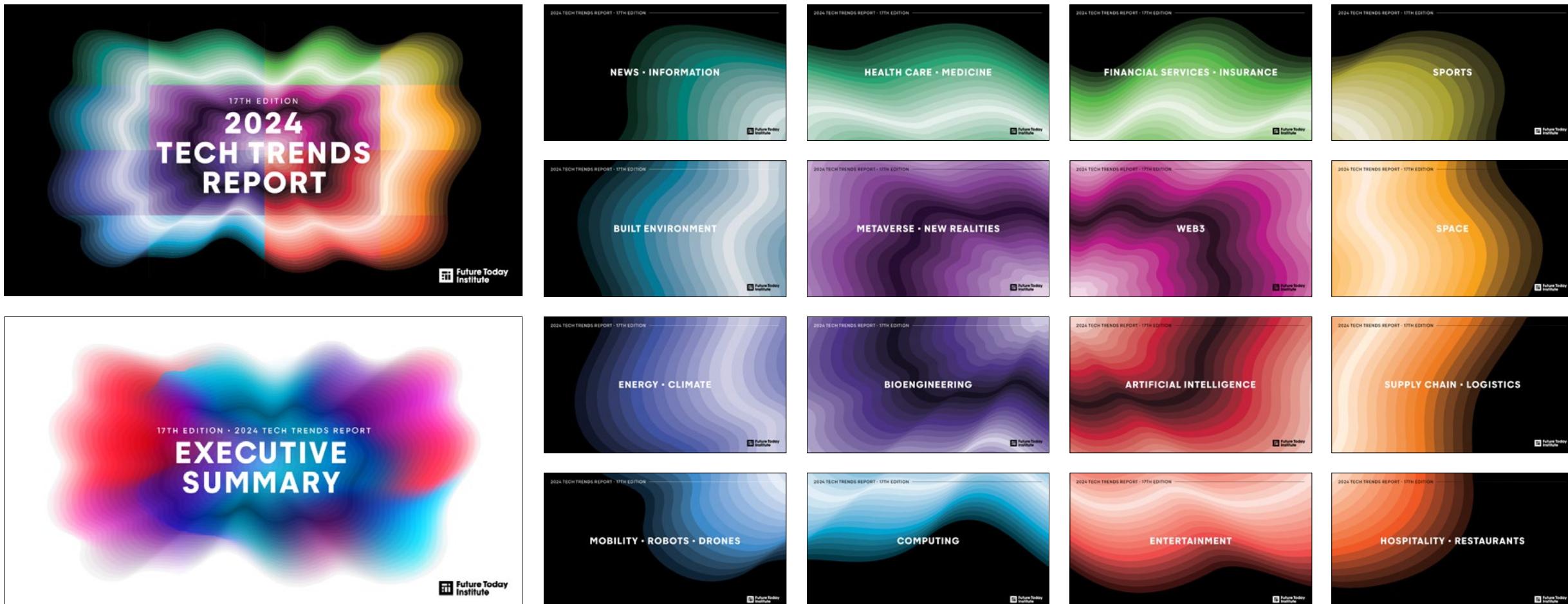
Amy Webb

Chief Executive Officer
Future Today Institute

FUTURE TODAY INSTITUTE'S 2024 TECH TRENDS REPORT

Our 2024 edition includes nearly 700 trends, which are published individually in 16 volumes and as one comprehensive report with all trends included.

Download all sections of Future Today Institute's 2024 Tech Trends report at <http://www.futuretodayinstitute.com/trends>.



IMPACT OF TRENDS ON YOUR INDUSTRY

Near-Term Relevance Long-Term Relevance

	AI	Generative AI	Bioengineering	Generative Bio	Computing Architecture	AR/ VR/ XR & Synthetic Media	Metaverse	Web3 Infrastructure	Mobility	Robots and Drones	Climate and Green Tech	Quantum
Agriculture	Light Blue	Light Blue	Light Blue	Light Blue	Dark Purple	Light Blue	Dark Purple	Dark Purple	Light Blue	Light Blue	Light Blue	Dark Red
Automotive	Light Blue	Light Blue	Dark Purple	Red	Purple	Light Blue	Dark Purple	Dark Purple	Light Blue	Light Blue	Light Blue	Dark Red
Aviation and Travel	Light Blue	Light Blue	Dark Purple	Red	Dark Purple	Light Blue	Dark Purple	Light Blue	Light Blue	Light Blue	Light Blue	Dark Red
Construction, Engineering	Light Blue	Light Blue	Light Blue	Dark Purple	Purple	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Red
Consumer Packaged Goods	Light Blue	Light Blue	Light Blue	Dark Purple	Red	Purple	Dark Purple	Dark Purple	Purple	Purple	Light Blue	Dark Red
Education	Light Blue	Light Blue	Dark Purple	Purple	Purple	Light Blue	Purple	Dark Purple	Purple	Purple	Purple	Purple
Financial Services	Light Blue	Light Blue	Purple	Red	Dark Purple	Light Blue	Purple	Light Blue	Purple	Dark Purple	Light Blue	Light Blue
Government and Policy	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
Health Care Systems and Services	Light Blue	Light Blue	Light Blue	Light Blue	Dark Purple	Light Blue	Purple	Purple	Light Blue	Light Blue	Light Blue	Dark Purple
Hospitality	Light Blue	Light Blue	Dark Purple	Dark Purple	Red	Light Blue	Purple	Dark Purple	Purple	Purple	Light Blue	Dark Red
Media (Entertainment)	Light Blue	Light Blue	Red	Red	Purple	Light Blue	Light Blue	Light Blue	Purple	Purple	Light Blue	Dark Red
Media (News)	Light Blue	Light Blue	Red	Red	Dark Purple	Light Blue	Light Blue	Light Blue	Purple	Dark Purple	Purple	Dark Red
Pharmaceutical and Medical Products	Light Blue	Light Blue	Light Blue	Light Blue	Purple	Light Blue	Dark Purple	Dark Purple	Light Blue	Light Blue	Light Blue	Dark Purple
Public and Social Sectors	Light Blue	Light Blue	Purple	Purple	Dark Purple	Light Blue	Light Blue	Light Blue	Light Blue	Purple	Light Blue	Dark Purple
Real Estate	Light Blue	Light Blue	Dark Purple	Red	Red	Light Blue	Light Blue	Dark Purple	Light Blue	Light Blue	Light Blue	Dark Red
Restaurants	Light Blue	Light Blue	Light Blue	Dark Purple	Dark Purple	Red	Purple	Purple	Dark Purple	Purple	Light Blue	Dark Red
Retail	Light Blue	Light Blue	Purple	Dark Purple	Red	Light Blue	Purple	Purple	Light Blue	Light Blue	Light Blue	Dark Red
Space and Aerospace Defense	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Purple	Purple	Purple	Light Blue	Light Blue	Purple
Supply Chain and Logistics	Light Blue	Light Blue	Purple	Purple	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Purple
Telecommunications	Light Blue	Light Blue	Purple	Purple	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue



2024 TRENDS

Trends are what we can know about today and are based on data and evidence. This year's trend report covers hundreds of technology trends across various industries and categories.



TRENDS

ARTIFICIAL INTELLIGENCE

While the hype continues, now is the time to prepare.

AI is a transformative, general-purpose technology with the potential to influence entire economies and alter society. From multi-modal AI to self-improving agents and wearables with on-board assistants, the ecosystem is rapidly changing. While AI advancements promise to reshape our world, emerging trends highlight unprecedented risks, underscoring the need for preparedness, governance, and alignment.

WEB3

Quiet developments and new regulations grow Web3.

While the industry reeled from failures and bankruptcies over the last year, developers have continued to develop new capabilities and features, moving ever closer to real-life practical applications for Web3. As regulations are on the horizon to be implemented in 2024, this could be a year of inflection, bringing Web3 from the experimental and theoretical to cold hard business cases.

METAVERSE & NEW REALITIES

Developments indicate a possible inflection point.

Apple's new headset leverages AI to overlay digital onto reality, representing a pivot from fantasy metaverses to real-life applications that may signal maturity. Meanwhile, complementary features to enhance virtual experiences are being developed. Though device costs are an ongoing barrier, integrating AI and XR creates fundamental synergies, potentially marking the watershed moment the industry has been waiting for.

BIOENGINEERING

Brace for impact in this breakthrough year.

Recent breakthroughs have accelerated the convergence of biology, information systems, and advanced platforms, and attention has been focused on generative AI. Very soon, that focus will shift to generative biology, where AI models will lead to the creation of novel molecules, drugs, materials, and living organisms. While biotech promises to reshape our world, it also requires preparedness and governance.

ENERGY & CLIMATE

Emerging and tested tech comes together for progress.

As the effects of climate change become more dire, governments are considering a more exotic set of technologies to combat the situation. Solar geoengineering, ocean chemistry manipulation, and domed cities are all concepts that gained significant traction in 2023. Meanwhile, significant gains have been made in enabling infrastructure for renewable energy, focusing on smart grids, energy storage, and carbon tracking.

MOBILITY, ROBOTS & DRONES

Challenges remain for electrification and autonomy.

Consumers are adapting to electric and semi-autonomous vehicles and those that collect increasing data. At the same time, battery technology is increasing, enabling vehicles, robots, and drones to perform longer. The rise of these machines suggests a future where they supplement and replace human tasks, highlighting a shift towards a more efficient, increasingly monitored work environment.

TRENDS

COMPUTING

AI is transforming human-computer interaction.

AI is changing what is possible in form factors, challenging underlying computing architecture. Researchers are pursuing energy-efficient architectures by reverse engineering the complex biological efficiencies of the human brain. As AI facilitates more intuitive communication, the technology could blend more seamlessly into human experiences, with computing centered directly around people rather than devices.

BUILT ENVIRONMENT

Automation and data collection transform practices.

In an industry used to following traditional practices, the past years have upended decade-old norms. Such shifts can provide critical solutions to new questions and signify a turning point that redefines industry standards and operational efficiency. This pivotal moment underscores the need for strategic adaptation, heralding a reinvention phase in response to evolving demands and technological advancements.

NEWS & INFORMATION

The news ecosystem hits an inflection point.

Emerging technologies like generative AI are shaping the future of content creation, distribution, and monetization. New applications of AI are reshaping the media value chain and forging new consumer behaviors for information search and discovery. In the year ahead, the initial frenzy of ChatGPT prompt hacking and product launches based on large language models will fade, but the information ecosystem will never be the same.

HEALTH CARE & MEDICINE

The barrier between digital and biological is vanishing.

The merging of digital and biological worlds enables a whole new range of treatments, the most exciting being cells within our bodies that can produce medication in response to external stimuli. Conversely, cyberbiommalware creates new, existential threats to our health that we are unaware we need to protect ourselves against. Both developments have the potential to upend the pharmaceutical and healthcare industry completely.

