
2022
EXECUTIVE SUMMARY
TECH TRENDS
16TH EDITION
FUTURE TODAY INSTITUTE
Future Today Institute

THIS YEAR REQUIRES FOCUS

In August 2017, a rare explosive event known as GW17817 took place in space. Two stars collided, unleashing a blast energetic enough to form an incalculable number of new stellar bits that continue to travel through interstellar space. Over time, this stardust will combine into small objects, evolve into large rocks, fuse with even more material, and form into planets. One incredibly violent disruption will someday lead to the formation of a new corner of the universe. This is how our own sun and Earth, and all of human existence, came into being.

Lately it's as if we've been living through the aftermath of cataclysmic explosions: the release of generative artificial intelligence systems like ChatGPT and Midjourney, a fusion breakthrough that could someday generate zero-carbon energy, Russia's ongoing invasion into Ukraine, deep uncertainty about a global recession, and AlphaFold's protein-folding algorithms that predicted structures for nearly all cataloged proteins known to science, to name a few. These and other forces of change are colliding, going supernovae, and resulting in an unfathomable amount of new signals—bits of change that, over time, result in the trends that shape society.

Now more than ever, it's important to carefully track new trends as they emerge. But that isn't easy, given the rapid pace of change. For that reason, the theme of our 2023 Tech Trends report is Focus. It is crucial to focus when new signals are forming because some may be lasting and develop into impactful trends, while others might burn out and fade away. In an increasingly complex and fast-paced world, leaders who focus on the trends that matter and adapt to changing circumstances make better decisions and see improved outcomes. Trends enable them to anticipate near-term change, understand the factors influencing their industries, and develop a point of view on the future.

Our research is presented in 14 in-depth reports that reveal the current state of play, a list of influencers to watch, key trends, detailed examples, expert perspectives and recommendations designed to help executives and their teams develop their strategic positioning. Some of the trends are new advancements on mature technologies, while others represent frontier technologies and areas of science. When we look at them collectively, new centers of gravity come into focus, and we can glimpse the impacts they will have on every sector.

Trends on their own cannot predict the future. Rather, future-focused organizations use them to deeply reflect on the tension between long-term and short-term goals and to reduce uncertainty. By understanding the trends and changes shaping the landscape, executives can make informed decisions and capitalize on new opportunities in the year ahead.

We invite you to join us in observing how the stardust settles into new signals and trends. Share your feedback with us at **2023trends@futuretodayinstitute.com**.

Amy Webb
Chief Executive Officer
Future Today Institute

IMPACT OF TRENDS ON YOUR INDUSTRY

Near-Term Relevance — Long-Term Relevance

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

16TH EDITION • 2023 TECH TRENDS REPORT •

ARTIFICIAL INTELLIGENCE

Future Today Institute

AI TRENDS SUMMARY

AI is a force multiplier on technological progress because it is an enabler of other technologies and powers the evolution of business, government, and society.

Key Insights for 2023

We have entered the "text-to-everything" era. Soon, we will use natural language to operate and interact with computers rather than graphic user interfaces (GUIs).

We expect to see increased activity in the specialized AI accelerators space this year. Watch the UK's Graphcore, which built a new type of processor for machine intelligence to accelerate machine learning and AI applications, and Cerebras, which built one of the fastest AI accelerators based on the largest processor in the industry, as well as AWS Inferentia accelerators. Will Nvidia's GPU/AI accelerator moat get disrupted this year?

It's possible for agents to learn the right skills but the wrong objectives; an AI system can be asked to learn something that then could be used for harmful purposes. Commercial AI products could inadvertently incentivize bad behavior.

GENERATIVE AI

If the 2010s were known for perception AI—systems that sensed signals such as images and text—to understand the world around us, the 2020s will be known for generative AI. These systems not only sense and understand the world but can also generate new content, concepts, and ideas while communicating with us.

AI is emerging as an assistant for all knowledge workers. Within the next 18-24 months, we will see assistive technology developed for a variety of professions. Think: GitHub's Copilot for financial analysts, commercial real estate developers, and lawyers.

In the next 18-24 months, generative AI will be incorporated into consumer applications. Already, Canva, the popular online graphic design tool, has integrated Stable Diffusion in its platform. Microsoft has incorporated OpenAI's DALL-E 2 image-generating system into its Microsoft Designer and Image Creator applications, which is a big upgrade to clip art. Google's Bard includes an API to encourage developers to start building new products. Notion, the freemium productivity and note-taking web application, uses LLMs for assistive writing.

General-purpose models will be commoditized in the near-future. This will lead to large language model (LLM) features being integrated into every app. The first players to succeed in the space will likely be creative apps, and all of them will have LLMs as a backbone to inspire and augment human creativity.

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.

In the next 12-18 months, watch for the proliferation of large-scale open-source models and tools including Stable Diffusion and HuggingFace.

Publicly available LLMs are often the foundation for AI startups, but some researchers and technologists are questioning their defensibility when it comes to capturing value. The moat is in data. Techniques and models will largely get commoditized, and served via the infrastructure layer, where real value will be realized.

Long-term sustainability depends on network effects to gather enough user data. User-generated data can be harnessed to differentiate systems by offering tuned models on top of foundational/commoditized LLMs, creating a flywheel effect. Longer term, we expect to see niche LLMs owned by a select few players, while general-purpose LLMs become commoditized.

AI TRENDS SUMMARY

At the infrastructure layer, we anticipate a variety of generative AI services built to better serve a variety of applications. In addition to OpenAI, specialized players are entering the market, including AI21, Cohere, Snorkel.AI, and Scale.AI.

ENTERPRISE

Top talent will start breaking away from the largest players—Google, OpenAI, Meta—to form their own startups, which will include conversational agents, artificial general intelligence programs, AI-first biotech companies, and the like.

Consolidation will continue to be a driving theme in 2023. Here's just one example: Microsoft plans to increase its investment in and leverage OpenAI for Bing to pull market share away from Google search.

Google's powerful ChatGPT rival, Bard, uses an AI model called LaMDA. Launched February 2023, could catalyze a new race for conversational search.

We anticipate increased enterprise adoption of AI. Leaders see AI as necessary for growth in the current macroeconomic environment, even as new developments make some job categories obsolete.

AUTOMATION

AI coding assistants will grow in popularity. OpenAI's Codex, introduced in 2021, evolved from research to open commercialization by the middle of last year. GitHub CoPilot is now available as a subscription ($10 per month). As of January, Amazon's CodeWhisperer is available in preview. Internally, Google is using a machine language–powered code completion tool—it may at some point be made available to everyday users, possibly this year.

We expect to see AI more deeply integrated into health care and life sciences later this year. Generative AI will yield new proteins, antibodies, and drugs, while biology and chemistry-specific models will result in faster discovery, further providing practical use cases and leading to increased investment.

Could 2023 mark the beginning of the end of human radiologists? Lithuania-based Oxipit, an AI-first medical imaging startup, built an autonomous system that reports on chest X-rays that show no abnormalities. The technology is good enough that it received state-level certification to operate independently, without a radiologist in the loop.

REGULATION AND GEOPOLITICS

Will this be the year the government breaks up Big Tech? US lawmakers have begun work to decouple Google's ad business from the rest of the organization. In the European Union, powerful new regulations of tech platforms could go into effect. In China, regulators have eased up slightly on Big Tech crackdowns—but the Chinese Communist Party is intent on focusing new R&D toward servicing the country's long-term growth ambitions.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Artificial intelligence should be part of every strategic plan, as it crosses multiple dimensions, from workforce automation, to digital transformation, to everyday business processes and business intelligence. It is imperative that executives and senior managers understand what AI is, what it is not, and what strategic value it adds to the business.

As no-code and low-code applications become more widely available, Future Today Institute analysis shows that innovation teams will be in position to build powerful systems for decision management, business intelligence, and product ideation. Generative AIs will improve an organization's efficiency and enhance creativity, leading to hybrid human-machine creative teams. AI-assisted design will dramatically increase the number of prototypes that can be automatically generated with prompts.

We recommend that chief strategy officers in every field develop a solid understanding of AI to engage more closely with others in the C-suite to develop a cohesive point of view on digitalization, augmentation and automation—as well as to develop strategic plans. Importantly, businesses should keep abreast of emerging regulations that could restrict the use of consumer data, algorithms, or generative AI systems. Risk models should be developed to determine plausible near-futures, so that leaders can adjust their strategies accordingly.

When it comes to talent and workforce development, the need for highly skilled people is fast outpacing the graduation rate of universities. This might lead to a shift in higher education: It's plausible that companies in search of AI specialists might opt for modular certifications, which can be earned faster than traditional four-year degrees. Talent sourcing and retention will continue to pose challenges for tech companies—and for organizations in other industries that need a trained workforce but may not be able to provide the same perks as the hottest AI players.

In nearly every industry, AI will serve as a force multiplier for growth, bringing efficiencies, better tracking, business intelligence, and assistance with decision-making. As training costs decline, more applications will be built. Spending on AI systems and hardware is likely to explode this decade, creating significant enterprise value overall.

KEY QUESTIONS FOR YOUR TEAM

1

How do these trends change our perspective on our current AI investment and capabilities?

2

Is our organization positioned to leverage AI for growth, in addition to realizing new efficiencies?

3

When we engage in long-term strategic planning, how does the evolution of AI factor in?

4

Are we adequately preparing our workforce to succeed in a world in which their knowledge tasks might be augmented or fully automated by AI?

5

What is our process to vet, verify and monitor our vendors?

Is the AI we're using explainable?

If not, does that open us up to additional risk?

6

Does our team have an expansive enough viewpoint on emerging threats and attack surfaces?

7

What parts of our business make us vulnerable as AI evolves?

8

What is our point of view on the use of generative AI systems?

9

If proposed antitrust legislation passes in the US and the EU further regulates Big Tech companies, how does this create a strategic opportunity for our organization?

Or, what might our organization lose?

10

How might we develop the knowledge, experience, and talent in place to leverage these AI trends?

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Future Today Institute

WEB3 TRENDS SUMMARY

A trustless and decentralized web holds significant benefits for consumers and businesses and will enable them to engage seamlessly.

Key Insights for 2023

Security is top of mind for those invested in Web 3.0. Cybersecurity breaches across 2021 and 2022 exposed nascent Web 3.0 systems' weaknesses, which platforms will need to address to ensure Web 3.0 is reliable and scalable.

Efforts are emerging to use Web 3.0 capabilities for public good. From tracking environmental sustainability, to improving access to food, and archiving items of historical importance, emerging blockchain solutions go beyond art exchanges and decentralized currency to try to solve some of the world's most pressing problems.

Proof of work consensus mechanisms were the cornerstone of early blockchain protocols, but proof of stake is rapidly emerging as the leading consensus tool because of its efficiency, reduced need for computing power, and less onerous environmental impact.

Tracking the origin and ownership of items, content, data, and assets continues to be the predominant use of blockchain, but the technology is expanding beyond its initial focus on NFTs (non-fungible tokens) to include personal data, virtual representations of real-world assets, and other types of data.

Health care, food, supply chain, journalism, and energy are some of the industries that will see Web 3.0 uses expand and new capabilities emerge in the coming year.

Digital identity is a key area of development in the Web 3.0 landscape. For Web 3.0 to function, individuals will require methods of identification and ways to validate transactions, but the tools to do so are still inchoate.

Regulation of Web 3.0 technologies is being developed in a variety of countries. Organizations that provide or use Web 3.0 capabilities will need to remain informed about these regulations to ensure they are in compliance.

Web 3.0 is changing the way individuals interact globally. While governments are mostly shaping regulations today, large communities are already beginning to form in Web 3.0 that have a comparable level of economic power. Regulations that do not take into account the borderless nature of Web 3.0 may be difficult to apply in real-world settings.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Web3 describes a nascent collection of technologies that will continue to develop and mature over the next several decades.

For many, Web3 feels speculative, and thus not a candidate for deep investment. However, Web3 technologies and those that enable it, including artificial intelligence, advanced network connectivity, and user applications, are evolving rapidly. Organizations taking steps to prepare will be positioned to respond as the technology does scale, by connecting it with their value propositions and improving their market offerings.