FINANCIAL SERVICES & INSURANCE

Modernization is slow, but consumers are ready to run.

The financial services sector, dominated by legacy giants, is facing a critical juncture where embracing technology like open banking, digital identity, and blockchain is not just advantageous but imperative. This industry must shift from reactive to proactive, underscoring the importance of anticipation and preparedness in navigating the future of the financial and insurance industries.

SPORTS

Analytics and customization are transforming sports.

Technology is enhancing the capabilities of managers, coaches, athletes, and fans. Teams and leagues are seeing progress in scouting, training, performance analytics, and rehabilitation thanks to tools like mixed reality, computer vision, and AI. Smarter stadiums offer unique, immersive experiences, driving engagement and revenue streams that support further improvements in a game's quality and spectator experiences.

TRENDS

SPACE

Space exploration is entering a new era.

Defined by old geopolitical rifts and new spacefaring nations, this emerging era goes beyond past dynamics to involve a broader constellation of smaller nations and private enterprises, all enabled by the decreasing cost of space access. With lowered launch costs, zero gravity could unlock scientific discoveries previously impossible. The dream of a multi-planetary humanity stirs deep questions about our priorities.

HOSPITALITY & RESTAURANTS

Tech-driven efficiency can't replace personalization.

Contactless payments, immersive pre-experiences, augmentations that recognize a guest's personalized needs upon entering the premise, and automated back-of-house functions offer opportunities for owners and operators to capitalize on that can provide elevated experiences and a reduction in overhead costs—but human workers might hold these positions, driving an ongoing tension between efficiency and a personal touch.

SUPPLY CHAIN & LOGISTICS

Real-time data and instant everything shape new terrain.

Regional instability, materials disruptions, manufacturing relocation, and labor tensions create hardship for businesses and manufacturers trying to bring their goods to consumers, who are also becoming more demanding. As businesses strive to meet these demands, they will be compelled to rethink their strategies, technologies, and workflows, marking a pivotal moment in the report on industry trends.

ENTERTAINMENT

AI's impact on live entertainment is just beginning.

Taylor Swift's concert film demonstrated that secondary live experiences resonate deeply. Add to that haptics, holographic transmission in real-time, and climate considerations that have consumers looking for local options, and a whole new world of performance experiences opens up. These developments create completely new ways to engage with content and opportunities for new business models.



LIKELY NEAR TERM DEVELOPMENTS • ARTIFICIAL INTELLIGENCE

GENERAL	ENTERPRISE	AUTOMATION	REGULATION AND GEOPOLITICS
<p>Commoditization of General Purpose Models</p> <p>In the near future, expect the commoditization of general purpose models. LLMs are becoming widely accessible and integral to app development. As these models become ubiquitous and cost-effective, akin to cloud services, their adoption will standardize across industries, diminishing their role as a competitive differentiator.</p>	<p>Talent Shift in AI Industry</p> <p>Expect a significant talent crunch as top innovators depart major tech giants like Google, OpenAI, and Meta to launch their own ventures, ranging from conversational agents to AI-first biotech firms, signaling a broad diversification and specialization within the AI sector.</p>	<p>AI Assistants Transform Coding Landscape</p> <p>AI coding assistants, such as GitHub's Copilot and Meta's Code Llama, are transforming software development with advanced autocomplete functions and innovative debugging tools, offering both premium and free solutions to enhance coding efficiency and creativity. Expect to see more improvements to these tools and more tools to launch in this space.</p>	<p>US Strategy on AI and China Relations</p> <p>The US is expected to intensify efforts to get allies to limit their collaborations with China in AI development, following President Biden's enhanced export restrictions on semiconductors. With the Netherlands aligning with US requests, further demands on allies to adopt similar stances aim to curb China's AI advancements.</p>
<p>Large Reasoning Model</p> <p>Vertically integrated solutions will garner a higher transactional value. Some companies will win by providing "a refined/value-added LLM product" to the end consumer and meeting the customer in desired distribution channels, such as LLMs for health care, legal, finance, and architecture.</p>	<p>Consolidation in 2024</p> <p>Consolidation will persist this year, building on moves like Microsoft's 2023 increased investment in OpenAI for Bing, aimed at capturing market share from Google search. Similar strategies by major tech companies are anticipated throughout 2024.</p>	<p>AI Integration in Health Care and Life Sciences</p> <p>Generative AI will lead to breakthroughs in proteins, antibodies, and drugs. Specialized models will continue to accelerate discovery in biology and chemistry, sparking more practical applications and boosting investment.</p>	<p>Europe Begins Regulating AI</p> <p>The European Commission will open its European AI Office, which will oversee the development and use of safe artificial intelligence (within Europe, at least) and assist with the implementation of the AI Act. The office will enforce general purpose AI rules, monitor compliance, and attempt to become a hub for international cooperation on AI governance.</p>
<p>Adoption of Natural Language Interfaces</p> <p>The evolution toward natural language interfaces will soon diminish the reliance on traditional graphic user interfaces. This shift will enable more intuitive interactions with computers, using everyday language. This transition may also influence device form factors, potentially leading to an increase in wearables and the development of AI-specific devices and operating systems centered around LLMs.</p>	<p>Increased Enterprise Adoption of AI</p> <p>The current macroeconomic environment is driving leaders to view AI as essential for growth, anticipating increased enterprise adoption despite the potential for making some job categories obsolete.</p>		<p>Challenges in US Chip Manufacturing Expansion</p> <p>The US move to onshore chip fabrication will experience growing pains associated with higher labor costs compared to Taiwan. This shift may lead to increased expenses in constructing fabs and producing domestically made chips, surpassing initial estimates outlined in the CHIPS Act.</p>

LIKELY NEAR TERM DEVELOPMENTS • WEB3

BRIDGING THE WEB DIVIDE

Many of the technological limitations of blockchain have been resolved or reduced, but adoption is the next hurdle for blockchain technology and crypto markets. Many forces are driving and limiting adoption today, and the speed of adoption will depend on the intersection and final outcomes of these forces. Even in the depth of the bear market, the industry is seeing very promising signs of interest and adoption from traditional industry players. However, major roadblocks—like regulation—persist, and these factors are largely out of the hands of the crypto industry.



Enshrined Account Abstraction

Account abstraction is a proposed upgrade to Ethereum that, when implemented, will provide flexibility in account setup via smart contracts. This will give users easier routes to maintain self-custody of tokens, more akin to account management in Web2.



Verifying AI Output

AI models are sowing online discord. Deep-fakes and misinformation are major issues for political elections and online interaction. Zero-knowledge cryptography could enable verifiable online content and remove distrust behind content consumed online.



Globally Successful Web3 Game

The video game industry is years into the creation of top titles that have blockchain built into the core of the gameplay. The similarities of these games to titles gamers are familiar with, combined with new ways to play, should attract crypto natives and Web2 gamers.



US Regulators Forced to Decide

SEC investigation and regulation of crypto assets is causing pressure to mount. Major decisions around the SEC's regulatory scope, classification of securities, and legality of decentralized finance are coming to a head, which could shift the entire crypto market.



Tokenized Asset Network Adoption

Traditional global financial players are working on private blockchains to facilitate the transfer of tokenized financial assets, which are quicker to transfer and settle, and which help companies avoid the regulatory and security concerns of public networks.



Crypto Double Down in Africa

In sub-Saharan Africa, crypto is more than a “nice-to-have”; it’s a financial necessity. A mix of financial instability and demographics in this region have led to the quiet adoption of crypto payments, which will lead to a greater industry focus in the region.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



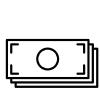
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • METAVERSE & NEW REALITIES

THE FOUNDATIONS OF THE METAVERSE

As virtual experiences become more embedded into daily life, we can expect growing pains. Regulators must balance guidelines that ensure integrity without restricting an nascent industry. Tapid advances precipitate more seamless, intuitive user experiences. Hands-free environments feel within reach as innovations like gesture control tech remove friction. Past the hype, enterprise use cases will gain traction, and efficiency gains will drive adoption beyond novelty appeal. Generative AI will further accelerate proliferation by enabling amateur creators to construct fully realized 3D worlds without coding skills. With increased adoption, interoperability will rise as a priority. Metaverse technology has perpetually searched for a wide audience—if it fails to reach the mainstream consumer, industrial use cases may take over. Medical, industrial, or civic metaverses may be the first to find product-market fit. Their focused nature could lend itself more readily to creating utility and value.

Completely Hands-Free Experience

As delivery routes and last-mile deliveries continue to increase in speed and complexity, automation will let logistics companies create an intricate web of delivery offerings that can be unique to each customer.

Extended Reality Gets Serious

With workers continuing to grow in scarcity, virtual agents will take over back-of-house work in the warehouse. These virtual agents will soon be able to oversee themselves and their cobot workers, reducing the need for human intervention.

Metaverse-Tailored Offerings

As climate change continues to be a disruption, logistics providers will explore how they can insure against extreme weather events. These costs could be passed along to consumers who choose goods from more volatile regions.

Regulators Target Virtual Trading

With manufacturing locations moving closer to the consumer and e-commerce increasing, manufacturers need to consider how to create products in the exact spot as their consumers.

Metaverse World Building for All

Increased automation and use of virtual agents raise the need for workers to know how to manage new tech-enabled work and tasks. This upskilling could be done through remote learning and working opportunities.

Consumer Push for Interoperability

Global conflicts, combined with consumers and businesses wary of supporting governments with values antithetical to their own will increase demand for verification of supply chains. Granular data collection and transmission will enable this shift in transparency.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • BIOENGINEERING

RAPID ACCELERATION

The rapid integration of artificial intelligence into bioengineering is catalyzing unprecedented innovation. The near future will see significant changes to traditional industries such as meat, dairy, textiles, and pharmaceuticals, while advancements should pave the way for sustainable solutions in carbon capture, plastics recycling, and biodiversity enhancement. Near-term breakthroughs in healthcare will lead to cataclysmic, long-term disruption. Leaders should deepen their understanding of bioengineering's vast potential and associated risks, enabling them to spearhead innovation in products and services, streamline processes, improve materials, and achieve cost efficiencies. This convergence also opens up new avenues for collaboration, allowing companies to explore untapped markets and forge strategic partnerships that can drive forward their competitive edge.



CRISPR's Emerging Economic Impact

The size of the global market for CRISPR technologies and their associated products is projected to exceed \$4 billion by mid-decade. In the US alone, CRISPR could contribute \$19 billion to GDP by 2032.



Life Extension Backlash

Life extension breakthroughs promise longer lives for some, yet they will strain social services, pensions, and other support systems for the elderly, challenging our preparedness for an aging population.



Supply Chain Disruption

In the next year, new materials poised to improve shipping's environmental footprint may disrupt traditional supply and cold chain operations dependent on outdated tech, posing significant threats to established companies.