There are parallel lessons from Web 1.0. The applications we see today were unimaginable to most at one time, because the software and hardware had not yet sufficiently advanced. Those organizations that closely tracked its development, however, and grew with the technology, were well equipped to pounce when the technology scaled (think: Amazon or Nintendo).

Over the next five to 10 years, Web3 will enable a growing number of applications for governmental, corporate, and consumer use that extend well beyond financial or marketing applications. Nearly every company and industry has the potential to be revolutionized by Web3 technology. So, leaders need to think differently about not only how they deliver their products but also the type of service and offerings their stakeholders now value.

Organizations will need to confront unfamiliar technologies, develop new pipelines for talent, and align their products to suit this new paradigm. The majority of organizations will be impacted at the Layer 3 level as their offerings and distribution channels become disintermediated by peer-to-peer capabilities, and stakeholders begin to demand more seamless transactions.

Businesses are advised to prepare for Web3 as they would for any other transformational technology:

GAIN FAMILIARITY

Develop a basic understanding of blockchain technology and its history. Create a point of view for your organization on the definitions of Web3 and the metaverse, and the differences between them. Follow a few key players in the space. Buy some cryptocurrency, even if only for the experience of having a crypto wallet.

IDENTIFY AND PRIORITIZE TRENDS

Prioritize trends that sit in the layer your organization must interact with most closely.

EXPLORE WHITE SPACES

Explore white spaces to gain new insights. Where are the opportunities for innovation and growth? Where are the threats to the organization's ability to thrive? Where are the downstream risks to partners or customers?

DEVELOP A POINT OF VIEW

Envision scenarios that reveal plausible future worlds where Web3 technologies have reached critical mass. Identify the top ways you could use Web3 technology to enhance your value proposition.

CREATE YOUR ORGANIZATION'S VISION

Develop a long-term vision to fill key underlying technology gaps to drive investment, M&A, product development, talent acquisition, and planning decisions.

KEY QUESTIONS FOR YOUR TEAM

1

What, if any, layers of the Web3 ecosystem do we need to participate in by creating or developing a capability?

2

In what ways would our stakeholders benefit from interacting with our company and each other more directly?

3

What value do we have to share with stakeholders, and how could it be tokenized for easier transactions?

4

What physical assets does the company use or distribute that would benefit from tokenization for tracking or traceability?

5

How might we be impacted if data is less available in the future as consumers control their data more tightly?

6

How would an increase in cryptocurrency adoption impact our business model?

7

How might Web3 drive an increase in globalization within our industry?

16TH EDITION • 2023 TECH TRENDS REPORT • METAVERSE

Future Today Institute

METAVERSE TRENDS SUMMARY

The metaverse - a collective virtual shared space - may not be fully developed yet, but its impact on industry and consumer interactions is already widely felt.

Key Insights for 2023

Interfaces will become more immersive as both virtual spaces and the physical world are interlaced with rich digital media experiences.

The metaverse is not a single technology, protocol, or entity; it means many different things to many different stakeholders. Executives should get clear about expectations and interests being brought to the table.

Smart eyewear, in the form of glasses and contacts, will upend industries and interfaces designed for smartphones. New computing interfaces like headsets and glasses will take years to reach wide user adoption, but web-based standards already make augmented experiences possible using today's smartphones.

AR applications are ripe for consumer adoption because they solve for real-world convenience needs like navigation and contextual information, and yet they may be furthest away due to the technical challenges of heads-up displays, glasses, and contact lenses.

Interoperability and standards are still being worked out, but they are key to making spatial computing transferable across worlds, whether it's about a shared understanding of coordinates or transferring attributes of virtual goods and identity avatars across platforms.

People will create multiple digital versions of themselves, each tailored for specific purposes. This will lead to fragmentation—and a widening gap between who a person is in the physical world and who they project themselves to be in various online platforms.

Economic headwinds may have tempered recent exuberance over new realities, but the infrastructure work that will pave the path for future development is underway.

Embodied, spatial presence in virtual worlds only increases the need for ethical and humane guardrails for responsible use of technology.

XR technologies pose as many accessibility challenges as they do opportunities.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Now is the time for focused experimentation and learning in the short term, and imaginative scenario planning for the long term, as industries reckon with the disruptive potential of novel computing interfaces that will succeed the internet-enabled smartphone.

STRATEGY

New reality technologies are still very nascent, so it's worth thinking in both the near term and longer term when setting goals and priorities. From infrastructure, to hardware, to software—everything about immersive and spatial technologies is in development and up for grabs. Strategic plans should include provisions for interoperability, data portability, and transparency.

INNOVATION

As digital and physical realities become intertwined, innovation teams in many industries have an opportunity to pursue new moonshots. In 5 to 10 years, if consumers are wearing heads-up displays in the form of glasses or contacts, how could a retail, QSR/fast casual dining, or fan experience look radically different? How does this affect the medical patient's experience? How might connected eyewear integrate with a car or truck? In what ways could a digital twin be additive to real estate, insurance, and city planning? Developing sound moonshot ideas and the applications to match will enable companies to positively contribute to new realities and the metaverse even as emerging platforms are being built.

R&D

Come to virtual and augmented layers of the world with a curious explorer's mindset. Experimentation is the name of the game at this stage, so think bold, imagine what's possible, and be ready to learn from early endeavors. Brands should be a part of the emerging ecosystem, at the very least to learn how consumers behave, interact, shop, discover, and create. Beyond gamified experiences, innovation teams should work toward co-creating digital worlds alongside consumers and technology partners to champion inclusivity and sound ethical practices.

GROWTH

After the short-term hiccups of the current economic climate, Future Today Institute anticipates sustained growth for new realities tech and the metaverse ecosystem over the long term. Austerity will only refine efforts in the technologies' development and filter out the hype. Brands may be more risk-averse in their willingness to experiment in uncertain economic conditions, but the foundations for the spatial frontier of the internet will continue apace. Use this time to imagine longer-term scenarios and effects on your industry, and consider disruptive risks and opportunities.

KEY QUESTIONS FOR YOUR TEAM

1	2	3	4	5	6	7	8
Where might the new realities aid or disrupt our industry and/or our business's value chain?	What affective state or emotions are we hoping to evoke for customers in immersive environments?	What is our customers' demonstrated appetite for immersive media experiences?	What happens to our customer relationships if the smartphone interface disappears?	How can brands ensure that new realities and metaverse spaces are inclusive?	How will we incorporate input and iterate with customer feedback?	How do these new realities efforts serve and align with our brand values?	What does success in the metaverse look like for us today?
	Care, ease, delight, empathy, wonder?	What, if any, assumptions are we making about our user base?		What voices are represented at the table? Who are we overlooking or missing?			In 10 years?

KEY QUESTIONS FOR YOUR TEAM

9	10	11	12
What buy-in and support do we have for taking experimental risks with emerging technologies?	How dependent upon a proprietary platform is this effort, and what are the risks associated with that dependence?	What ecosystem partners, platforms, and communities are we working with to leverage domain expertise?	What other intersecting trends and forces could affect our efforts—climate change, quantum computing, chip shortages, geopolitical unrest, novel pandemics?
What is our risk appetite for investing in pilots and exploring new business?	What requirements would we have if we prioritized interoperability and decentralization?		
	If digital identities aren't interoperable across platforms, what problems might that create for our business?		

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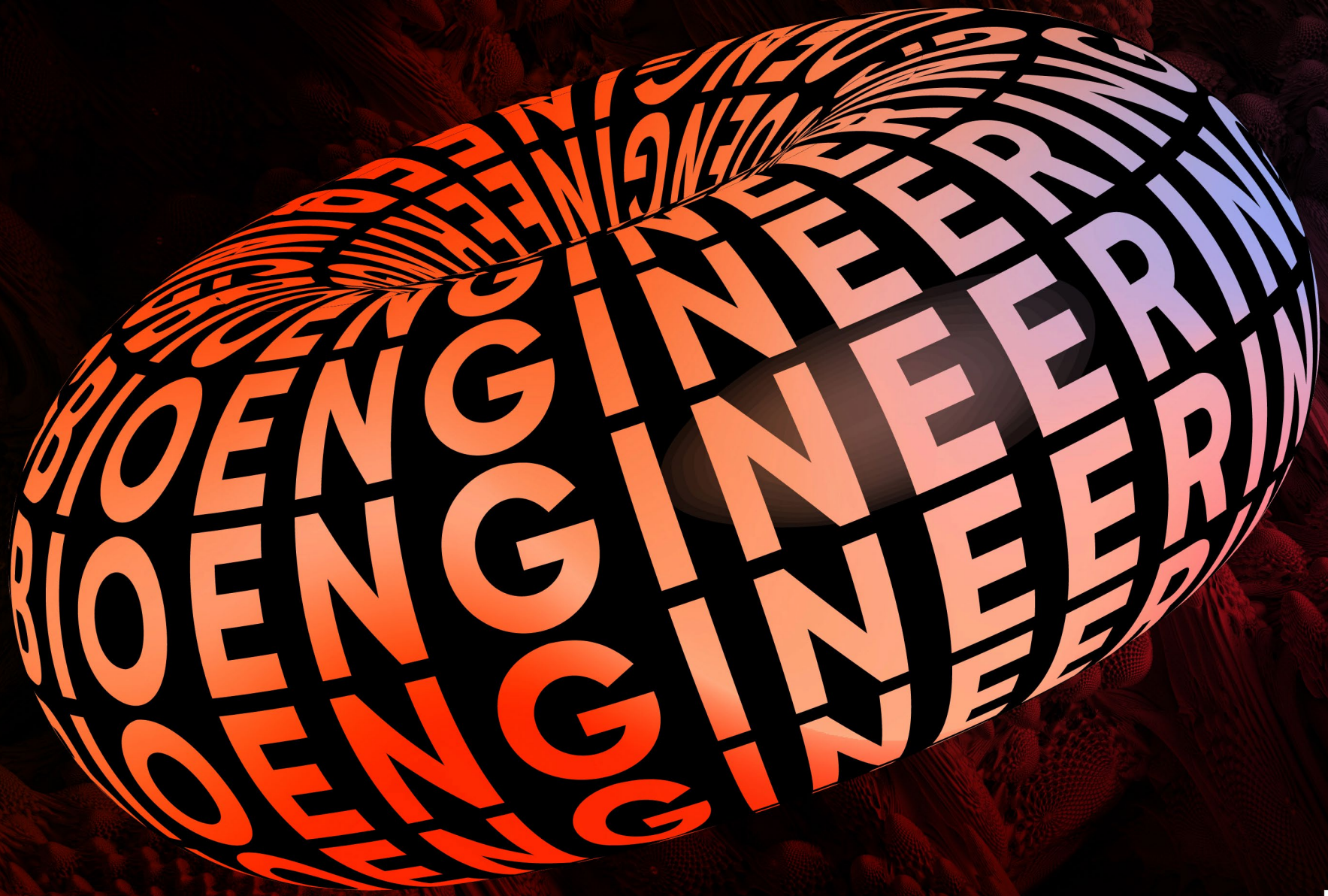


Future Today Institute

BIOENGINEERING TRENDS SUMMARY

Breakthroughs in bioengineering mean incredible opportunity for every industry, but could also pose new risks as the technology is developed and implemented.

Key Insights for 2023

Bioengineering is a modern "general purpose technology" that has the potential to influence entire economies and to alter society through political, economic, and social structures.

Innovations in biotechnology are currently defined by five key areas: biomolecules, biosystems, biomaterials, biocomputing, and biomachine interfaces. Major breakthroughs in one field either reinforce or accelerate breakthroughs in the others.

Based on viable technologies and use cases that exist today, estimates of the combined total economic impact of bioengineering range from $2 trillion to $4 trillion per year beginning in 2030.

Emerging trends in synthetic biology, CRISPR, artificial intelligence, and engineering will result in new opportunities for health care, pharmaceuticals, agriculture, food and beverage, beauty, chemicals, sustainability, energy, and materials production industries.

Disruptions to conventional meat and dairy production, textile manufacturing, and pharmaceutical development are on the near-term horizon.

Advancements will result in optionality for carbon capture, plastics recycling, and biodiversity improvement.

Ethical concerns around genetic engineering have yet to be resolved; this could prove to be a challenge as new techniques, such as genetic surgery, become available to the public.