GMO Misinformation

A new GMO backlash looms as public misinformation persists, with many unaware that the latest GMOs aim to boost produce and grains with enhanced nutrients, not just modify them for convenience or yield.



Regulatory Pressures

Federal Trade Commission actions spark fears of stifled innovation due to limits on scaling therapies via acquisitions, while the US Inflation Reduction Act ushers in a harsher pricing climate, impacting the biopharma industry's future reimbursement strategies for innovations.



Stark Health Divide

Biotech will revolutionize health care with novel drug therapies, yet their inaccessibility to developing economies risks creating a stark health divide, exacerbating global health inequalities.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • ENERGY & CLIMATE

CHANGE IS THE NEW NORMAL

Two opposing forces will make the corporate landscape highly volatile and unpredictable. On the one hand, active regulatory bodies, scaling of renewable energy production, and increased investment in innovation that aims to solve the remaining bottlenecks will require and empower corporations to integrate sustainability in ways not imaginable just a few years ago. On the other hand, economic headwinds in the form of heavy inflation and a looming recession might lead consumers to prioritize affordability over sustainability, and escalating geopolitical tensions could strain the supply chain, increase the price of raw materials, and hinder collaboration in research—slowing down innovation.

Price Beats Ethics

As inflation soars and the fear of a recession festers, consumers might put affordability above climate considerations, at least when it comes to their wallets. This will put additional strain on business owners, as they determine how to adjust for climate demands.

Shifts in Mobility

More and more people, at least in Europe, are committing to not use air travel. The resulting smaller spheres of mobility could lead to an increasing need for companies to have local hubs, especially as the terms of remote work are still being negotiated.

Rethinking Supply Chains

Governments are expanding their requirements for reliable and consistent reporting of direct and indirect emissions (scope 1, 2, and 3), putting pressure on corporations to curate their vendor networks and on the vendors to ensure their operations are still profitable under increased standards.

Accountability Changes

The resolution of a number of upcoming court cases will begin to determine government and corporate responsibility for climate change. If verdicts fall on the side of holding institutions responsible, we could see fundamental changes in how climate is addressed.

From Early Bird to Night Owl

Excessive heat impacts daily lives around the globe, forcing people to stay indoors during the day and only leave their houses in the evening. As these heat phases expand, industries dependent on people's physical presence will have to rethink operations as habits and timing of activities shift.

Climate Upskilling

With climate regulation expanding and evolving, and climate technology innovation accelerating (thanks to AI) and scaling, companies need to make sure they have the necessary know-how in-house to understand and monitor relevant developments.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



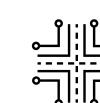
Public Health



Education



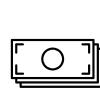
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • MOBILITY, ROBOTICS & DRONES

MORE CERTAINTY IN COMPLEX SYSTEMS

In the immediate future, a wave of transformative development is poised to reshape our world across various domains. From the continued integration of connectivity in automobiles—fueling advanced driver assistance systems and enriched in-car experiences—to the pressing challenges facing our electrical grids as we pivot toward an all-electric future and the changing regulatory landscapes impacting drones and autonomous systems, these developments underscore the dynamic nature of technological progress. They collectively signify an era of both challenge and opportunity, where adaptability and forward-thinking will be key to navigating the disruptive forces of technology.

Continued Connectedness

Automobiles are only becoming more connected. This will impact advanced driver assistance systems as well as infotainment within the cabin. Automobiles will be less isolating as drivers and passengers seamlessly expand how they connect to their lives outside the car.

Challenges to the Grid

As we idealistically transition to an all-electric future, many have speculated our electrical grids will not be able to handle this adjustment. Others are more optimistic. In time, we will have more certainty.

Supply Chain Disruptions Persist

Even as the supply of vehicles and chips for robotics stabilizes, manufacturers and sellers should still brace for continued supply chain disruptions. Additionally, chip nationalism and other geopolitical factors will also threaten supplies of goods.

New Modalities for Robotics

Researchers have developed many innovative modalities for robotics and drones, seeking inspiration from various sources. This innovation will continue, with unexpected inspiration from nature or animals, and some systems will incorporate several different modalities in their designs.

Viability of Drone Traffic Management

The escalating use of drones and eVTOLs has necessitated advanced traffic management solutions. As various regions have put measures in place, the viability of ubiquitous drone use will be determined in the short term.

Clarity on Robotaxis

Robotaxis have been the source of much controversy, as different companies have tested their systems with varying success. The near future will shed light on long-term feasibility, especially as regulations shift to account for recent events and developments.

11 MACRO SOURCES OF DISRUPTION



Technology



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Demographics



Environment



Government



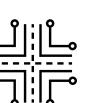
Public Health



Education



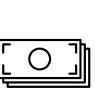
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • COMPUTING

AI, ARCHITECTURE & ALLEGIANCE

Geopolitical tensions are accelerating some key computing developments. Expect semiconductor talent shortages as nations adjust how they manage skills for self-reliance. Also expect the rush to prepare for “Q-Day” to become more urgent as countries race toward quantum advantage. We will see more companies boast quantum-resistant cryptography as a value proposition. And as countries become more wary of supply chain disruptions, more inputs will be brought in-house. As nations do this, RISC-V adoption may increase.

Technological developments in AI are also driving near term developments. To power AI, companies are rethinking computing architectures using inspiration from the human brain and existing gaming devices. AI will soon flip the script on human-computer interaction; rather than users learning to operate computers, AI allows computers to learn to interact on human terms. With AI, the computer will adapt to the person—not the other way around.



Research and Debates on OI

Expect a surge in organoid intelligence research. Organoids may be the key to AI's efficient boost, but the convergence of AI and OI may stir ethical debates.



Semiconductor Skills Shortage

Anticipate a talent crunch in the semiconductor sector as countries aim to internalize production. This skill gap will necessitate refocusing, driving universities and communities to prioritize these skills.



Chip Freedom

Expect a rise in RISC-V adopters as it transforms the chip industry. Offering freedom from costly licenses, RISC-V enables custom, application-driven hardware, making chip design more accessible, thereby lowering the entry barrier.



Surge in Q-Day Preppers

Businesses will prepare more seriously for “Q-Day”—when quantum computers can break internet encryption protocols. As China and the US both achieve breakthroughs toward quantum advantage, expect a surge in investments in this domain.



AI-Driven Form Factors

Expect an emergence of new form factors driven by AI, that diverge from the conventional laptop, keyboard, and mouse setup, as AI facilitates more intuitive communication methods. We might also see a surge in specialized devices designed for specific AI applications, like dedicated translation gadgets or AI-enhanced cameras.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



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Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • BUILT ENVIRONMENT

CLIENTS HAVE NEW REQUIREMENTS EXPECTATIONS

Integrated data and the output from models that use that data are becoming more of a requirement, allowing for greater manipulation and understanding in the preconstruction and documentation phases. Clients will continue to want proof that a project will perform financially, and to interact and engage with that data on a more routine basis. More regions and municipalities will also want plans that extend beyond the structure itself, including options for what to do with the materials once the life cycle of the project is complete, as well as plans for how to convert entire blocks or just rooftops into functional spaces. The upfront planning process will become even more important as technology will more clearly show what should be prioritized, such as a road to be fixed or a new sewer system to be installed.



Deconstruction Plans Become Required

Many areas already have deconstruction requirements, aiming to reduce waste heading to a landfill. These types of requirements will likely only continue to increase, which will change permit and construction planning.



Cities Organize Themselves

Urban planning and development requires long-term strategy and planning, which can be complicated by sudden societal shifts and needs. AI and digital twins will be able to help accommodate for these shifts, increasing the chances of automated planning directing where developments should take place next.



Immersive Design Leads to Spatial Relevancy

As the world becomes more immersed in technology, screens and devices are continuing to shrink. This means that spaces will need to accommodate for more immersive experiences in their design.



Built Environment Develops Data Markets

With a vast pool of human-centric data, the built environment is sitting on untapped revenue streams of information that could benefit many business sectors. Past client contracts may prevent this from occurring, but newly developed contracts would allow firms to sell this data.



Jurisdictions and Developers Require Second-Life Designs

Just as deconstruction will likely be regulated, so will adaptive reuse projects that address housing shortages. New mixed-use zoning or urban zoning developments will likely enable this change.



Smart Green Infrastructure Combats Eco-Anxiety

The urgency of climate change could lead to an increase in eco-friendly infrastructure that allows for power sharing and carbon-free transportation. These updates could bring resilience to areas where people worry about being displaced due to climate change.

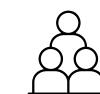
11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • NEWS & INFORMATION

THE PACE OF CHANGE ACCELERATES

Journalists are accustomed to the breakneck pace of change: Adjusting to rapid developments has been the watchword of media organizations for more than a decade. The year ahead will test whether news leaders have learned to search for disruption or whether they've gotten complacent. Barriers to creating compelling content will fall. The operating assumptions that let many digital publishers thrive on reach will crumble. There will be a race to derive value from existing content, either by licensing it to tech companies or building publisher-owned LLMs. New categories of devices will demand new publishing formats. Successful news organizations will triage these competing threats to find opportunity; too many publishers will do nothing and find their relevance diminished.



Evolution in copyright law

Generative AI tools have outstripped settled law. Expect to see litigation challenging whether crawling content to train a large language model constitutes fair use. The impacts of that legal wrangling could be compounded by new laws or regulations.



Subscription fatigue

The conversion to a subscription economy is happening in news but also in retail, gaming, automobiles, and more. All those programs are competing for a finite share of consumer spending, so publishers need to ensure they are essential to remain competitive.



New modes of search and discovery

Generations Z and Alpha have different consumption patterns than older generations. These differences are especially stark when looking at how younger users find news. Publishers need to tailor their strategies to reach those potential consumers.



Fragmented information access

Not everyone can afford a news subscription. As paywalls at premier publishers get tighter, essential reporting may not reach the communities that need to see it. This is of particular concern for the 2024 US presidential election.



Easier content creation

Expect to see a new suite of productivity tools aimed at transforming the creative process. Those tools will have a cultural—and economic—impact as they lower the barriers to publishing text, photos, and videos. Legacy creators will struggle to adapt.

11 MACRO SOURCES OF DISRUPTION



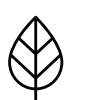
Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



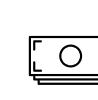
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • HEALTH CARE & MEDICINE

CHALLENGES FROM ALL SIDES

The health care system is battling with increased needs for services, a rise in costs, disruption of supply chains because of geopolitical tensions, and an uptick in diseases based on worsening climate conditions. Technology is coming to the rescue but can only accomplish so much: A fractured data landscape, lack of infrastructure, and a lack of data ownership and sharing regulation make timely solutions unrealistic. On the other hand, increasingly sophisticated patients, thanks to powerful sensors on smart devices, are actively taking charge of their own health. As higher expectations for quality care rise by such patients, medical professionals need to deliver an all-encompassing, holistic approach to their services.