There is no singular global framework governing bioengineering. As a result, we can anticipate geopolitical conflict stemming from the development and use of emerging bio-based technologies in the years to come.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Bioengineering is a long-horizon collection of technologies that will continue to develop and mature over the next several decades. It may feel premature to take action today; however, advancements in this field will have a compounding effect. AI offers a useful analogy here: The entire field of AI developed largely unnoticed by the business community, until suddenly it seemed to be both ubiquitous and a necessary part of daily operations. Leaders who were tracking AI developments and had developed a point of view wound up with valuable first-mover advantages.

In the coming decade, bioengineering technologies will force leaders to confront their cherished beliefs about their core products and services, and they will challenge existing business models. Leaders will need to seek out new partnerships, develop new pipelines for talent, and align stakeholders on the moral and ethical uses of engineered biology.

We advise businesses to prepare for the bioengineering age as they would for any other transformational technology:

FAMILIARITY

Get to know the science, history, ecosystem, and players. Read books on synthetic biology and CRISPR. Cultivate relationships with experts. Attend a few conferences, just to learn. Follow VC funding and learn about their startups.

TRENDS

Prioritize the trends that are most critical to the organization in the near term, and project the likely business impact.

WHITE SPACES

Explore white spaces to gain new insights. Where are there opportunities for innovation and growth? What might threaten the organization's ability to thrive? Where are there downstream risks to partners or customers?

REHEARSE THE FUTURES

Generate scenarios that reveal plausible future worlds where bioengineering technologies have reached critical mass. Where can the organization play and win? What challenges can be identified up front?

VISION

Develop a long-term vision on bioengineering technologies to drive investment, M&A, product development, talent acquisition, and planning decisions.

KEY QUESTIONS FOR YOUR TEAM

1

Are we adequately prepared for the bioengineering era?

2

In what ways will bioengineering influence our manufacturing process?

Our supply chains?

Our product lines?

3

How could we leverage bioengineering to give us a competitive advantage over our competitors?

4

How could bioengineering affect our business model in the next 2 years?

5 years?

If our typical product development cycle takes 5-10 years, what do we need to do differently starting today?

5

What new opportunity spaces can bioengineering unlock for our business?

Where does this open a new market?

6

How could bioengineering make our company vulnerable?

Does this change our perspective on risk?

7

Do we have the knowledge, experience, and talent in place?

8

What will it take to socialize the opportunities and risks of bioengineering inside our organization?

How can we create a sense of urgency among our stakeholders?

16TH EDITION · 2023 TECH TRENDS REPORT · CLIMATE & ENERGY

CLIMATE

Future Today Institute

CLIMATE, GREEN TECH AND ENERGY TRENDS SUMMARY

While challenges stand in the way of addressing climate change, tech advancements have stoked hope for the development of a sustainable future.

Key Insights for 2023

ENERGY PRODUCTION

Next-generation solar cells are thin, flexible, and printable, and they expand the spectrum of wavelengths from which they can extract energy, dramatically growing the application opportunities for the technology.

Wind is moving offshore. New types of turbines—vertical or bladeless, for example—might provide more efficient alternatives to horizontal ones, or can be used side by side to catch winds at different altitudes.

Startups aim to tap into geothermal energy 20 kilometers beneath the earth's surface. If successful and scalable, this could provide the majority of energy needed in the world.

Hydrogen can now be made from sewer gas (hydrogen sulfide) using nothing but visible light, making the production much more affordable.

Biofuels from hemp and algae could be more efficient to produce than from traditional biomass, bringing down the fuel's price and making it more likely that governments implement blending requirements.

Former landfills and mining sites can be repurposed for renewable energy development. They often have existing infrastructure and permitting advantages compared to other swaths of real estate.

The Lawrence Livermore National Laboratory's National Ignition Facility produced a nuclear fusion reaction that resulted in a net energy gain. Decades in the making, the breakthrough potentially paves the way for emissions-free energy—though realistically that won't happen for decades more. Many challenges remain, including devising the supporting infrastructure and storage for fusion energy.

New methods of harvesting energy can supplement or replace more traditional carbon-emitting energy sources. Waves, tides, and currents in bodies of water could provide more reliable sources of energy than wind or solar. Even sweat can provide a way to power small electronics and medical devices, producing no toxic byproducts.

Rare earths can be found in mining waste, opening the door to diversifying the world's supply. China currently controls 80% of the global market in rare earths.

ENERGY INFRASTRUCTURE

The costs associated with renewable energy have decreased significantly, but other barriers still limit the scale of these energy sources. More efficient and faster-charging batteries and novel methods of energy storage at the grid level are leading the way to affordable, environmentally friendly, lasting, flexible, and scalable solutions.

New technologies are making it possible to move and harvest energy in groundbreaking ways. Ultra-high-voltage power lines, power-beaming microwaves, and space-based solar power are among the solutions that will allow energy to be transferred to undersupplied regions or moved to areas experiencing energy shortages.

Grids are becoming more resilient and dynamic. This will be of supreme importance as more intense storms and forest fires increase as climate change worsens.

EMISSIONS REMOVAL

Volcanic sand and genetically edited crops could be significant natural carbon capture and storage (CCS) opportunities, in addition

CLIMATE, GREEN TECH AND ENERGY TRENDS SUMMARY

to expensive mechanical CCS installations at plants.

Companies are developing ways to use carbon dioxide captured from smokestacks or simply the air. A suite of new products ranging from fashion accessories to imitation meat can be made from the captured gas. The most viable products will combat environmental challenges by not only taking excess carbon out of the atmosphere, but also minimizing processes that emit extra carbon dioxide.

Tracking technologies are enabling both consumers and manufacturers to take control of their carbon footprints. Companies can develop competitive advantages by being more transparent with their value chains, appealing to environmentally conscious consumers.

EMISSIONS REDUCTIONS

Carbon-neutral or carbon-negative cement, 3D printing and AI-aided project planning, and the use of alternative materials such as recycled plastic all have the potential to significantly reduce the construction sector's emissions.

By using computer vision to better identify materials, recycling programs can boost their accuracy and profitability and thereby increase opportunities to bring new life to old products.

New materials are radically changing the built environment and bringing new life to the construction industry. A suite of biomaterials and advanced materials science will reduce carbon emissions and even result in carbon being stored within these new materials.

Consumer and industrial products are being equipped with solar and electric capabilities to reduce carbon emissions and provide reliable solutions for unstable energy grids. They are also being equipped with capabilities for reducing microplastics in the ocean.

The transportation sector is minimizing emissions through a series of innovations that improve vehicle aerodynamics, optimize charging, and even enable vehicles to be charged while moving. These innovations will be necessary for a critical mass of users to adopt electric alternatives.

Behavioral changes such as shifting to plant-based diets or using renewable energy for heating, cooling, and cooking will have measurable effects on reducing carbon emissions.

ENVIRONMENTAL MANIPULATION

Rewilding projects are growing and are getting a lot of public support, as healthy and balanced ecosystems also help combat climate change.

Cloud manipulation—brightening or seeding—might help reduce Earth's temperature or increase the amount of rain. Overall implications to the world's ecosystem are not clear.

The oceans could be our best bet for removing CO2 from the air, if humans "help" them by, for example, adjusting their alkalinity or encouraging the growth of phytoplankton. However, the effects of these experiments on the wider maritime ecosystem have not been explored.

EFFECTS OF CLIMATE CHANGE

Using AI, satellites, and drones to monitor the effects of climate change reveals data and new discoveries that otherwise would remain unknowable.

New types of city projects have garnered attention as climate change forces humanity to rethink where and how we live. Examples include domed, floating, and underground cities—all of which completely upend life as we know it.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

OPPORTUNITIES

Interim Solutions

It takes time—decades—to implement green processes and methods such as carbon capture and storage technologies or infrastructure upgrades to accommodate renewable energies and distributed grids. Long interim periods come with their own specific subsets of pain points. Are there developments in your industry that would benefit from products that address these transient states?

The Energy Opportunity

The energy sector is experiencing a shift in the power dynamics of stakeholders as customers demand and search for environmentally friendly products and services. Decentralization of the grid and non-dispatchable energy sources such as wind and solar are not only introducing new players to the energy market, but demands on the grid itself are fundamentally changing to accommodate frequent energy transformations and changes in energy direction. How can your company rethink energy, be it as a possible additional product or an alternative form of production?

Environmental Justice

Discussion about wealthy countries paying reparations to smaller, poorer countries that are disproportionately affected by climate change has gained momentum. Wealthy nations pledged payments during the COP27 last year. How can your company go beyond introducing green practices and help alleviate the damage done?

Go Local

By reconfiguring supply chains, manufacturers can source materials closer to production lines, minimizing the need to transport goods and products over long distances. Through innovations such as using repurposed carbon to make products, organizations can have more control over where products are made, allowing them to incorporate more instances of near shoring.

Get Ahead of Regulation

As more emphasis continues to be placed on ESG, the onus will be on organizations to provide transparency into their inner workings and environmental impacts. It will behoove organizations to get ahead of these new expectations. Aside from the adoption of more stringent ESGs from shareholders and investors, swift regulatory changes will catch many organizations off guard and have significant bottom-line ramifications.

THREATS

Cybersecurity

Technology enables and facilitates the shift to environmentally friendly processes in many of our most important industries—energy, food, industrial processes. However, this also makes those industries vulnerable to cyberattacks. As you upgrade your company's digital infrastructure, are you making sure that your systems are adequately protected? And how are you preparing for outages caused by cyberattacks?

Unexpected Impacts

Disrupted supply chains have caused balloon flights from the National Weather Service's Storm Prediction Center to be canceled, reducing data collection and compromising forecasts. The number of cities across Europe declaring clean air zones is expected to rise exponentially by 2025, forcing polluting vehicles off the road and possibly affecting last-mile delivery. Most leaders are aware of the direct impacts of climate change and environmental regulations on their businesses—shortages of raw materials, for instance, or a fragile supply chain. But are you aware of the second- and third-order impacts on your business of shifts in consumer behavior and an evolving regulatory landscape?

A Shortage of Qualified Workers

Although many tech workers have left the industry to find climate-related roles, the world will still face a dearth of talent dedicated to ensuring a climate-resilient future. Roles will become increasingly specialized, as the need for new technologies will also create the need for careful operation and maintenance. Universities can be slow to adjust to such changes, so climate-conscious organizations will have to source and train much of the available talent on their own.

Planning for Climate Migration

Climate migration will become an existential threat sooner and to a greater degree than many are anticipating. As climate migration increases, businesses will have to adjust their operations, supply chains, and skilled talent. Many will face decisions to uphold human rights and equality.

The End of Greenwashing

Are you prepared for complete transparency? As the ability to track CO2 emissions increases and industries can account for and track emissions throughout the entire value chain and lifecycle of a product, it will be easy to determine who greenwashes and who is implementing truly environmentally friendly practices.

KEY QUESTIONS FOR YOUR TEAM

1

Are we aware of how climate change will affect our entire value chain?

Considering our location, supply chain, and the cost of raw materials, how will our customers be affected?

2

Can we produce our own energy, and potentially even sell surplus energy to third parties?

3

How can we and/or our vendors become part of the circular economy?

4

Will our products or services still be relevant in a world that is moving toward environmentally friendly processes and a lifestyle suited to a new climate reality?

5

Does my team or department need new skill sets to optimally address climate or energy questions?

6

Do we know our complete CO2 footprint, and are we prepared for stricter environmental regulations?

7

Can we capture the CO2 we emit? And what would it take to enter the CO2 market?

8

How should we prepare for more frequent and more severe extreme weather events?

9

What alternative materials are we prepared to integrate into our built environment or our products to create more sustainable behaviors?

16TH EDITION • 2023 TECH TRENDS REPORT • MOBILITY, ROBOTICS & DRONES

ROBOTICS DRONES MOBILITY

Future Today Institute

ROBOTS, DRONES AND MOBILITY TRENDS SUMMARY

While challenges stand in the way of addressing climate change, tech advancements have stoked hope for the development of a sustainable future.

Key Insights for 2023

As these mobility, robotics and drone markets mature, they are tackling three key areas of transformation:

Electrification: Mobility is making substantive shifts to battery-powered vehicles, while robotics and drones remain committed to an electric future.