Rising Consumer Expectations

Consumers have increased access to information about their health, which will affect their expectations of routine examinations. Professional insights must exceed and incorporate the information available to the consumer directly, or services will be viewed as superfluous.



Fighting Misinformation

Social platforms have rolled back their COVID-19 content moderation policies and reduced staff in monitoring departments in recent rounds of layoffs. The increased amounts of AI-generated content will continue to challenge sharing accurate health communication.



New Stakeholder Ecosystems

When health care moves to the sphere of the consumer, through smart devices or medical services administered in the home, new service needs that mimic those typically provided in a hospital arise. These can be digital (data analysis) or physical (food delivery, care, etc.).



Novel Health Threats

As the effects of climate change worsen, disease patterns will change globally: Respiratory illnesses will increase in areas exposed to smoke from wildfires, or vector-borne diseases will emerge in regions with rising temperatures.



Decreased Access, Quality in Care

Health care systems are struggling to provide sufficient care, especially in rural regions. Telemedicine offers potential support, but these areas often lack the required digital infrastructure and medical personnel allowed to reach them.



Fight for Patient Data

Sensors from consumer-facing smart devices are becoming more precise and increasing the type of biological information they can collect. Health care providers need to ensure that they can access that data to provide adequate services to their patients.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



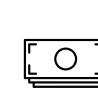
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • FINANCIAL SERVICES & INSURANCE

ACTION IS THE VERB FOR 2024

Financial institutions and insurance providers have spent years experimenting, pondering, and investigating new and influential technologies. To a great extent, the volatile market of the last several years created the optimal environment for thinking rather than doing. But 2024 will be different: New AI standards, scaled CBDCs, and forthcoming stablecoin regulations mark this year as a year of action. If financial institutions and insurance providers leverage this opportunity to make real progress on their technological investment, 2024 could be an inflection point for the industry.



Inflation (Should) Remain Steady

Current views suggest inflation will remain steady this year after cooling in late 2023. While Fed rate cuts will help maintain stability, rising housing and rental costs at the beginning of 2024 have put upward pressure on inflation, making it a space to watch.



AI Standards Development

Top tech firms are participating in a joint effort led by the US Department of Commerce to create standards around the safe use of AI. While not purely FI-focused, the outcomes will likely inform how banks and insurance companies use the tech.



US Election Outcomes

In addition to the presidential election, several senate seats are up for grabs in 2024 that could determine key outcomes in banking regulation over the next several years, particularly in Ohio, Montana, and California.



CBDC Launches

Several countries, including India, Brazil, and Singapore, have planned to launch CBDCs in 2024. While the scale and maturity of the efforts vary, 2024 should serve as a proving ground for whether CBDCs work in the wild.



US Stablecoin Regulation

The Clarity for Payment Stablecoins Act of 2023 was passed by the House Financial Services Committee in 2023 in July, leaving many hopeful that the official legislation will pass sometime in 2024. The bill would regulate stablecoins like other financial institutions.



Technology Investment

A recent survey showed that 92% of banks plan to increase technology spending in 2024. This investment will likely focus on data and AI, leading to strategic hires in specific areas of expertise. Hopefully, these investments will be practical and not experimental.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



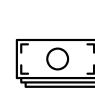
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • SPORTS

SPORTS: COMPLEX AND DYNAMIC

The sports industry is poised for a major transformation in 2024, with a host of exciting challenges and innovations on the horizon that will have a profound impact on the way fans engage with sports, creating bespoke and immersive experiences like never before. However, alongside these technological advancements lie a range of business and political obstacles that must be overcome, putting the efficiency of decision-making mechanisms to the test.



More Immersive Experiences

Sports teams already use mobile devices to provide augmented experiences and activations for in-person events, and now this capability will occur in homes. Spatial computing allows for more 3D renderings of a game as if you were there.



Broadcasting Rights Lead to Turmoil

As live sports broadcasting contracts become more expensive, streaming platforms and tech companies will make more competitive bids to expand their user base. However, overpaying for negotiating rights could lead to long-term financial impacts, putting streaming platforms in significant financial trouble.



Olympics Serve as a Protest Platform

The Olympics have always served as a geopolitical platform, but the 2024 Games could be exploited in unprecedented ways. Considering the Israel-Hamas war and Jewish populations in France, along with Ukrainian's aversion for Russia, the Olympics will likely serve as a venue of protest unlike what we've witnessed in the past.



Increased Web3 Adoption

This year will reveal the true usefulness of Web3 technologies such as using blockchain for creating consolidated golden records, digital fan passports, and dynamic ticketing, and highlight how these novel approaches will impact the fan experience. As teams and leagues work out the issues and take advantage of Web3, more organizations are likely to adopt it.



Influence Expands from the Middle East

Golf has felt the impact of Saudi Arabia's sovereign wealth fund through the merger of the PGA Tour and LIV. Likewise, Qatar has leveraged its sovereign wealth fund to impact soccer clubs FC Barcelona and Paris Saint-Germain. These nations will expand their control with increased economic investment in sports including soccer, boxing, cricket, and even basketball.



Automated Game Management Expands

Technologies for managing games and matches, such as electronic line calling in tennis, automatic balls and strikes systems in baseball, and semiautomated offside technology for soccer, are creating fairness and minimizing human error. More leagues will be pressured to adopt similar technologies, especially as the stakes increase from sports betting.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



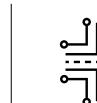
Public Health



Education



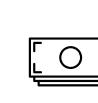
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • SPACE

UNLOCKING POTENTIAL IN SPACE

When it comes to space exploration, there are never any guarantees. Missions are often delayed, and the complex nature of space travel often results in the failed execution of even properly laid plans. A wave of transformative developments will make our space-based futures look brighter, however. Based on near term developments and milestones, we will have more certainty on the viability of certain technologies such as asteroid mining, in-situ resource utilization, and space-based manufacturing. We will achieve new breakthroughs, placing humans in new environments. Additionally, we will unlock new mysteries and potentially learn more about our origins.



Space Manufacturing Takes Off

With significant interest from government organizations such as NASA, combined with the engineering know-how of startups like Redwire and Varda, the industry will soon know the viability of manufacturing in space and the true benefits of working in microgravity.



Asteroid Mining Viability

Asteroid mining in and of itself will not be a near term development. However, we should know more about its viability as startups like AstroForge have reestablished their interest in the activity and have insightful missions planned.



ISRU on the Moon

As a demonstration of oxygen production on Mars by NASA's MOXIE has shown, in-situ resource utilization (ISRU) is crucial for space exploration. In due time, a demonstration of oxygen or water production will take place on the moon.



Humans on the Moon

NASA's Artemis program has its sights on sending humans back to the moon and plans to do so by 2025. This along with the recent flurry of lunar activity, including India's unmanned Chandrayaan-3 landing, expect humans to be there again soon.



New Discoveries by the JWST

Since its successful deployment in space, the James Webb Space Telescope has continued to uncover new revelations and inspiration. The JWST will continue to discover more about space, potentially giving us new clues about our origins.



Affordable re-entry

Expect a rise in companies focused on cost-effective return vehicles and methods to retrieve goods manufactured in space. If viable, this point-to-point space delivery and off-Earth industry promises immense expansion for commercial interests.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



Public Health



Education



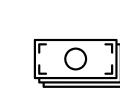
Geopolitics



Infrastructure



Economy



Wealth Distribution

LIKELY NEAR TERM DEVELOPMENTS • HOSPITALITY & RESTAURANTS

POTENTIAL DISRUPTIONS CONTINUE TO LOOM

While many customers need stability to know if they should move forward with taking a trip, stability is not assured, which is normal. However, new tensions are arising that could further disrupt the market and industry. Much of these disruptions are due to customers demanding more personalization, which creates more work for businesses. That's especially difficult when these new technologies are increasingly vital to remain competitive, but the labor force lacks the skills needed to implement them. These shifts to the market also offer opportunities to increase services and provide new touch points.

Labor Tensions

As technology adoption increases, service unions could begin to feel pressure to block developments they feel would replace their members. Examples include the outcome of the recent SAG-AFTRA strike.

Power Stability

With climate change continuing to disrupt energy infrastructure, hotels and restaurants will need to prioritize improvements to remain stable for customers. This will be a challenge as the construction industry is also dealing with a labor shortage.

AI Avatars

Brand representatives can curate their interactions based on a consumer's preferences and response to targeted media. Booking interactions will be more friendly as a result, and dining experiences feel more personal. These nuanced relationships will transcend short-term brand mascots.

Dark Dining

As space becomes a premium, store footprints will continue to shrink, creating fewer positions for human workers and more for robots. This can increase market presence, but will require greater upfront investments and market research.

Delivery Everywhere

Convenience will continue to win out. Delivery has returned to pre-pandemic levels, but now consumers expect to be able to get items not just at home but wherever they are at any given time. This will require new tracking methods and omnichannel delivery methods.

Technology Upskilling

Current hospitality education institutions may need to add courses on technology and how to use it within the industry. QSRs will face challenges if they depend on employees lacking technological skills, necessitating upskilling cycles to train them to use new in-store technology.

11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



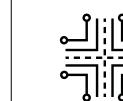
Public Health



Education



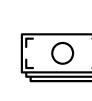
Geopolitics



Infrastructure



Economy



Wealth Distribution



LIKELY NEAR TERM DEVELOPMENTS • SUPPLY CHAIN & LOGISTICS

ON-DEMAND DRIVES INSTANTANEOUS PROCESSES

Change—whether from consumer demands, new technologies, or global shifts—is the one a constant in the supply chain and logistics industries. It's what leads to new offerings and services, such as the industries' need to respond to the increasing expectations for on-demand and instantaneous deliveries, communication, production, and reports. Innovations in tracking and tracing goods, automation, and expedited and near-shored manufacturing are happening, but attention is still needed to address the shortages in capital and talent. Proper investment to meet the gaps through technology will be expensive, and could create a burden many smaller companies cannot bear unless they create a clear strategic roadmap. With talent droughts occurring in all three they will have to keep competing for talent and seek out workers willing to be upskilled.



Personalized Delivery Gets Automated

As delivery routes and last-mile deliveries continue to increase in speed and complexity, automation will let logistics companies create an intricate web of delivery offerings that can be unique to each customer.



Climate Insurance for Protection

As climate change continues to be a disruption, logistics providers will explore how they can insure against extreme weather events. These costs could be passed along to consumers who choose goods from more volatile regions.



Combating a Skills Drought

Increased automation and use of virtual agents raise the need for workers to know how to manage new tech-enabled work and tasks. This upskilling could be done through remote learning and working opportunities.



Virtual Agents Take Over

With workers continuing to grow in scarcity, virtual agents will take over back-of-house work in the warehouse. These virtual agents will soon be able to oversee themselves and their cobot workers, reducing the need for human intervention.



Instant Manufacturing Meets Demands

With manufacturing locations moving closer to the consumer and e-commerce increasing, manufacturers need to consider how to create products in the exact spot as their consumers.



Verification Based on Values

Global conflicts, combined with consumers and businesses wary of supporting governments with values antithetical to their own will increase demand for verification of supply chains. Granular data collection and transmission will enable this shift in transparency.

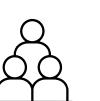
11 MACRO SOURCES OF DISRUPTION



Technology



Media &
Telecom



Demographics



Environment



Government



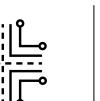
Public Health



Education



Geopolitics



Infrastructure



Economy



Wealth
Distribution

LIKELY NEAR TERM DEVELOPMENTS • ENTERTAINMENT

TIGHTENING THE BELT

After the golden age of content, all signs are now pointing toward efficiency measures. Fears of a recession, inflation, a widening wealth gap, and geopolitical instability have many people holding on to their financial resources. And that's especially true in the entertainment industry, as problems with the streaming business model, increased production costs based on the new union contracts, and fractured audiences create an environment of extreme frugality. Technology looks like a knight in shining armor, promising to increase production speeds and reduce costs without decreasing quality—if it is incorporated ethically and sustainably. After the unions' negotiated contractual guardrails, those goals may be easier to achieve.



Lower Production Budgets

As studios work toward making their streaming services profitable, new lean processes will walk the line between providing enough content variety to avoid subscription fall-off and actually making money.



Sustainability Practices

Gone are the days when entertainment companies just have to take their direct emissions into account. They'll also have to consider reducing fan and production travel emissions, recycling, and using sustainable materials when planning and executing content.



Overpresent Celebrities

Digital celebrities, both those with human counterparts and those without, allow anytime access for fans but run the risk of eradicating the defining feature of celebrity: scarcity.



Engaging Broader Demographics

The aging population in Europe, Asia, and to a lesser degree the US, requires strategizing about what topics will make people over age 60 tune in. On the other end of the spectrum, Gen Z requires special enticement to watch long instead of short-form content.



Live-ish Experiences

As people have less disposable income, they will seek alternative entertainment options. Local pubs broadcasting a game or smaller, local live venues might be more attractive experiences than stadium concerts.



Copyright Chaos

Microsoft launched its Copilot Copyright Commitment, assuming users' legal copyright risks when using the company's AI Copilot. However, as long as there is no clear regulation, the use of many AI tools will continue to carry substantial legal risk.

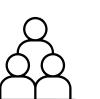
11 MACRO SOURCES OF DISRUPTION



Technology



Media & Telecom



Demographics



Environment



Government



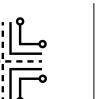
Public Health



Education



Geopolitics



Infrastructure



Economy



Wealth Distribution



2024 UNCERTAINTIES

Uncertainties represent what we cannot know—and identifying them can reduce the risk of blind spots down the road. In this year's report, we highlight five top uncertainties that will shape 2024.



UNCERTAINTIES

01

How quickly will AI revolutionize business, and in what ways?

02

What global challenges will bioengineering be able to address?

03

How will countries and businesses commit to decarbonization?

04

How will humans prioritize their work environments in the future, and what will these preferred workplaces look like?

05

In the context of increasing protectionism and geopolitical tensions, what is the future of the global chip manufacturing industry?



[JUMP TO UNCERTAINTY 1](#)



[JUMP TO UNCERTAINTY 2](#)



[JUMP TO UNCERTAINTY 3](#)



[JUMP TO UNCERTAINTY 4](#)



[JUMP TO UNCERTAINTY 5](#)

01

How quickly will AI revolutionize business, and in what ways?



UNCERTAINTIES

How quickly will AI revolutionize business,
and in what ways?



**Stratification Scales
by Function or Task**

GET THE DETAILS



Stratification by Industry

GET THE DETAILS



AI Scales Up for Consumers

GET THE DETAILS



**Efficiency Optimization
in the Back Office**



**Bolstered Productivity
and Performance**



**Cautious Scaling in
Complex Industries**



**Agile Scaling in Less-
Regulated Industries**



**AI Serves as a
Creative Playground**



**A Revolutionary
Consumer-Facing
Assistant**

UNCERTAINTIES

Stratification Scales by Function or Task

AI scales along two distinct trajectories: by function or by task. Functional scaling involves embedding AI into key business operations, like accounting or IT, to enhance productivity. Conversely, task-based scaling increases efficiency for routine activities like email, leading to workforce streamlining. Both offer unique advantages for leaders, who must choose between broad operational transformation or targeted task refinement.

SCENARIO 1

Efficiency Optimization in the Back Office

AI emerges as a linchpin, enhancing efficiency for back-office operations like calendaring and leading to a cascade of broader organizational and cultural shifts. But there are human capital implications: As AI takes root, the workforce gradually contracts.

With efficiency gains, companies reconsider budgets, diverting funds from labor to tech. This shift fosters a culture of innovation, as employees are reassigned to more strategic, creative, or complex tasks that AI can't easily replicate. But it also will require companies to reevaluate talent strategies, prioritize adaptability and technical proficiency, and expand HR departments to include upskilling programs and change management.

SCENARIO 2

Bolstered Productivity and Performance

Integrating AI into the business ecosystem results in meaningful workforce reduction, as the tech can tackle work that previously required multiple humans.

Management adapts to overseeing hybrid teams of humans and AI, fostering collaboration and redefining performance metrics. Money previously allocated for salaries and benefits is redirected toward technology investment, research, and development, potentially driving further innovation. Ultimately, AI leads to more informed decision-making, risk assessment, and predictive analytics, and businesses tailor their AI solutions to specific departmental needs to gain competitive advantages.



UNCERTAINTIES

Stratification by Industry

As AI matures, its scalability pivots around industry-specific applications. The speed with which AI scales across certain industries is a function of technological receptivity and reflects the regulatory landscapes that govern them. Business leaders must carefully measure tradeoffs between these two challenges, calibrating their AI integration strategies to align with industry characteristics and regulatory confines.

SCENARIO 1

Cautious Scaling in Complex Industries

Sectors like financial services and health care stand to gain improved productivity and efficiencies as AI leaders by processing vast data streams and achieving decision-making acumen beyond human speed. However, lagging regulatory updates temper this progress.

Slower to replace the nuanced judgment of human experts with AI systems, businesses take a more deliberate scaling strategy. They invest in AI R&D to create more sophisticated models built on equitable data training. Their cautious approach extends to data privacy and security, as they implement strong measures to safeguard sensitive information.

SCENARIO 2

Agile Scaling in Less-Regulated Industries

Industries less encumbered by compliance hurdles—such as consumer packaged goods and retail—are quick to capitalize on AI's potential. It becomes a dynamic catalyst for innovation, enabling rapid ideation and deployment of new products and services.

AI's ability to analyze vast amounts of data in real-time is leveraged to personalize customer experiences, from tailored product recommendations to enhanced service interactions. It also creates supply chain resilience by predicting demand, optimizing inventory, and identifying potential disruptions.



UNCERTAINTIES

AI Scales Up for Consumers

Two primary use cases of AI alter everyday life. The first is through creative and experimental applications that introduce a sense of play and innovation to regular activities. They are reshaping entertainment, social media, and online engagement by providing novel, personalized experiences. The second sees AI as a practical assistant, seamlessly integrating into daily routines to manage tasks, offer recommendations, and streamline decisions. This form of AI is becoming a dependable extension of personal efficiency. These manifestations of AI highlight its versatility and growing significance in shaping consumer behavior.

SCENARIO 1

AI Serves as a Creative Playground

For consumers, AI is more about novelty and entertainment than utility. Students integrate generative AI into their projects, pushing the boundaries of creativity and academic exploration. Social media enthusiasts use it to embellish their online personas and captivate their followers.

Consumers now expect more interactive and personalized digital experiences across all platforms, influencing a shift in how products and services are designed and marketed. At the same time, the digital divide is more pronounced as a broader segment of the population becomes adept at navigating and manipulating digital environments and tools.

SCENARIO 2

A Revolutionary Consumer-Facing Assistant

The AI assistant transcends its fledgling origins to become an essential element of daily life. It simplifies complex tasks and executes functions with a level of access and autonomy that mirrors human assistance. Consumers find tangible ease in their routines as AI assistants manage calendars, make informed purchases, and even anticipate needs before they arise.

The downside: The role of AI in decision-making processes raises ethical questions, especially if these systems begin to influence areas like personal relationships, employment opportunities, and even legal decisions.

OPPORTUNITIES & THREATS

THREATS

1 Workforce disruption

As AI takes on more responsibilities, companies must manage job losses and reskill employees to avoid negative backlash.

2 Regulatory non-compliance

Strict governance in regulated sectors can curb AI innovation/adoption if transparency, accountability, and ethical standards are not upheld.

3 Data privacy issues

As AI leverages increasing amounts of consumer data, rising public concern around data privacy may warrant increased regulation and standards around data use.

OPPORTUNITIES

1 Increased productivity and efficiency

AI implementation in back-office and core business functions can result in exponential productivity gains, superior efficiency, and cost reductions.

2 Enhanced data-driven decision-making

AI will provide business leaders with previously inaccessible insights, predictive analytics, and risk assessments to inform strategy and planning.

3 Competitive differentiation

Customized enterprise AI solutions present opportunities to develop proprietary platforms, hyper-specialized tools, and new business models that distinguish an organization.



STRATEGIC QUESTIONS

1

Are you mainly focused on leveraging AI in your organization for functional efficiency, task-based productivity gains, or both? What are you doing to build those strategies?

2

Do you have the data governance foundations and AI accountability measures to comply with existing and emerging regulations?

3

How might your offerings need to shift as consumer and business buyer expectations evolve?

4

How might emerging AI systems create a compounding effect for your business? Is there a part of your business that could be vastly improved or optimized if a component or compound could be altered slightly?

5

How will third-party AI assistants change consumer expectations of your products and services?



02

**What global challenges will
bioengineering be able to address?**



UNCERTAINTIES

What global challenges will bioengineering
be able to address?

Better Living

GET THE DETAILS



Infrastructure Resilience

GET THE DETAILS



Securing Agricultural Infrastructure

GET THE DETAILS



Subscribe or Die

The Never Retiring Workforce



**Widening
Societal Gap**



**Self-Sustaining
Highways**
(The End to Infrastructure Bills?)



World War Food



**Community-Focused
Food**



UNCERTAINTIES

Better Living

Bioengineering initiatives and research present a change in our approach to health care and even aging. Researchers use generative biology to create new therapeutic compounds and test the viability of gene editing. That work results in better drugs, personalized treatments, engineered tissues, and alternatives to one-size-fits-some medicine. Experiments are underway to alter genetics to cure ailments and diseases, with success already being achieved in hearing loss reversal and sickle cell treatment. Scientists leverage animal alternatives as they work to enhance limb, organ, and joint regenerative capabilities.