Automation: Mobility is seeing growth in automated safety features, while the capabilities and use of drones and robots to automate specific tasks and jobs continue to rise.

Autonomy: All three markets are looking to impart more autonomy on their machines, allowing them to become more effective. More autonomous operations would help the three markets in their quest to solve the last mile delivery problem.

ELECTRIFICATION

Companies are reimagining the interior of vehicles to improve the driver and passenger experience, creating a third personal space for consumers, outside their homes and workplaces. EVs afford designers an open and blank space to work with. Entertainment is a focus, but improved connectivity and comfort are also factors, especially for companies looking to develop interiors for when fully autonomous driving emerges and passengers can work, play, or relax in the vehicle. Reimagining how vehicles are used is encouraging non-automotive companies to capitalize on the growing market, and create a deeper connection between home and car.

Bidirectional charging will open up new markets and other uses for electric vehicles. EVs can now power job sites or venues, supply emergency power, and serve as a backup to the grid. One day, these vehicles could augment the broader electrical grid or allow more homes to operate off-grid.

EVs prices have already begun to drop, fueled by tax credits and companies lowering prices to entice consumers. Battery prices are also expected to fall over the next five years as economies of scale take shape, new materials and methodologies become viable, and recycling becomes more prominent.

Legislation phasing out internal combustion engines has been enacted across the European Union, Canada, and a handful of US states. Businesses will be forced to respond to these mandates, as well as consumer expectations of Environmental, Social and Governance (ESG) goals. These regulations may push other industries to adapt and adjacent industries, such as warehousing and wholesaling, may see price increases as supply chains pass along new costs.

Drastic shifts in how engines are powered and designed will shift the risk characteristics of the mobility industry, as well as the manufacturers of these components. These shifts may require a re-examination of underwriting standards by insurance carriers. Another consequence will likely be a shortage of qualified vehicle maintenance professionals. As more automakers adopt direct-to-consumer car sales, dealerships are facing a very different future and their maintenance departments may disappear.

Vehicle expenses and insurance costs are likely to increase as additional entertainment options are added to vehicles. Customers will also be exposed to a growing number of new business models like subscription services that lock factory-installed features behind a paywall, or more instances of à la carte feature selection.

The market is moving toward consensus on the future of the EV market. Standardization of charger types and connections, charging locations and access, and charging costs are coming into

ROBOTS, DRONES AND MOBILITY TRENDS SUMMARY

focus, but more legislation and regulations are needed to bring the industry down a single path, rather than continuing to branch into numerous business models.

Hydrogen fuel is without question an excellent green alternative, but adoption rates for this technology are still unclear. For construction or industrial operations out of reach of existing grids, hydrogen may present a cheaper alternative than installing longer-term solar or wind. Military operations may seek hydrogen fuel solutions if they are interested in lessening their carbon impact. However, it is likely that fossil fuel availability and the lack of needing to change vehicle architecture will inhibit extensive growth here.

AUTOMATION

Ultimately, automation will reduce risks in the workplace and on roads since most accidents are caused by human error. Businesses should be looking at increasing automation in their operations to reduce the risks of accidents and injuries.

Robots and drones are here to stay and they will impact employment opportunities for workers. At this point, a lack of capital investment is slowing widespread adoption, as well as the reluctance to remove humans from the workplace. A large number of jobs can be automated, and labor market shortages are compelling businesses to increase robot adoption. Machines do not ask for a raise, take time off, or need health benefits. However, machines need a technically trained workforce to maintain them and repair them when they break down.

A rise in automation also means that governments, labor or trade unions and organizations, academic institutions, and nonprofits need to begin preparing for and anticipating the wave of shifting employment needs. Former human employees will need financial support. Students will need to learn new skills and many former workers may be forced back into school. Just as there are now ongoing discussions of how academia needs to adjust to the release of ChatGPT, there should be a re-examination of worker training for the automation age.

AUTONOMY

Autonomous vehicles, robots and drones produce an immense amount of data, and most companies are not capturing enough of this valuable information. Insights gleaned from this data could drive efficiencies across operations, or be sold to interested parties from other industries.

Compared to the steady adoption of EVs, the autonomous vehicle market is still uncertain. While a few key players are emerging, regulation is still muddled and inconsistent, though new rounds of lawsuits and investigations may resolve some outstanding issues. However, in order for autonomous vehicles to scale, it will require cooperation across a complex spectrum of participants, including regulators (both state and national), technology developers, consumers, and those responsible for building the infrastructure. A task that will be challenging and time consuming.

Developing solutions to the last mile delivery problem are of paramount importance. Transportation companies, robotics makers, and drone producers are seeking ways to accomplish this with little or no human intervention. If companies can develop drones that more viably transport heavier packages with drones, this may truly enable the elimination of some last mile deliveries that need to be completed with a vehicle or person. This could even expand to industrial operations, allowing companies to move heavy materials around without fixed machinery or large vehicles. Construction companies could move materials between job sites, and industrial firms could move products across different stages of production.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Despite some of the headwinds against mobility, robotics, and drones, the major breakthroughs that these markets promise feel like they are more of a matter of when versus if. Electrification will take hold over the next 10 years, with autonomy not far behind. Substantial automation will be driven by the widespread adoption of robots and drones with their autonomous capabilities growing daily. With these changes coming, organizations should have plans in place to take advantage of or defend against the coming changes. Impacts are coming for all businesses regardless of their direct or tangential connection to mobility or machinery. Most companies should prepare for:

- Capturing and operationalizing data from vehicles, robots, and drones.
- Finding opportunities to enable automation in their operations.
- Knowing how insurance will be meaningfully impacted by automation.
- Understanding how mobile spaces are and could be used differently.
- Learning the impacts of electrification.

All businesses and governments need to absorb increasing volumes of data, as well as capabilities to analyze and utilize the data.

There are opportunities to capture revenues from the data generated by a fleet, robots, or drones. This information can assess the health and efficiency of an operation, suggesting corrections to save on the bottom line, but also to mine insights and sell this information to other companies. Would an insurance carrier like to know how robots are performing and how frequently they are down? Would they like to know how accident rates have fallen? Would a government or department of transportation like to know what their roads look like? Are vehicle routes efficiently mapped and planned? If your company has the ability to answer these types of questions, you should be questioning how quickly you can use it.

Manufacturing, warehousing, delivery, and labor-intensive businesses need to reevaluate operations to find opportunities for automation.

Companies should identify opportunities where robots or drones fit their operations. Some workers will be replaced, and others will need to be trained to work alongside the new machines.

Labor shortages present challenges, and robots and drones offer solutions.

Drones and robots can take over repetitive, dirty, and dangerous jobs, allowing the workforce to focus on more complicated tasks, keeping them happy and safe. Pulling people out of these jobs will dramatically lower insurance costs. Employees who sit in an office have a lower insurance cost for a reason—they are substantially less likely to get hurt and need care or rehabilitation.

Automation will meaningfully impact liability, workers' compensation, and property premiums and risks.

Insurance companies should determine how to promote automation. Increased automation could meaningfully impact liability and workers' compensation market premium opportunities as fewer employees are placed in more dangerous positions. Installing more machinery may offset those changes by raising property risks.

Businesses should weigh the change in expense structures that will come with automation. Companies will more than likely see a savings on premiums and insurers will save on claims

HOW TO PREPARE

What should your organization do now to prepare for these trends?

payouts. It is far more advantageous for a business and an insurance carrier to know exactly what the probable maximum loss is. A machine offers that luxury, as people are unpredictable and fragile.

Automakers, retailers, software, and entertainment businesses should explore how workers and consumers will expect to use mobile spaces differently.

With dramatic shifts to vehicle architecture underway, how people use their cars needs to be rethought. Will a car become a third space, between home and work? An EV could some day become a remote workspace. The van life concept—living in a vehicle, always on the move—spread during the pandemic, and new technologies may encourage a new wave of nomadism that utilizes modern, digital comforts. Will this change where people live? How will this impact the workforce? Employers must be prepared for a staff that demands remote work options.

Businesses, governments and municipalities will need to incorporate electrification and infrastructure investment into their long-term (5-10 years) strategic plans.

Businesses will need to plan for the transition to EVs. Hard questions will need to be asked and an organization will need to decide how quickly it will make the switch. ESG considerations should not be ignored, especially as consumers make the switch. They will likely demand the same, if not more of the businesses they buy from.

Governments of all localities and sizes need to begin planning for a different-looking environment that their constituents will work, reside, and play in. Fundamental changes are coming to how roads, offices, shops, and homes are constructed—all centered around charging the incoming wave of EVs.

KEY QUESTIONS FOR YOUR TEAM

1

If our company wants to take advantage of the new push for market share in the modern vehicle interior, are we delivering a product or service of lasting value that is transferable between vehicle types (ICE, EV, semi-autonomous, autonomous)?

Can our product or service survive decades of significant, ongoing change?

2

How can we leverage bidirectional charging and other new uses for electric vehicles?

3

Are we collecting data from vehicles, operations, people, and machinery?

If not, what would it take for us to do so?

How could we leverage that data to make our business better?

Who else would be interested in our data?

4

Are we prepared for the next chip shortage or some other failure within the supply chain?

5

Are we prepared for changes in our workforce?

How will shifts in birth rates, changes in educational attainment, job satisfaction, and monetary needs change who we hire and what skills we look for?

KEY QUESTIONS FOR YOUR TEAM

6

Can we leverage robots and drones to eliminate dull, dirty, or dangerous jobs in our operations?

7

What would our business look like with half the number of human staff?

How would it function differently?

How would we feel about making this change?

8

Can we accommodate the implementation of a new robot/drone as seamlessly as we could hire and train someone?

Do we have the space and knowledge to do so?

9

For insurance carriers weighing the loss of workers' compensation premiums to automation—would we rather pay to fix a broken machine or a broken person?

10

Can we offer our robots or drones as a service to others?

What if they were autonomous?

16TH EDITION · 2023 TECH TRENDS REPORT · COMPUTING

COMPUTING

Future Today Institute

COMPUTING, NETWORKING AND QUANTUM TRENDS SUMMARY

Incredible computing achievements over the past several decades have paved the way for the creation of new computing architecture and applications.

Key Insights for 2023

Regions slow to adopt 5G will get left behind in multiple sectors.

6G is the sixth generation of wide-area wireless technology, and is already in development. Unlike 5G, 6G does not require an entirely new infrastructure. It builds upon the infrastructure that's being put in place for 5G. This means that when 6G is available, adoption will be quick.

The metaverse will not happen without significant advances and implementation of computing and connectivity technologies, among them 5G, middle-mile fiber networks, and high resolution video technology.

Satellite internet will squeeze margins of other communication service providers and render them less relevant.

The semiconductor shortage made the vulnerabilities in the global supply chain brutally clear. Chip shortages reverberated throughout the world economy and drove countries to accelerate domestic chip production via subsidies and enact protectionary policies. These protectionary policies may have unintended consequences.

Organic computers may help us overcome Moore's law since they can store more information than a transistor and do so with less energy.

Quantum computers will be able to break into any conventionally encrypted computer. To keep data and secrets secure, governments and companies must act now to implement post-quantum cryptography.

Computationally intensive processes are ideal candidates for quantum applications. By utilizing quantum to perform Monte Carlo methods, researchers can include more random values in the simulation—thus improving accuracy—without compromising speed. And quantum computers are ideally suited for simulating molecule behaviors, thereby drastically speeding pharmaceutical drug discovery and development.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

The future of computing presents both threats and opportunities for business. To prepare for the future, businesses should consider implementing the following actions.

PREPARE FOR FUTURE SUPPLY CHAIN DISRUPTIONS

The ongoing effects of the chip shortage, coupled with inflation and geopolitical tensions, will continue to make it difficult for some industries to meet demand. Businesses should be proactive in finding ways to mitigate the effects of the chip shortage, such as by diversifying supply chains or finding alternative sources of chips.

SECURE IOT

While the iInternet of Things (IoT) will bring many benefits, it also introduces vulnerabilities through the collection and transmission of personal data and the possibilities of weak security measures. Businesses should ensure their IoT devices are secure and that appropriate measures are in place to protect personal data.