SCENARIO 1

Subscribe or Die

Health care shifts from reactively treating sickness and diseases to proactively addressing potential health issues before they emerge. With the goal of making up for any future lost “reactive” revenues, the largest health care systems use M&A to join the bioengineering landscape as facility providers and treatment hubs. People subscribe to bio-based services, which they must use to continue getting access to health-promoting and anti-aging solutions. Big Bio creates the ultimate subscription package: Continue paying, or face an untimely alternative.

SCENARIO 2

The Never Retiring Workforce

Economic conditions have not drastically improved for Millennials and Gen Z, who cannot afford to retire. Thanks to preventative medicine, genetic surgeries, and new therapies, the life expectancy of Americans spiked from 77 to 115 years. Many older individuals feel physically and mentally capable of working indefinitely, while younger generations face a bottleneck in career advancement.

The implications are profound, and not just in the US. HR professionals and labor economists prompt a reevaluation of career trajectories, retirement planning, and intergenerational equity, hoping to stave off a collapse.



UNCERTAINTIES

Infrastructure Resilience

Our infrastructure is no longer crumbling and fragile. By creating new compounds and modifying existing ones, bioengineering significantly enhances construction materials' strength, durability, and flexibility while reducing reliance on harmful chemicals and petroleum-based compounds.

Compounds that self-heal extend the lifespan of infrastructure by autonomously repairing damage.

New materials, designed with generative biology, result in "living" buildings engineered with sustainable, organic materials.

SCENARIO 1

Widening Societal Gap

As bioengineering technologies mature and scale, the demand for traditional construction and maintenance services wanes. Construction firms that don't adapt—struggle, and those specializing in bioengineered solutions—thrive.

While new homes are increasingly constructed with these innovative materials, integrating them into existing homes proves financially prohibitive for many homeowners. A two-tier infrastructure landscape emerges, where newer developments boast remarkable resilience and sustainability features, and older constructions lag.

SCENARIO 2

Self-Sustaining Highways (The End to Infrastructure Bills?)

Bioengineering introduces advanced materials for highways and bridges that incorporate microorganisms, which produce substances to naturally repair damages, thereby enhancing durability and slashing maintenance expenses. These innovations adapt to fluctuating environmental conditions, offering better resistance against extreme weather patterns and contributing to infrastructure longevity. Some highway infrastructures mend themselves and reduce CO₂ levels, while bridges utilize embedded sensors for ongoing health monitoring, ensuring safety and operational efficiency.



UNCERTAINTIES

Securing Agricultural Infrastructure

Bioengineering addresses the global food security challenge by revolutionizing how and where we grow our food. Improved crop yields enable food cultivation in diverse and previously inhospitable locations. Bioengineering also offers solutions to the most pressing agricultural challenges, such as developing famine and disease-resistant crops, engineering drought-tolerant plants that thrive on less water, and reducing reliance on chemical fertilizers and pesticides by creating all-natural pest resistances. Crops now withstand shifting weather patterns, while soil health is improved.

SCENARIO 1

World War Food

Wealthier nations, foreseeing the vulnerabilities of relying on traditional agriculture, heavily invested in synthetic biology and food synthesis technologies to produce engineered foods customized for nutritional content.

This shift has created a new divide in the global economy, with disparities in food production capabilities. Agrarian countries, dependent on their exports of traditional crops, face widespread unemployment and social unrest. They retaliate through cyber sabotage and proxy conflicts, attempting to disrupt their wealthier counterparts' engineered food supply chains.

SCENARIO 2

Community-Focused Food

Genetic modification and environmental adaptation have revolutionized agriculture. Crops flourish in deserts and on urban rooftops, making food production sustainable and accessible. The urban heat island effect is reduced, and fresh produce and cultured proteins are available at local shops. Suburban and rural communities have embraced cooperative farms growing bioengineered crops resistant to various adversities, enhancing local biodiversity and fostering shared responsibilities and benefits. Commercial farming has shifted toward sustainability, with genetically engineered crops achieving faster growth and higher yields, leading to reduced land use, shorter supply chains, and less reliance on imports. Food is grown closer to where it is consumed, leveraging advanced technologies to create a resilient, efficient, and eco-friendly food system.

OPPORTUNITIES & THREATS

THREATS

1 Genetic Privacy and Discrimination Risks

A rise in bioengineering raises concerns over genetic data privacy. There's a risk that insurers, employers, or third parties could misuse individuals' genetic data, leading to new forms of discrimination.

2 Automation In Employment

Integrating bioengineering in various industries may lead to significant job displacement. Traditional agriculture, construction, and health care roles could be transformed or made obsolete by automated processes.

3 Geopolitical Conflict

The strategic advantage gained through bioengineering capabilities could become a source of global tension. Leading nations may exert influence over others, leading to new forms of dependency and inequalities.

OPPORTUNITIES

1 Adapting to the Never-Retiring Workforce

The increase in life expectancy will drive shifting career dynamics, allowing businesses to develop new career paths, flexible working conditions, and retirement plans that accommodate an aging but active workforce.

2 Bridging the Gap in Health Access

Advancements in bioengineering offer unprecedented opportunities to address health inequities globally through more cost-effective production of pharmaceuticals.

3 Improved Food Access

Synthetic biology revolutionizes global food strategy by boosting crop resilience, enhancing nutrition, producing sustainable ingredients, developing alternative proteins, and reducing waste, leading to more resilient food systems.



STRATEGIC QUESTIONS

1

How can synthetic biology be used to solve previously unsolvable problems in your product R&D pipeline?

2

What impacts do you anticipate synthetic biology will have on your supply chain and procurement strategies?

3

How will your customers and the market respond to products or services developed through synthetic biology?

4

What skills and talent do you need to leverage synthetic biology in your business effectively, and how do you plan to acquire them?

5

How do you plan to manage intellectual property rights and protect innovations in the field of synthetic biology, and what challenges do you foresee in this area?



03

**How will countries and businesses
commit to decarbonization?**



UNCERTAINTIES

How will countries and businesses commit to decarbonization?

**Blue Economy**[GET THE DETAILS](#)**An Expanded Environmental Support Ecosystem**[GET THE DETAILS](#)**Inclusive, Multifaceted Environmental Protection**[GET THE DETAILS](#)**Sustainable Growth and Innovation****Exploitation and Environmental Degradation****Grid Optimization****Environmental Efforts Stagnate****Holistic Benefits Are Realized****Over-regulation and Complexity Dominate**

UNCERTAINTIES

Blue Economy

The blue economy, which promotes the sustainable use of ocean resources, plays an increasingly important role in countries' sustainability efforts by harnessing the ocean's economic growth while ensuring marine environmental health. This approach includes sustainable fisheries, renewable marine energy, and eco-friendly tourism, all aimed at preserving ocean ecosystems and promoting economic resilience.

SCENARIO 1

Sustainable Growth and Innovation

Marine technology breakthroughs vastly improve sustainable fishing, ocean-based renewable energy efficiency (like wave and tidal power), and ocean cleanup efforts, significantly reducing marine pollution.

Concurrently, robust international agreements are instrumental in the effective management of marine resources. These agreements introduce strict regulations to prevent overfishing and protect marine habitats from destruction. Because of these combined efforts, the health of the marine ecosystem improves.

SCENARIO 2

Exploitation and Environmental Degradation

Inadequate global governance fuels overfishing, unregulated marine development, and pollution, drastically diminishing ocean resources.

Wealthier nations disproportionately deplete these resources, leaving smaller coastal communities to bear the brunt of environmental harm and resource scarcity. Ignoring sustainable methods leads to a sharp decline in biodiversity, undermining the blue economy's growth, affecting worldwide food security, and disrupting climate balance. These effects are most acutely felt by small coastal communities reliant on the ocean for survival.



UNCERTAINTIES

An Expanded Environmental Support Ecosystem

Countries expand their environmental efforts beyond a narrow focus on renewable energy to include broader ecosystem support. This involves enhancing infrastructure such as power grids and EV charging networks, implementing environmental, social, and governance (ESG) policies, and bringing greater transparency to carbon trading schemes. The aim is to take a more holistic approach to sustaining healthy ecosystems while still continuing the transition toward clean energy.

SCENARIO 1

Grid Optimization

Energy grids have been upgraded through deployment of advanced energy storage systems, such as large-scale batteries and pumped hydro facilities. We now store excess renewable energy. There is widespread adoption of highly efficient electric heat pumps for heating and cooling to reduce energy use and curb emissions. New ESG policies include transparency for CO₂ trading schemes.

Businesses supporting optimized grid initiatives benefit from reduced energy costs thanks to improved stability and more energy-efficient technologies. These businesses also tap into emerging renewable energy markets, creating new revenue streams. Those leading the transition to sustainable power grids have a first-mover advantage.

SCENARIO 2

Environmental Efforts Stagnate

Persistent power outages and insufficient electric vehicle infrastructure disrupt economic activities, causing a dip in productivity and risking job losses. Since ESG regulations vary across regions, compliance is difficult. This leads to higher operational expenses and hampered economic expansion. A lack of transparency in carbon trading markets breeds investor skepticism, obstructing the development of green finance.



UNCERTAINTIES

Inclusive, Multifaceted Environmental Protection

The concept of environmental protection has evolved to become more inclusive. Countries and businesses now recognize that it encompasses efforts to mitigate climate change and initiatives for biodiversity conservation and the promotion of humane working conditions. This broader approach integrates ecological sustainability with social responsibility, reflecting a more holistic understanding of our interconnected world.

SCENARIO 1

Holistic Benefits Are Realized

Nations prioritize the conservation of diverse ecosystems, leading to increased ecotourism, research opportunities, and sustainable resource management. Responding to labor group advocacy, businesses adopt fair labor practices, including raising wages and prioritizing safer work environments.

Companies embrace comprehensive sustainability strategies that integrate ecological, social, and economic considerations, leading to significant reductions in resource waste and improved financial resilience. These strategies are effective because they strike a balance between environmental consciousness and business viability, aligning with consumer preferences for environmentally responsible goods and services.

SCENARIO 2

Over-regulation and Complexity Dominate

Expanded environmental protection efforts bring complex and often competing regulations to the forefront, and governments have to wrestle with noncompliance and enforcement challenges. Businesses face exorbitant costs navigating this convoluted regulatory landscape, stifling innovation and hindering economic growth. The high cost of transitioning to environmentally friendly legislation poses barriers to entry for smaller businesses, reducing market competition.