INVEST IN INFRASTRUCTURE

Smart telcos can establish dominance early by providing the best building blocks for the metaverse ecosystem. Companies can position themselves now to provide edge computing services, and capture in-metaverse data to help their customers improve decision-making and products, or provide trusted cybersecurity services fit for the virtual world.

PROTECT AGAINST IP THEFT

Quantum computing could be used to reverse-engineer proprietary technology and algorithms, leading to the theft of intellectual property (IP) or trade secrets. Businesses should take steps to safeguard their IP, such as by implementing strong cybersecurity measures and being proactive in threat detection and mitigating potential threats.

GROW THE QUANTUM TALENT POOL

There is a shortage of skilled quantum workers, which could hinder quantum breakthroughs and make it difficult for companies to compete in the era of post-quantum cryptography. To prepare for the future, businesses should focus on attracting and training technically skilled labor in quantum computing.

KEY QUESTIONS FOR YOUR TEAM

1

How will the limitations of Moore's law affect the performance and capabilities of current business processes?

2

How can we take advantage of new computing architectures and models?

3

How should we plan for, and adapt to, the rollout of 5G and the development of 6G?

What are the consequences of falling behind these technologies for our operations and competitive position?

4

What are the implications to our business depending on which country is the first to achieve quantum supremacy?

5

Do we have the necessary skills and expertise to take advantage of these emerging technologies?

If not, what do we need to do to upskill or attract the right talent?

6

Is our business or industry vulnerable to computing-related supply chain disruptions?

If so, what steps can we take to mitigate the risks and eliminate points of failure?

7

How can we engage with researchers and developers of neuromorphic computing technologies to collaborate on the development and deployment of these technologies, and how can we stay informed about the latest developments in this field?

8

How can we ensure that our deployment of emerging technologies, like AI and quantum computing, is done so in a responsible and ethical manner?

16TH EDITION • 2023 TECH TRENDS REPORT • NEWS & INFORMATION

Future Today Institute

NEWS AND INFORMATION TRENDS SUMMARY

Virtual environments, artificial intelligence, and new ways of consuming information are forcing news and information business models to transform.

Key Insights for 2023

Generative applications of AI—like OpenAI's DALL-E 2 image generator—have gone mainstream. This new class of tools is actively rewriting workflows and creating new norms for consuming media.

Large language and transformer models are revolutionizing how search engines answer questions. These innovations will radically alter the way consumers discover new content—and how publishers build relationships with their audiences.

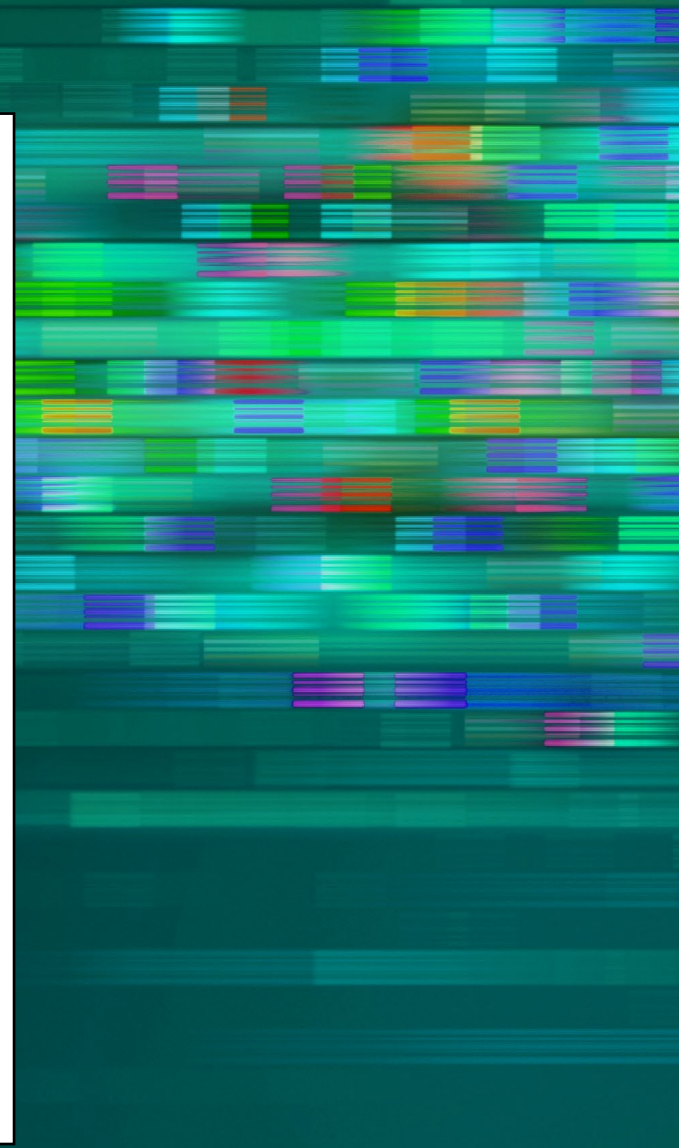
Trust in news is at a historic low around the world, leaving news organizations vulnerable to reputational crises, which might originate from human error or from a coordinated assault by bad actors.

Journalists increasingly need technical knowledge to trace stories, protect themselves from cyberattacks, and monetize their work. The demand for these skills can be filled by training, building external partnerships, or breaking down silos in legacy organizations.

Innovative applications of emerging technology generate excitement and enthusiasm from funders, but legacy media companies remain skeptical of changing operations.

AI researchers are actively investigating how algorithms can be used to improve news recommendations, detect fake or misleading media pieces, and identify facts in disparate sources.

Without engagement from journalists and media organizations, this work risks solving the wrong problems or creating deeper issues for the future of news.



HOW TO PREPARE

What should your organization do now to prepare for these trends?

Executives will be challenged in 2023 to grow market share and revenue.

Subscription programs will battle economic headwinds and market saturation.

Inflation will put growing pressure on consumers to prioritize expenses. The temptation for publishers will be to fight churn exclusively with tried-and-true market tactics like discounting to get more subscribers in the door, and price discrimination to earn more from a diminishing subscriber base. The way forward, however, is for publishers to seek real innovation for their core products to ensure continued relevance—and the integrity of their value chain into the future.

Evolving search interfaces will change how consumers discover new content.

Voice assistants and natural language search results will gradually replace the traditional link-based search-engine result page, disrupting a key audience growth tactic and decreasing traffic to on-site paywalls. This trend will force publishers to reconsider how they connect with new users.

Device manufacturers can deliver bundled content, disrupting publishers' relationships with audiences.

Apple News and Google Discover aggregate a mix of local and national news directly onto the home screens of Apple and Android devices, respectively. Those apps—designed by highly resourced teams out of Silicon Valley and backed by large content-licensing budgets—directly serve the news needs of many consumers, diminishing the need to turn to a local newspaper or public broadcaster.

Innovation related to the creation, distribution, and monetization of information is happening across multiple, unrelated domains.

Resource-constrained publishers need to stay abreast of developments in AI, hardware manufacturing, and network connectivity. The uncertainty posed by those domains is magnified by the impacts of government regulation, changing demographics, and shifting social expectations. Most legacy publishers—and even digital upstarts—don't have the organizational culture to respond to those multidisciplinary challenges.

Trust in institutions—and in news media, particularly—is at historic lows.

News organizations live and die by their reputations. Without trust, it's impossible to build the audience needed to sell advertising at scale or to convert consumers to subscribers.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Organizations seeking to take an active role in shaping the future of news should monitor emerging opportunity spaces.

- Large language models like OpenAI's GPT-3 and Google's Pathways Language Model can be used to generate and publish new types of content.
- Emerging devices will demand new programming formats. Creators who partner with tech companies early will be able to set norms and negotiate better deals than those who wait.
- Advances in generative AI have created production-ready tools that can power multilingual translation, chatbots, and personalization.
- Generative AI also makes it easier to transform the format of content: Text can become audio. Audio can be paired with visuals to create video. Video can be summarized effectively into text. This opens the door for creators to distribute content in formats, and on platforms, they might not otherwise have explored.
- In a low-trust environment, brands that build and maintain durable relationships with consumers will thrive. Publishers that have accrued trust over decades can translate that across distribution formats with thoughtful product development.
- Teams of computer scientists around the world are exploring how to apply artificial intelligence to identifying lies and misinformation on social media and in the news. Organizations that identify those researchers could build relationships to shape and play a role in that research. They may also identify talented AI experts interested in working on problems related to the future of news.

KEY QUESTIONS FOR YOUR TEAM

1

Are we prepared for a future where generative AI further reduces barriers to creating compelling content?

A world where the power to distribute content is increasingly concentrated among device makers?

2

How would our organization respond to a trust crisis in our audience?

Are we prepared to defend against bad actors who want to smear our brand?

3

What new opportunities are possible for our company using generative AI?

4

What assumptions about content distribution are baked into our operating model?

How might those change over the next two years?

What can we do to mitigate the risk that those assumptions are wrong?

5

Does my team or department need new skill sets to optimally address climate or energy questions?

6

Is our company's revenue concentrated in one place? How long would it take to meaningfully change that?

7

What ethical norms do new technologies challenge when they create content?

8

Do we have the knowledge, experience, and talent in place to respond to emerging threats?

Do we need to build new partnerships with technologists?

9

What will it take to socialize the opportunities and risks posed by new technologies inside our organization?

How can we create a sense of urgency among our stakeholders?

16TH EDITION · 2023 TECH TRENDS REPORT · **FINANCIAL SERVICES**

Future Today Institute

FINANCIAL SERVICES TRENDS SUMMARY

Digitization, invisible interactions, and developments from incumbent players and new entrants is rapidly transforming the financial services sector.

Key Insights for 2023

Multiyear efforts to digitize financial services are finally coming to fruition, enabling the explosion of financial technologies that underpin the movement to open banking. Open banking can lead to open finance, which can accelerate open data, and fundamentally change how scarce resources are distributed and allocated.

Customer-centric and socially responsible approaches are increasingly table stakes in the design of financial services products.

In 2023, expect increasing commoditization of financial services infrastructures.

During the next 18-24 months, Decentralized Finance (DeFi) will mature, sparking new investment, growth, and adoption.

Future Today Institute expects mainstream financial services and decentralized financial services to run in parallel for some time. As DeFi continues to mature, organizations will gain hard-fought insights around structural and customer protection systems. We anticipate legacy finance will evolve while trying to build connective tissue to decentralized systems, with the explicit goal of absorbing enough functionality to avoid total disintermediation.

Look for large nonfinancial players with significant centralized market power, such as platform providers and regulators, to play increasingly active roles in setting rules and guiding the evolution of financial services.

As back-office infrastructure has opened up and become standardized, banking-as-a-service providers are growing increasingly popular. We anticipate growth in the space during the next 24 months.

New forms of data modeling and credit scoring will expand access to financial systems in 2023. Responsible innovation will be crucial to the future of alternative credit scoring, especially as machine learning techniques and generative artificial intelligence systems are applied at scale.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Executives will experience ongoing rapid change as the digitization of financial services matures. This will substantially increase the complexity and interconnectivity of the entire financial services ecosystem.

1. CORPORATE INNOVATORS

- Prepare to fast follow as waves of startups reach maturity and demonstrate viability of new markets and business models.
- Look to startups with new business models and local product market fit that seek to expand regionally or globally.
- Build the corporate muscles to make strategic decisions in uncertain environments by creating clear guidance across the organization.
- Develop intentionality around acting, watching, or ignoring.

2. REGULATORS

- Work with creators and builders to convey institutional knowledge learned from past dealings with legacy financial services.
- Seek out diverse perspectives and opinions.
- Stay focused on the intent of key rules, and regularly revisit them to ensure they achieve that intent.
- Be sure to understand the market power of each stakeholder.

3. DEFI BUILDERS

- Prepare for potential regulation.
- Adopt a global mindset with local implementation.
- Support parallel development to legacy financial services, while establishing sufficient rules and guardrails for the industry to mature.
- Prepare for DeFi and legacy financial services to become increasingly interlinked.

4. STARTUPS

- Look to flywheel business models, and a land-and-expand commercialization strategy.
- Expect securing funding will become significantly harder, and limit burn rates accordingly.
- Build milestones and checkpoints into growth projections, and be prepared to forego certain expenses and deals if those milestones aren't achieved.
- Assume flat or down valuation funding rounds.
- Get to breakeven as soon as possible.