In striving to meet a multitude of environmental goals, overemphasis on specific areas like biodiversity conservation diverts finite resources from urgent climate mitigation needs, impeding overall sustainability progress.

OPPORTUNITIES & THREATS

THREATS

1 Compliance Complexity

Diverse and changing ESG regulations across regions can complicate compliance efforts, increasing operational costs and reducing competitiveness.

2 Technological Obsolescence

Rapid advancements in energy technologies could render existing products and services obsolete, posing a threat to businesses unable to innovate quickly.

3 Implementation Costs

The costs associated with adopting comprehensive sustainability strategies could be significant, particularly for small and medium-sized enterprises (SMEs).

OPPORTUNITIES

1 Short-Term Gains

Businesses prioritizing short-term economic gains over sustainability may benefit from lower compliance and operational costs in the short term but could find themselves ill-prepared over the mid-term as new technologies and regulations begin to scale.

2 New Revenue Streams

Companies in the energy storage, electric heat pumps, and renewable energy sectors could tap into new revenue streams as their technologies and services become increasingly in demand.

3 Comprehensive Sustainability

Companies that adopt and integrate broad sustainability strategies can appeal to a wider customer base, reduce waste, and improve operational efficiencies.



STRATEGIC QUESTIONS

1

How is your business leveraging technological advancements in marine technology to promote sustainable growth within the blue economy?

2

What strategies are in place to adapt to and comply with international marine resource management agreements, such as in your supply chain practices?

3

How is your business preparing to align with new ESG policies, and what investments are being made to upgrade or support the infrastructure for renewable energy and grid optimization?

4

How is your business diversifying its operations or supply chains to ensure resilience and sustained growth?

5

What measures are in place to navigate the complexity of expanded environmental regulations without stifling innovation or economic performance?



04

How will humans prioritize their work environments in the future, and what will these preferred workplaces look like?



UNCERTAINTIES

How will humans prioritize their work environments in the future, and what will these preferred workplaces look like?

**Work Is Task-Dependent**[GET THE DETAILS](#)**Enabled by Smart Workspaces and AI Agents**[GET THE DETAILS](#)**Purpose-Driven Locations**[GET THE DETAILS](#)**Decentralized Work Communities****Reskilling for Task-Based Work****Smart Workspaces Empower Talent****AI Agents Manage Logistics****Personalized Coworking Ecosystems****Division in Urban Areas**

UNCERTAINTIES

Work Is Task-Dependent

Companies emphasize skill-focused tasks over traditional role-based assignments. This approach opens up opportunities for both fixed-location and remote workers, breaking down previous barriers in talent pools. Consequently, employees have the flexibility to work from home or community-based locations.

SCENARIO 1

Decentralized Work Communities

The social elements and team structures of traditional offices diminish in importance. Without defined roles anchoring them together, employees perform their individual tasks remotely.

Workers split time between truly remote work and convening in smaller satellite workspaces when they want a sense of community. Employees enjoy the flexibility to simultaneously hold multiple “careers,” contributing varied tasks to an ecosystem of employers rather than being siloed at any single organization.

SCENARIO 2

Reskilling for Task-Based Work

Ensuring the right skills for each job is a priority. Sensitive to the high search costs for new talent, companies are interested in retaining and training existing employees to meet evolving task needs. Traditional offices are nimble learning centers focused on immersive training for current staff.

This cultivated talent pipeline of cross-functional employees, versed in specific on-demand abilities, replaces siloed departments. Companies equip their workforce with precise capabilities rather than seeking elusive candidate fits.



UNCERTAINTIES

Enabled by Smart Workspaces and AI Agents

Workflows are enabled by fluid, personalized environments that empower productivity with human and artificial partners working in concert. People are free to perform, augmented by supportive spaces that travel with them.

SCENARIO 1

Smart Workspaces Empower Talent

Offices function as intelligent computing zones. Spatial computing and natural language processing enable embodied interaction. Employees' tasks and projects surface on walls and tables as they enter a room. Workers can literally get a grasp on their work by manipulating 3D projections by hand. Voice commands replace typing for nimble modification.

Employees gain sensory proximity to their work. Previously abstract digital files are now tangible in augmented environments that both feel familiar and unleash workspace innovation.

SCENARIO 2

AI Agents Manage Logistics

Specialized AI agents handle distinct tasks. A product manager AI agent could aid market analysis, prioritize features, and develop business cases. Meanwhile, a developer agent would focus on automating code generation and detecting bugs.

Each person's AI agent coordinates to remove logistical burdens. Christina's assistant tracks that she prefers morning meetings. Jeff's assistant knows he favors early afternoons. By sharing insights into their humans' constraints, the assistants identify 11 a.m. as the optimal meeting time. Because the assistants dynamically adjust activities based on their human's context, they enable new flexibility: Workers can perform efficiently wherever they happen to be.

UNCERTAINTIES

Purpose-Driven Locations

Workers want transparency and a seat at the table to make company decisions. Labor unions and employees continue to push for greater autonomy and new benefit packages and locations. Companies join together to offer a complex of potential work environments, creating stability in some urban regions.

SCENARIO 1

Personalized Coworking Ecosystems

Employees have access to coworking ecosystems that cater to their lifestyles. For health buffs, wellness hubs provide gyms, cold plunges, and saunas. Parents join family-friendly sites with childcare and nursing spaces. Rather than isolated offices, companies cluster in amenity-rich locales to give workers choices.

Workers evaluate these full experience packages when considering job opportunities. Companies differentiate with tailored sites while still coming together in broader mixed-use developments. Competing businesses may not share ecosystems, but complementary industries do, recognizing the potential for expanded talent recruitment and retention.

SCENARIO 2

Division in Urban Areas

The urban centers of cities are becoming patchworks of utilitarian spaces that lack the vibrancy and interconnectedness of traditional urban life. As offices emptied out due to employee cynicism, businesses turned their properties into lab spaces, vertical farms, and storage. Socio-economic divides are deep, as these spaces do not address communal needs, only corporate interests. Once vibrant downtowns focus on efficiency and production versus community connection. Manufacturers are using the empty spaces to fill warehouses and production sites closer to their consumers. Malls and other shopping facilities that moved out of downtown now compete with these manufacturing centers.



OPPORTUNITIES & THREATS

THREATS

1 Ethical Challenges with AI Integration

Integrating AI agents into the workforce introduces cultural and ethical challenges, including dependency on technology, potential job displacement concerns, and ethical considerations around AI decision-making.

2 Overdependence on Technology

Heavy reliance on smart workspaces and AI for operational efficiency could lead to overdependence on technology, making companies vulnerable to tech failures, outages, or obsolescence.

3 Fraud Risk

As decentralized work scales alongside increasingly sophisticated AI, various forms of deepfakes could present a security risk to remote working environments, necessitating businesses to improve their cybersecurity preparedness.

OPPORTUNITIES

1 Talent Ecosystem Development

Companies and industries can develop talent ecosystems that foster cross-pollination of skills and ideas by creating networks of complementary businesses and coworking spaces that enhance talent satisfaction and retention.

2 Urban Redevelopment and Repurposing

Municipalities and businesses will need advice on repurposing urban spaces that have lost their traditional vibrancy due to shifts in work patterns.

3 Purpose-Driven Workspace Solutions

Companies may create purpose-driven locations and co-working ecosystems that align with their employees' values and lifestyle preferences. This could involve strategic planning for the use of corporate real estate to support community engagement, wellness, and collaboration.



STRATEGIC QUESTIONS

1

How can we develop a continuous learning and development ecosystem to ensure our workforce remains adaptable and skilled for future tasks?

2

In what ways can we leverage smart workspaces and AI agents to enhance productivity without compromising security, privacy, and employee well-being?

3

What do we need to reevaluate or adjust in order to remain competitive in attracting and retaining top talent as the workspace evolves?

4

How can we leverage data and analytics to improve remote work productivity and employee engagement while respecting privacy and autonomy?

5

How can we use new and emerging technologies to foster innovation and creativity in a predominantly remote or hybrid workforce?



05

In the context of increasing protectionism and geopolitical tensions, what is the future of the global chip manufacturing industry?



UNCERTAINTIES

In the context of increasing protectionism and geopolitical tensions, what is the future of the global chip manufacturing industry?

 **Chip Imports and Exports Are Increasingly Restricted**

[GET THE DETAILS](#)

 **Protectionist Policies Result in a Skills Gap**

[GET THE DETAILS](#)

 **The Cost of Data Centers Rise**

[GET THE DETAILS](#)

 **The US Dominates**

 **China Rallies**

 **In-House Production and Training Ramp Up**

 **Open Borders for Chip Industry Growth**

 **Tech Companies as New Energy Providers**

 **The End User Pays**



UNCERTAINTIES

Chip Imports and Exports Are Increasingly Restricted

The industry continues its pivot toward strategic autonomy. Defensively, the US is onshoring chip production to prevent supply chain disruptions like those during the Covid semiconductor shortage. Offensively, the US is strategically preventing exports to get a leg up in the AI race against China. Meanwhile, independent companies, like OpenAI, want to create new types of chips that won't run afoul of government regulations.

SCENARIO 1

The US Dominates

The US tightens enforcement of chip exports to prevent adversaries from attaining US chips and manufacturing equipment. US allies are required to do the same. Technologies like geotracking prevent leaks in export controls, thereby more effectively curbing US technologies from getting to China and Russia. This challenges those countries' reliance on foreign chips, pressuring their big tech to innovate with less sophisticated resources.

Since China is a major player in the consumer electronics market, the restrictions lead to higher prices and limited availability of various consumer goods worldwide.

SCENARIO 2

China Rallies

US-led export controls do not prevent China and other adversaries from acquiring powerful chips from companies like Nvidia. Black markets emerge for such chips, and IP espionage efforts ramp up. With these powerful chips, China's AI rivals US AI companies in capabilities. There is a bifurcation of "Eastern AI" and "Western AI."

China also continues to dominate global legacy chip production. Legacy chips underpin everything from microwaves to military weapons systems. China boxes out foreign competitors through dumping, rendering the US dependent on China, at least for legacy chips.



UNCERTAINTIES

Protectionist Policies Result in a Skills Gap

The expertise required for chip design and production, previously outsourced affordably, is now lacking domestically. As a result, manufacturing chips domestically has become a costly endeavor. This has sparked intense competition among companies to attract and acquire talent specialized in chip design and manufacturing.

SCENARIO 1

In-House Production and Training Ramp Up

Semiconductor companies are bringing chip production in-house and cultivating essential skills internally. They also in-source skills training by reaching out to high school students, offering a direct path into the burgeoning US chip industry. This new model positions the semiconductor sector as a realm of new blue-collar workers. By providing in-house training and certification, these companies offer young talent a debt-free alternative to college education, enabling them to start earning immediately while learning specialized skills.