5. VC INVESTORS

- Seek out companies with break-even strategies and healthy unit economics.
- Prepare for internal rounds and decreasing valuations.
- Help failing companies shut down quickly, and with dignity.

6. RETAIL INVESTORS

- Expect story stocks and meme stocks to revert to more standard valuations.
- Prepare for new asset classes, like NFTs and fractional investments, to become a part of a well-diversified portfolio.
- Keep an eye out for financial advice from non-traditional sources.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

HOW TO SPOT SECTOR OPPORTUNITIES

White space

- Watch entities that set rules for owners of relationships with large customers: governments, platform operators, banks, exchanges, etc.
- Watch for when those entities make rule or access changes that enable startups to enter previously restricted spaces.
- After startups enter such spaces to iterate and fail fast, look to large corporates to seek partnerships or deals to capture those markets.

Ignored space

- Look to startups that fulfill the customer needs that large institutions don't address, either because doing so would cannibalize their business or because it doesn't pay off to target small but fast-growing market segments.
- Look to geopolitical tensions to create more room for domestic first solutions.

MACRO OPPORTUNITIES RIPE FOR ACCELERATED CHANGE IN 2023

- Using financial data accessed through open banking.
- Converting existing money movement to real-time and near real-time frequency.
- Efforts to make DeFi mainstream (regulation, on and off ramps, governance).
- Orchestration of back-office intermediaries for invisible customer and business experiences.
- Commoditization of financial services.
- Financial inclusion to increase the global market for financial services.
- Creators increasing their market power.
- Platforms reinforcing their walled gardens.
- Social responsibility becoming table stakes.

KEY QUESTIONS FOR YOUR TEAM

1

What areas are being ceded to startups, whether intentionally or unintentionally?

2

What happens if financial services become a commodity?

3

What opportunities arise when players across all industries are forced to open their back offices to third parties?

4

How do pre-programmed financial decisions like standing orders evolve to represent intent, such as "make sure my checking account never runs out of money"?

5

How does this industry sell to an algorithm? Do business models break if a human isn't the ultimate decision-maker?

6

What does the consumer banking website of the future look like?

7

How do financial players adapt to the changing balance of power between individuals and institutions?

8

Who owns a customer relationship, and how many intermediaries can there be between the customer and the final product?

How do we balance complexity versus simplicity?

How many intermediaries is too many to deliver great customer experience or to ensure safety and security?

9

How can the industry learn from, and prepare for, the influx of new startups?

10

Who within our organization is ensuring our readiness to quickly follow what's happening at the fringe?

Future Today Institute

HEALTH CARE AND MEDICINE TRENDS SUMMARY

A constellation of forces is aligning, and promising to result in a transformation of every aspect of health care: operational, clinical, financial, and patient care itself.

Key Insights for 2023

Amazon is health care's most ambitious disruptor, and its every acquisition or new service announcement moves markets. In January 2023, the company announced RxPass, a $5-per-month subscription service for unlimited prescriptions. In the future, look for Amazon to execute on a broad strategy that aims at nothing less than reworking the entire US health care ecosystem.

Venture capitalists now target rural communities, which traditionally lack access to health care, with medical startups. In order for bio- and health tech-focused startups to find footings in the market, they need real-world applications. This means getting a foot in the door of health care systems, which is what investors are doing as they launch partnerships to create pilot sites for the startups in their portfolios.

Membership-based services and health tech startups are creating new direct-to-consumer (D2C) models that better fit the needs and lifestyles of younger, digitally savvy generations.

Americans can now legally obtain their medical data, though existing systems make it difficult to access most of it. That will change starting in 2023, thanks to new policy changes, which will create new opportunities and operational challenges for health providers.

Breakthroughs in sensors and artificial intelligence are expanding the possibilities for remote diagnosis. Data captured by clinical-grade sensors is triaged by algorithms, thereby reducing the time from insights to action.

Brain-computer interfaces will begin clinical trials in 2023.

Medical misinformation will continue to pose significant risks. In addition to disinformation campaigns about viruses and vaccines, a new breed of medical deepfakes in diagnostic imagery maliciously adds––or removes––tumors and other conditions.

Whole-genome sequencing, to screen babies for genetic diseases, could become a routine part of wellness exams in the near-future. Emerging therapies are allowing doctors to treat genetic disorders in utero.

Researchers are developing genetically engineered organs in animals for xenotransplantation, or transplantation into human patients. This could unlock a new type of medical agribusiness—and, of course, a whole host of ethical concerns.

Since the start of the pandemic, consumer adoption of digital fitness technologies has skyrocketed. Health and fitness apps, connected fitness equipment, and health-focused wearables are up 13%, 15%, and 16%, respectively, since early 2020. The next wave of fitness and health-focused technology growth will focus on scaling meditation, sleep, and mental health technologies so they are more affordable—and more accessible—for the mass market.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

As emerging technologies bring the power of the laboratory into our homes and AI expands the possibilities for remote diagnosis, knock-on effects will be realized this decade. Ongoing disruption is likely.

Executives and their teams must confront their cherished beliefs about what health care has always been—and develop new mental models for what it could be in the future. It would be a mistake to focus only on three- or five-year strategic plans, because big tech players (Amazon, Meta, Google, Apple) and well-capitalized startups play a longer game. In the next few years, leaders will need to develop a refined vision for future growth. We recommend that you evaluate how the technology trends in this report are likely to shape the futures of health care operations, as well as the practice of medicine and the health insurance ecosystem.

Companies seeking to take an active role in shaping the future of health and medicine should be developing a point of view on technology (hardware, software), data collection, the patient experience, external partners, and the talent pipeline. Which of these will likely impact your enterprise earliest? Which might take longer to develop, but could have a larger impact on your operations?

Wearable devices are moving from the fringe to the mainstream, and consumers are looking for actionable insights. They are also more health-conscious in the wake of the pandemic. Additional factors include the rollout of 5G networks and relaxed rules on telemedicine and remote patient monitoring. Longer-range road maps in the health, medical, and wearable space can balance near-term expectations with more aggressive research agendas. Rehearsing the futures of health care using strategic foresight has never been more important.

KEY QUESTIONS FOR YOUR TEAM

1

How could home-based diagnostic systems disrupt our business?

2

If direct-to-consumer tests threaten our profitability, can we develop new products or services to compete with upstarts?

3

How might emerging technology unlock new growth opportunities for our business?

4

If we source new/more biometric data, could we develop new and deeper insights about our patients and customers?

5

How could advancements in some of these health and medical tech trends make our company vulnerable?

6

How do these trends change our perspective on risk?

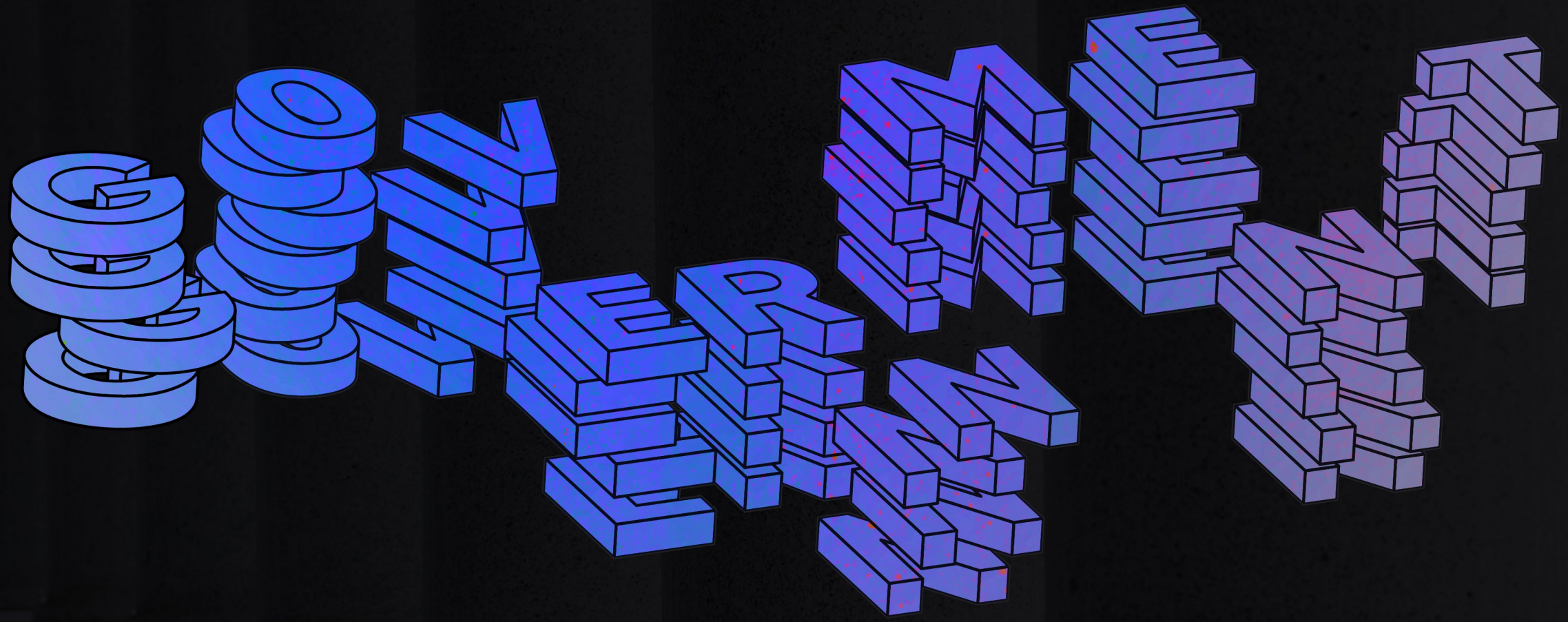
7

Do we have the right knowledge, experience, and talent in place to take advantage of these trends?

8

In a field where breakthroughs can't be scheduled and research can take a decade or more to produce a viable candidate, how can we create a sense of urgency and take meaningful action right now?

16TH EDITION • 2023 TECH TRENDS REPORT • GOVERNMENT, POLICY & SECURITY



Future Today Institute

GOVERNMENT, POLICY AND SECURITY TRENDS SUMMARY

The intersection of a global polycrisis and increasingly sophisticated cybersecurity risks are contributing to the creation of a new global disorder.

Key Insights for 2023

The internet has permanently splintered. Policies in the West to promote a free internet largely failed, leaving a fragmented digital ecosystem with competing interests to grow. If there ever was a truly open, global internet, it's over.

Data from myriad sources is now viewed as a component of geopolitical power. Country leaders view data as central to competitive advantage, while tech companies rely on it to thrive and grow. This positions Big Tech and government as adversaries in countries like France, the US, and the UK, while China's Big Tech companies are reluctant bedfellows with the Chinese Communist Party (CCP) leaders.

In 2023, the EU will finalize its AI Act, which will focus on the use of AI systems that use citizen data for potentially detrimental purposes. It's viewed as the world's first attempt at creating broad, enforceable standards governing the use of AI. While AI developed for national security or military uses will likely be exempt from the EU's new regulations, social media platforms like Facebook and TikTok could find it difficult to comply.

The global pandemic accelerated digital transformation. From newly automated city services to the now widespread acceptance of telehealth, modernization initiatives are being deployed across local, city, state/provincial, and national governments. This sets the stage for long-term digital transformation of government administration.

Industrial policy has suddenly reemerged as a tool to bolster science and technology competitiveness. After falling out of favor in the US during the 1980s, there is now growing enthusiasm in many countries for new policies supporting technology-driven industries considered strategically important (such as the semiconductor chip industry).

Beijing has hundreds of basic research projects underway, ranging from new quantum systems and supercomputers to synthetic biology and genetic engineering. China has restructured its higher education system, positioning universities to conduct basic research at scale. As the country starts to surpass the US in government-funded basic research, the US and other governments now see basic research as a path to enhance competitiveness.

Chinese companies will respond to government calls in 2023 to share their prosperity with society through public-private partnerships and financial support of basic research. Tencent, China's mega e-commerce, social media, gaming, and super app giant, will contribute $1.5 billion over 10 years to catalyze basic research in biology, math, physics, and life sciences.

In the US, proposed bills to invest hundreds of billions into technological development could change the way we think about the government's role in value creation. Those bills include the Infrastructure Investment and Jobs Act, ($550 billion), the Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act ($280 billion), and the Inflation Reduction Act ($390 billion). Collectively, they mark the most aggressive funding plan for technology and science in a generation.

The United Arab Emirates hopes to become a neutral, global hub for emerging technology and policy innovation. In the coming year, look for advancements in health care, autonomous driving, cryptocurrencies, e-commerce, and AI. The UAE has publicly stated plans to be home to at least 20 unicorns––startups worth $1 billion or more––by the end of 2031.

Multilateral export controls are created by groups of states to informally govern the exports of certain technologies for mutual benefit. But increasingly there is misalignment among allies,

GOVERNMENT, POLICY AND SECURITY TRENDS SUMMARY

especially when it comes to China's semiconductor industry. Such controls could backfire in 2023.

In 2023, existing and proposed privacy regulations will challenge organizations, thanks to local and regional variations. Within the EU, sweeping frameworks like the GDPR are being enforced differently in member countries, while stringent new biometric regulations in the US vary from state to state. Complexity is unlikely to be resolved.

Biometric data isn't stored as securely as it should be, opening the door to theft and manipulation this year.

During the past three years, the risk of ransomware has escalated across local governments, school districts, and hospital systems. Ransomware gangs are now offering their services for hire, and even marketing their capabilities and tools to outsiders. Hackers are professionalizing, developing commercial products, and operating increasingly lucrative businesses.

Cybercriminals could start targeting underwater IT infrastructure, including subsea cables that allow countries to exchange power and citizens to get online. Fully 95% of the world's internet traffic travels underwater at some point, making it difficult to protect from espionage.

Powered by AI, lethal autonomous weapons systems can find targets on their own and make decisions to complete a mission. Last year, 70 nations delivered a joint statement at the UN General Assembly calling for a ban on autonomous weapons—little progress has been made in the months since.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Because of globalization, technology, government, and security are completely intertwined.

Manufacturing the equipment required by modern business—laptops, mobile phones, machinery—relies on a supplier network often spanning numerous countries. The means of collecting, using, and storing data typically crosses state and country lines. With policy uncertainty growing and advanced technologies creating new pressure for lawmakers, it's more important than ever for executives to monitor developments and for government leaders to engage in meaningful, long-term planning to forecast knock-on impacts of potential legislation.

The intersection of technology, policy, and politics affects every organization. As lawmakers craft new types of regulations to address emerging technologies, businesses must address policy uncertainty in their strategic planning. Anticompetitiveness lawsuits and antitrust investigations will have a chilling effect on merger and acquisition activity by the big tech companies. If one organization under scrutiny provides some (or all) of your technology stack, further improvements and features could be paused if lawsuits siphon off resources. Likewise, how a company collects, uses, and stores data; the technology acquisitions business units develop; the vendors and partners they select; and investments they make in security all affect its future. The dynamic nature of cybersecurity will directly impact corporate strategic initiatives in digital transformation, operating income growth, international expansion, and more.

Policy uncertainty creates hurdles for innovation teams, and in both the US and China, the administrations have demonstrated clear, decisive plans. This should give innovators the foundations to work on new products and services related to climate change, transportation, biotech, artificial intelligence, and blockchain technologies. Security innovators have a unique set of skills that could aid in a company's approach to privacy and safeguarding. One of the biggest challenges companies face is a lack of creativity about adversaries or next-order outcomes. For example, before a company launches a new product, it should host a workshop to investigate possible ways the product could unintentionally bring harm to the business.

It's clear that China intends to lead the world in many areas of R&D, including AI, biotech and synthetic biology, pharmaceuticals, transportation, climate change mitigation, and space. In recent years, China launched new efforts to repatriate researchers from US and European posts. But tech companies are also poaching talent from academic departments as well as other companies. With so much competition, companies should develop strategies for R&D team acquisition and retention. Security should be top of mind, but within many companies, R&D units struggle to keep pace with the changing technology landscape. This can result in pet projects taking up too much time without leading to desired results—or moving without consideration of security or privacy implications. The cadence of R&D teams must be adjusted to prioritize privacy and security.

As we build our new normal—working from anywhere, managing security breaches, adapting to patchwork regulation—adaptability will be key to every organization's ability to thrive and succeed.

KEY QUESTIONS FOR YOUR TEAM

1

How do the trends change our perspective on risk?

2

Is our organization appropriately resourced to prevent against and respond to cyberattacks?

3

Does our team have an expansive viewpoint on emerging threats and attack surfaces?

4

What aspects of our business make us a target for attacks?

Will our company's values, or the way we interact with consumers, attract the ire of hactivists?

5

As lawmakers, are we carefully considering the downstream impacts of proposed regulations?

Have we developed scenarios to understand possible second- and third-order impacts?

6

As technology evolves, how will our local, state, provincial, country-level regulations keep pace without stifling innovation and growth?

7

If our company operates in markets where a patchwork of regulations is likely to persist, how can we adapt?

8

How can we play a role in shaping policy related to our industry's evolution?

9

Can we develop actionable, long-term plans that will withstand leadership changes?

10

How can we develop the knowledge, experience, and talent to leverage these trends?

16TH EDITION · 2023 TECH TRENDS REPORT · **SPACE**

SPACE

Future Today Institute

SPACE TRENDS SUMMARY

Tech breakthroughs that enable humans to explore space like never before are leading to a new space economy, but they also create political challenges.

Key Insights for 2023

Access to space, by private citizens or commercial entities, is becoming more affordable, and cost is just one of the barriers to entry that are lowering for both public and private institutions.

As accessibility increases, previously unrepresented nations are entering the space race, as well as startups and enterprises worldwide. This increasing accessibility is resulting in surprising collaborations.

Nations with like-minded initiatives are setting their sights on space, resulting in the formation of alliances including space blocs. As more blocs form and space exploration continues, existing treaties governing space are proving increasingly obsolete.

Geopolitical tensions are beginning to prove consequential in space. China once considered Russia an important collaborator for future moon projects and missions, but as sanctions resulting from Russia's invasion of Ukraine have impeded progress, China is looking for new long-term partners.

Space junk creates concerns not only as waste but as clutter that can endanger or inhibit further development—it threatens our ability to leave the planet and use satellites and telecommunications devices that impact our experience on Earth. The need for its removal provides revenue opportunities for the space economy.

Even with a reduction in the expense of sending payloads—the spacebound crafts, cargo, or people necessary for development beyond Earth—costly resource production and in situ manufacturing will be required for long-term space missions to succeed. One example might be creating oxygen from Mars' carbon dioxide–rich atmosphere. Opportunities for resource extraction and mining, as well as in situ processes for harvesting materials, will drive revenues for the future space economy.

The ability to manufacture in micro- and zero-gravity environments—areas in space with less gravity than Earth, or where gravity is completely absent—will become a competitive advantage. Products and services that employ micro- and zero-gravity dynamics, such as orbital labs that grow stem cells, will create new uses.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

Companies not explicitly working within the space economy should still monitor trends in this report. Future Today Institute research suggests that emerging developments over the next decade will intersect with a host of adjacent industries, from agriculture to energy to telecommunications and beyond.

UNCERTAINTY AROUND BAD ACTORS

Militant acts by fractious and implacable governments are increasingly threatening the operation of satellites and megaconstellations. Hostilities materialized in 2022 relating to commercial satellites used to aid Ukraine against the invasion by Russia. Defense initiatives are being enacted to stave off the potential threats of these bad actors, but little can be done proactively.

ADHERING TO COMPLIANCE AND REGULATORY CHANGES

As authorities emphasize judicious action regarding the use of satellites and payloads entering orbit, strict regulations, especially if enacted quickly, could disrupt operations. Startups with business plans relying on megaconstellations for space-related activities and commerce could be caught off guard by caps on the number of satellites entering orbit, or by regulator restrictions on uses.

OPPONENTS TO SPACE-BASED INNOVATIONS

Vocal critics of space exploration and innovation abound. They suggest we focus first on Earth-based challenges, rather than expediting resources to impact our experience in space. If such sentiments prove contagious, they could decrease governmental interest, affecting funding opportunities for startups and rendering our space aspirations futile.

BEING UPENDED BY SMALL BUT MIGHTY PLAYERS

Space's democratization should appear as an unbounded opportunity, but a failure by traditional entities to take advantage of it could result in smaller, more nimble startups and organizations beating their competition to the chase. Spending time in space will require applications from industries present on Earth. Organizations must act quickly or risk missing out on first-mover advantages.

OPPORTUNITIES FOR GROWTH AND TRANSFORMATION

Our analysis reveals unique opportunities for organizations to unlock innovation and growth.

Devising processes for manufacturing products in micro and zero gravity will result in competitive advantages. By employing the inner-dynamics of reduced gravity, industries can fabricate items at higher quantities or with minimal constraints. Spillover effects of space technologies have been an industry hallmark for decades, and organizations will find opportunities to apply the solutions they offer here on Earth. With proper application, existing technologies can have monumental impacts.

For example, mounting concerns resulting from space junk accumulation create revenue opportunities for companies centered on cleaning up messes. Both the public and private sectors will have a growing, vested interest in keeping the orbit free from dangers associated with the detritus. Meanwhile, extraction of local resources and in situ processing will be critical to survival in space and on new planets. Organizations that can provide necessary tools and solutions for mining and manufacturing will benefit. Provisions may include greenhouses for growing food, protein-producing bioreactors, or implements to unearth resources from regolith.

KEY QUESTIONS FOR YOUR TEAM

1

What new opportunity space can we create from the phenomenon of micro and zero gravity? (The answer might concern an aspect of production, or the offering of a service to be experienced firsthand.)

2

How can a space factory or lab give us an advantage over our competitors?

3

Are we prepared for the existential risk that the Kessler Effect could cause for services we use in our daily lives, such as GPS and telecommunications? What backup options do we need in place when space debris interferes with essential systems?

4

What new service and business models can be developed as sending payloads to space becomes more affordable?

5

How can we use satellite data and associated insights? Can we find better, alternative ways to serve our customers and help them understand the planet we live on?

6

How will the newest discoveries made via the JWST inform our worldviews and R&D investments?

7

What plans can we put in place to prepare to serve a multi-planetary species?

8

How will our activities in space affect and inform our geopolitical relationships on Earth?

16TH EDITION · 2023 TECH TRENDS REPORT · SUPPLY CHAIN & LOGISTICS

SUPPLY CHAIN & LOGISTICS

Future Today Institute

SUPPLY CHAIN AND LOGISTICS TRENDS SUMMARY

Geopolitical and workforce challenges crippled the supply chain in recent years, but advancing technologies could enable a more resilient future.

Key Insights for 2023

VISIBILITY/TRACK AND TRACE

Values-alignment driven consumerism and localism are disrupting where goods come from and require transparency in how they are produced.

Real-time, end-to-end visibility through the use of digital passports can prevent bottlenecks through customs and the passing of products from one source to another.

DIGITIZED MANAGEMENT

Warehouse space is a premium and should be utilized to its fullest with automation and management systems.

AI needs to be utilized beyond creating predictive analytics and should be tapped into to assist in decision making.

SHORTENING THE SUPPLY CHAIN

The utilization of crowd-sourced delivery platforms will continue as consumers continue to expect faster and more frictionless delivery.

Micro-fulfillment centers are a consideration when looking for more urban infill opportunities and for bringing goods closer to the consumer.

CLIMATE SUSTAINABILITY

Climate change, sustainability, and ESG are creating new challenges for companies to thrive in a world where consumers are determined to reduce their carbon footprint.

Packaging might be the next big wave in opportunities for creating a more sustainable supply chain, through the use of reusable and self-healing materials.

LABOR DEVELOPMENT, UPHEAVALS, AND SHORTAGES

Worker attraction and retention is achievable through upskilling and reskilling opportunities, especially when paired with new tech certifications that automation requires.

Continue to watch union action and difficult contract negotiations as they threaten to create new disruptions.

GLOBAL SUPPLY CHAIN DISRUPTIONS

Disruptions are coming from unexpected sources, for instance when social media spurs a buying spree for a particular product, causing unpredictable runs that manufacturers may not be prepared for.