SCENARIO 2

Open Borders for Chip Industry Growth

Progress in opening new fabrication plants, funded by the US Chips Act, has been slower than anticipated. The fabs' hosts, including cities in Texas, Ohio, and Florida, worry about becoming modern equivalents of Detroit—where initial high investments won't yield long-term benefits.

States traditionally resistant to open immigration policies are shifting their stance, and the US is responding with expedited visas for skilled workers, particularly from Taiwan, leading to a notable brain drain in the island nation and increased tensions with China.



UNCERTAINTIES

The Cost of Data Centers Rise

As AI-driven workloads intensify, the operational costs of data centers are escalating. The increased demand for processing power and energy to support complex AI tasks significantly drives up the expenses associated with maintaining and running these facilities.

SCENARIO 1

Tech Companies as New Energy Providers

Tech companies are venturing into producing alternative, cost-effective energy sources like small modular reactors and geothermal power. This move is not just about affordability; it represents a leap in overcoming long-standing negative perceptions of nuclear energy and its historical barriers of high costs and lengthy construction times.

The implications are profound, and not just for the energy sector: Apartment buildings will be powered, cooled, and lit efficiently by Amazon, and entire neighborhoods receive clean, cost-effective energy from Google or Microsoft.

SCENARIO 2

The End User Pays

Data center efficiency advancements have reached a plateau, compelling the industry to focus on expansion to meet increasing workload demands.

Providers can try to stay in densely populated areas that offer skilled labor availability and robust fiber networks, but they'll have to deal with increasing restrictions amid concerns that data centers exacerbate energy shortages. Or they could venture into less ideal locations lacking infrastructure and requiring substantial capital investment. Either option presents an increased cost of digital services for consumers and a significant ripple effect across the economy.



OPPORTUNITIES & THREATS

THREATS

1 Big tech gets bolder

Utilities could become disintermediated by tech companies, who find a competitive advantage in bundling energy with other services.

2 Regulatory disruption

Changes in trade policies and regulations in key markets could affect access to critical chip technologies and materials.

3 Tech transfer

Intellectual property and sensitive technology become entangled in technology transfer regulations, especially in countries involved in geopolitical tensions.

OPPORTUNITIES

1 Cultivate partner and supplier relationships

Businesses will need to develop new partners, manufacturers, and markets so they have first mover advantage if geopolitical tensions rise unchecked, impacting access to key components and markets.

2 Get local

Companies may invest in local or regional production capabilities to reduce dependence on global markets, increasing customization capabilities and time to market.

3 Fund alternatives

Technology firms must invest more in research and development to create more advanced or alternative chip technologies that address the emerging challenges.



STRATEGIC QUESTIONS

1

How will geopolitical tensions affect the cost of chips, and how can you mitigate these cost increases?

What financial cushions can be put in place to absorb potential shocks?

2

Do you have a robust crisis management plan that includes scenarios involving escalated geopolitical tensions affecting chip supply?

3

How must you enhance your cybersecurity measures to protect against potential threats exacerbated by geopolitical tensions, especially in critical infrastructure related to chip manufacturing and distribution?

4

How do geopolitical tensions affect your commitment to environmental sustainability and ethical sourcing, especially concerning rare materials used in chip production?

5

Considering the current and potential future geopolitical landscape, how should you adjust our long-term strategic positioning to ensure sustainability and growth?



ABOUT FUTURE TODAY INSTITUTE



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AMY WEBB

Chief Executive Officer

Recognized as the global leader in strategic foresight, Amy Webb advises business leaders through disruptive change, enabling them to navigate an unpredictable future with confidence and take actions that address global challenges, create sustainable value, and ensure a company's long-term growth. As founder and CEO of the Future Today Institute, Amy pioneered a unique quantitative modeling approach and data-driven foresight methodology that identifies signals of change and emerging patterns very early. Using that information, Amy and her colleagues identify white spaces, opportunities, and threats early enough for action. They develop predictive scenarios, along with executable strategy, for their global client base. In 2023, Amy was recognized as the #4 most influential management thinker in the world by Thinkers50, a biannual ranking of global business thinkers. She was also featured

on the 2021 Thinkers 50 list, was shortlisted for the 2021 Digital Thinking Award, and received the 2017 Thinkers50 Radar Award. Forbes called Amy "one of the five women changing the world," and she was honored as one of the BBC's 100 Women of 2020.

Amy also serves as a professor of strategic foresight at New York University's Stern School of Business, where she developed and teaches the MBA-level strategic foresight course with live case studies. She is a Visiting Fellow at Oxford University's Säid School of Business. She was elected a life member of the Council on Foreign Relations and is a member of the Bretton Woods Committee. She is a Steward and Steering Committee Member for the World Economic Forum, a founding member of the Forum's Strategic Foresight Council, a member of the Forum's Risk Advisory Council, and serves on the Forum's Global Futures Council. She was a Delegate on the former

U.S.-Russia Bilateral Presidential Commission, representing US interests in technology.

Regarded as one of the most important voices on the futures of technology (with specializations in both AI and synthetic biology), Amy is the author of four books, including the international bestseller *The Big Nine* and her most recent, *The Genesis Machine*, which was listed as one of the best nonfiction books of 2022 by *The New Yorker*. To date, her books have been translated into 19 languages. A widely published and quoted thought leader, Amy regularly appears in a wide range of publications and broadcasts.

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Melanie specializes in strategic transformation, quantitative and qualitative research, and scenario development. With deep expertise in the development and establishment of foresight capabilities within large organizations, Melanie regularly counsels C-staff on strategy and execution. She has spent years assessing the impact of major external forces such as increasing technological sophistica-

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Melanie is a recognized expert in fostering psychological safety within teams, a crucial element for operationalizing strategic foresight effectively. Her work emphasizes creating an environment where open dialogue and innovative thinking are encouraged, enabling organizations to embrace change and navigate future uncertainties with confidence.

Melanie serves in the World Economic Forum's Metaverse Working Group and is a founding member of the Dubai Future Forum's advisory group. She serves as a coach in the strategic foresight MBA course at the NYU Stern School of Business. Melanie holds a BS in Finance from Central Connecticut State University and a Fintech Certification from the Massachusetts Institute of Technology.



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Nick Bartlett is a Director at the Future Today Institute and leads our Insurance practice area.

Before FTI, he held positions in corporate strategy and insights generation roles, serving as a partner to senior leadership at multiple Fortune 100 financial services companies. Throughout his career, he has specialized in framework design, corporate innovation, strategic management, and insurance.

Nick has an extensive background in developing strategic insights across a variety of industries (e.g., manufacturing, transportation, construction, energy) and subject matter areas (e.g., small business, mobility, robotics, platforms & ecosystems), in addition to the shifting nature of business and consumer preferences. He has deep experience developing and implementing trend modeling

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He is a coach in the strategic foresight MBA course at the NYU Stern School of Business. Nick holds an MBA and a Bachelor of Arts in Public Relations from Quinnipiac University.



SAM JORDAN

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Sam Jordan is a Manager at Future Today Institute. She leads our Advanced Computing practice area, which includes technology, artificial intelligence, virtual realities, networking, telecommunications, and space. She is a distinguished practice area lead, where she enables organizations to navigate through uncertainty with innovative strategies. With a proven track record across various sectors, Sam's visionary leadership has driven growth and resilience for Future Today Institute's global clients and partners.

Before joining FTI, Sam was the CEO and co-founder of TrovBase, a secure data discovery and analysis-sharing platform. Sam grew the company from idea to launch and executed the company's transition from scientific replication to its current focus. In parallel, Sam engaged with the open science community, advocating for

better data management practices to address challenges in scientific replication. Previously, she worked for IBM, where she helped large enterprises in the retail and distribution sector modernize their IT stack. Her expertise centered around mainframes, assisting with the integration of new software and modern methodologies to legacy systems.

Sam is a coach in the strategic foresight MBA course at the NYU Stern School of Business. She holds a BS in Economics and Data Analysis from George Mason University and an MBA from New York University's Stern School of Business.



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Christina von Messling leads our European client portfolio and our Life Sciences practice area at Future Today Institute. She is renowned for her expertise in strategic foresight and an unparalleled ability to navigate complex industry landscapes. With a career spanning over two decades, she has guided multinational corporations through transformative strategies, leveraging his deep understanding of market dynamics and future trends.

Christina's diverse experience across sectors enables her to craft visionary scenarios and strategies, driving sustainable growth and innovation for clients worldwide. Having split her time between Europe, the UK, Brazil, and the US, she combines a global perspective with in-depth, holistic expertise of the main drivers of change: technology, geopolitical, economic, and societal

developments. She has advised leading pharmaceutical and healthcare companies, as well as beauty, entertainment, media, and retail brands.

Christina is a coach in the strategic foresight MBA course at the NYU Stern School of Business. She holds a Masters in Law from the Freie Universität Berlin, where she graduated within the top 10% of the nation. She works from offices in New York City, Berlin, and London.



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Mark Bryan is a Senior Foresight Manager at the Future Today Institute and leads our Built Environment, Hospitality, Retail, Restaurants & CPG practice areas. Mark excels in applying strategic foresight to design and the built environment, anticipating future need states for our physical and organizational spaces. His expertise in integrating strategic planning with innovative design principles empowers businesses to anticipate and adapt to future trends, fostering sustainable growth, resiliency, and transformative change in their industries.

Before FTI, Mark worked as a workplace strategist, designer, design researcher, and futurist for clients across the country, most recently through his role as Director of Innovation + Research at a design and architecture firm.

Mark's portfolio of clients includes national foundations, global CPG companies, international associations, product manufacturers, national retail brands, multi-family developers, healthcare systems, senior living facilities, restaurants, and large multinationals. Mark has produced original research and strategic analysis on the future of co-living, senior living, workplaces, play, hotels and resorts, dining, and distance learning.

Mark is a coach in the strategic foresight MBA course at the NYU Stern School of Business. He holds a BS in Interior Design from Virginia Tech and NCDIQ Certification.



ABOUT FUTURE TODAY INSTITUTE

About Us

Founded in 2006, Future Today Institute helps leaders and their organizations navigate turbulent times by reducing uncertainty, identifying existential threats, leveraging critical emerging technologies, and identifying opportunities for growth.

We help organizations lead into the future. Our consultants work with executives and their teams to define plausible futures and develop executable strategies. Combining deep industry knowledge, rich creativity and rigorous analysis, we make teams confident in taking meaningful action.

As the leading strategic foresight and futures management consultants to executive leadership teams worldwide, FTI's data-driven, applied research methodology identifies trends, calculates their impact, and through descriptive scenarios, reveals 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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For an introductory conversation to learn how Future Today Institute can assist your organization with its long-term strategic planning and foresight needs, please contact:

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