The rise in nationalism and global conflict are creating new challenges for transportation and logistics to overcome.

RESILIENCY THROUGH DIVERSIFICATION

Diversifying procurement can alleviate weaknesses in the global supply chain by considering nearshoring or reshoring.

New infrastructure may be needed to diversify routes as ports become smarter about preparing for future disruptions.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

The talent pool is shrinking in many industries. Finding skilled labor to fill empty roles is harder, and many experienced supply chain and logistics workers are retiring. Employing cobots and automation can be a double-edged sword, as workers may prefer to avoid companies that utilize these solutions. Training programs and skills development can develop and attract new talent, and retain the current workforce.

With consumers' demand for transparency growing, tracking the end-to-end loop can be a granular and challenging exercise. With new procurement and sourcing under consideration to fulfill environmental, social, and governance (ESG) goals, it presents an opportunity to improve the tracking of resource usage. Another challenge will be where to report the information gathered that will be of most relevance to the company, the consumer, and governments.

The pandemic, the war in Ukraine, and the process of decoupling with China highlight vulnerabilities in the supply chain and the need to prepare. Digital twin modeling can help predict such events, but acquiring the data to set up the model is challenging. These models should take into account global climate change disruption as well.

Last-mile solutions are among the most challenging for the logistics industry. Consumers have different expectations, depending on the market or the specific goods. Social media may help prioritize which products need to be first up on the last-mile list. Manufacturers can use this data to decide where to invest in micro-fulfillment or additive manufacturing warehouses within the urban infrastructure.

Future Today Institute research suggests that the future of manufacturing and the supply chain will be positively influenced by emerging technology. Opportunity spaces include:

VR TRAINING

Training in development of skills is no longer location dependent with virtual reality training modules, opening opportunities to tap into a global talent pool. Companies need to examine current training modules and invest in converting them into VR training modules, which could then be licensed to other businesses to generate new revenue.

SMART CONTRACTS

Smart contracts can be drawn up to determine when certain conditions are met, such as meeting ESG goals, before they go into effect. Since these contracts are stored on a blockchain, they can provide track and trace solutions when data is requested. Legal implications will be the first step to begin tackling where and when to use smart contracts.

NEARSHORING AND RE-GLOBALIZATION

Re-globalization and nearshoring both offer the prospect of stability through diversification. Finding the right balance between both options means understanding which global conflicts in which regions pose the most risk or opportunity. Monitoring these initiatives over time could guide a strategy for flexible manufacturing or access to new talent markets.

HUB-AND-SPOKE AUTONOMOUS MODELS

When considering the last mile, human and autonomous options are key considerations. As autonomous transportation becomes more viable, there is an opportunity to restructure the human talent pool to fulfill the last-mile delivery needs. This could become a marketing strategy for employees by allowing them to work closer to home. Logistics teams need to become well-versed in autonomous transportation to be prepared for industry changes.

KEY QUESTIONS FOR YOUR TEAM

1. How should we prepare for ESG disclosure requirements along our supply chain?
2. What training modules can be digitized for faster learning?
3. Where should autonomous enhancements be incorporated into the manufacturing process?
4. What decisions can we allow to be made autonomously within the supply chain and logistics framework?
5. Is the company prepared for a viral social media event that could affect product availability?
6. What is our risk tolerance given extreme weather events and our transportation partners?
7. Where do we need real-time monitoring for our supply chain?
8. Where we are over dependent on imports from countries that are near conflict-risk countries?
9. What emerging countries offer re-globalization potential for new sources and procurement of goods?
10. What digital twin models would best serve us for being better prepared for conflict, congestion, crisis, etc.?

Future Today Institute

ENTERTAINMENT TRENDS SUMMARY

Experiences are moving to a collaborative model, opening up the opportunity for repeated but not repetitive engagement with entertainment franchises.

Key Insights for 2023

STREAMING

Power is shifting from content platforms to influencers as the latter's options for sharing content increases and new opportunities to create revenue streams expand.

Tapping into a global talent pool will become easier than ever with a range of new tools that expand collaboration for hybrid teams.

With the introduction of haptic devices, storytelling will engage all of the senses, not just vision and sound.

Storytelling will venture into personalization. Instead of creating a finite, linear product, different story modules will be combined in different ways.

Crowdsourced content, where viewers collectively decide what happens next, is gaining traction as a mainstream genre of narrative.

Digital twins of celebrities will start to expand the earning potential of their real-life counterparts.

This year, AI is moving from supporting to leading the creative process—writing scripts, creating music, and directing.

As dubbing becomes more automated, AI will translate and voice text and adjust the lip movements of actors to fit different languages.

One-stop-shop video creation software is scaling the production of marketing materials and might soon make its way into narrative storytelling.

THE ARTS

The NFT market has cooled. Uses in the visual art ecosystem are still elusive, but relevance might expand in gaming, as digital tokens can be used to grant membership or unlock experiences.

Intellectual property rights are not ready to sufficiently address new forms of entertainment or the globalization of content.

Performance spaces are turning into multiuse venues that not only accommodate different audience sizes and performance needs but also house shops, food and drink establishments, and museums.

Theater productions are experimenting with different forms of audience participation and personalization, blurring the lines between video game, live performance, and film.

Real-time holographic projections will open up the possibility of live experiences occurring in multiple places at once.

Virtual reality concerts will start to move from celebrity guest-stints in video games to standalone experiences.

Immersive art is delivering replicable works whose value lies in the cultural momentum they create, not their singularity.

AI art—still and video—is moving into the mainstream, raising questions about copyright issues and what makes art valuable.

Digital art has therapeutic effects, and health applications are emerging.

AMUSEMENT PARKS

Virtual reality rides in theme parks are morphing from passive, isolating experiences to interactive, social ones where guests can move freely through a space.

ENTERTAINMENT TRENDS SUMMARY

Smart contracts can enable demand-based bidding systems for products such as line-skipping passes, creating real-time optimization for guest experiences at theme parks.

The classic amusement park experience is expanding as companies produce not only small scale pop-ups and mega parks but also begin to integrate some of that imaginary-world feeling into consumers' daily lives via digital interactions.

Big entertainment players such as Disney and Universal aim to link their streaming with their theme park operations to provide holistic, personalized experiences.

Entertainment and education merge in museums, zoos, and other institutions that use augmented reality (AR) and VR to add interactive and gamified elements to their exhibits.

Personalized AR and VR elements in theme parks not only increase the realism of the imaginary world and pull the visitor deeper into the narrative; the technology also encourages repeat visits by making each individual experience of an attraction unique.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

RISKS

ESCALATED CYBER RISKS

Increased digitization often brings with it the risk of cyberattacks. As more core processes go digital, the implications become correspondingly more severe. If a digital celebrity is hacked, the damage to the brand can forever hamper its earning potential. As AI molds storylines to personal tastes, attacks can influence that experience and turn it into a harmful or traumatic experience for the viewer, whether the episode occurs on a streaming platform or in a theme park. When technology evolves, it is crucial to build and evolve security at the same time.

DIGITAL ABUNDANCE

A downside of digitization is its ease of replication and the potential for overexposure of the market to a particular asset. A large part of the value proposition of entertainment is the rarity and exceptionalism of its talent—there is only one Mindy Kaling or one Kathryn Bigelow. If technology enables omnipresence of talent and an exponential increase in production of assets, it may result in market fatigue and loss of interest.

MEDIOCRE STORYTELLING

Democratization of storytelling might empower audiences in new ways, but majority opinions do not necessarily create the most engaging stories. Taking risks, making unusual choices, and providing unique perspectives are crucial ingredients for excellent storytelling, a gift not given to everyone—and an improbable outcome of crowdsourced decisions. After the novelty factor of co-authoring narratives wears off, we might wake up to a landscape of mediocre storytelling that is not able to provide us the emotional engagement we crave.

A NEW VALUE PROPOSITION

The question remains how humanity will respond to content created by AI. Will audiences flock to digital twins of their favorite celebrities? How will we relate to and value stories that are created by non-humans? Storytelling has been used since the beginning of time to share experiences and create connections. Will the perceived value of synthetically created content, and as a result the interest in and willingness to spend money on that content, decline?

OPPORTUNITY SPACES

GLOBAL STORYTELLING

New collaborative tools provide the opportunity to employ a global talent pool that has been trained thanks to ever-widening access to digital creator tools. Such an abundance of diverse talent brings with it the opportunity for nuanced, localized storytelling that deepens access to and understanding of different cultures, demographics, and marginalized communities by creating shareable experiences.

DEFINING NEW ROLES & RESPONSIBILITIES

As AI takes center stage in the creation process, it shifts responsibilities for those who have previously been in control: directors, producers, designers, and artists. New skills need to be developed that emphasize creative direction, supervising, and adjusting, rather than doing the actual act of creating. This shift will also change the power dynamics of an industry traditionally driven by the idiosyncratic visions of its most successful creative talents. Whoever is able to define the new paradigm and set up corresponding processes and business models will set the bar for the rest of the industry to follow.

DECONSTRUCTED NARRATIVES CREATE NEW INCOME STREAMS

As storytelling evolves from finite, linear products to responsive environments that are customizable by the audience, every story has the potential to turn into a franchise with long-lasting earning potential. Deconstructed narratives free up collaborative iteration between the audience and the originator of the idea, and provides a canvas for exploration. Every engagement with the content can provide a singular experience for the viewer, resulting in enduring curiosity about the possibilities—and willingness to spend to experience them.

HOW TO PREPARE

What should your organization do now to prepare for these trends?

SCALING PERSONALIZED CONTENT

If entertainment companies can access more data about their consumers—not just the data from within their own ecosystems but also data from, say, Google or Facebook—they can begin to create personalized experiences at scale. These would be limited primarily by the capabilities of the tools creating the experiences—for instance, the ability for AR and VR systems to provide real-time responsiveness, or of AI to reassemble and customize content according to a viewer's profile. Beyond that, the biggest limitation will be the entertainment industry's own ability to produce enough modular content to customize.

KEY QUESTIONS FOR YOUR TEAM

1

How can you ensure the safety of future digital assets? As content evolves from a finished product to a personalized, ever-changing experience, how can you monitor and prevent unwanted alterations from third parties and cyberattacks?

2

What changes do you need to make to your organization to create interactive, modular content in addition to a linear storytelling product?

3

How would digital entertainers, such as digital twins of real celebrities or digital originals, impact your business model?

4

Will generative AI, such as Dall-E, Bard or ChatGPT, disrupt your business, and how can you leverage it to your advantage?

5

How can you begin to pave the way for blockchain integration into your operations to make processes more efficient, safe, and transparent?

6

There is a tension between the desire for personalized experiences and the power of communal experiences. Have you determined what your customer prefers? And how can you optimally combine these approaches in your product?

7

What will the average attention span be in five years, and how can you adjust your product to optimize it for consumption?

8

How can the implementation of hybrid, modifiable physical spaces best enhance user experiences?

METHODOLOGY

Future Today Institute conducts in-depth qualitative and quantitative research throughout the year to identify emerging trends. We review patent and trademark filings, pre-print and published scientific papers, investment rounds, online search trends, macroeconomic data, publications from governments worldwide, news mentions, influencer posts and other sources, and we use a proprietary system to identify patterns, which are then grouped into nodes and evaluated using a set of standardized indicators. Qualified trends are further scored for their trajectory, momentum and timing. Additionally, we harness the deep subject matter expertise of our Future Today Institute network, leading to valuable insights about the topics we cover.

In continuous publication since 2007, Future Today Institute's annual report includes maturing and emerging trends grouped into two categories: industry and technology. Industry trends reflect the ways in which technology is shaping the future of an entire industry. Technology trends are specific developments within one arena, such as artificial intelligence. Covering a wide range of technologies across industry sectors creates a holistic view of change and provides leaders with a clear understanding of their potential impact. Trends are published as individual Industry and Technology reports, as well as in one combined report with all of our research.

Monitored regularly, trends help executives recognize emerging threats and opportunities in the near-term and enable them to develop perspectives, strategies and plans for the future.

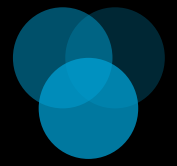
Seven-Step Forcasting Funnel

SIGNALS & LONG-TERM TRENDS

What is INFLUENCING the future?

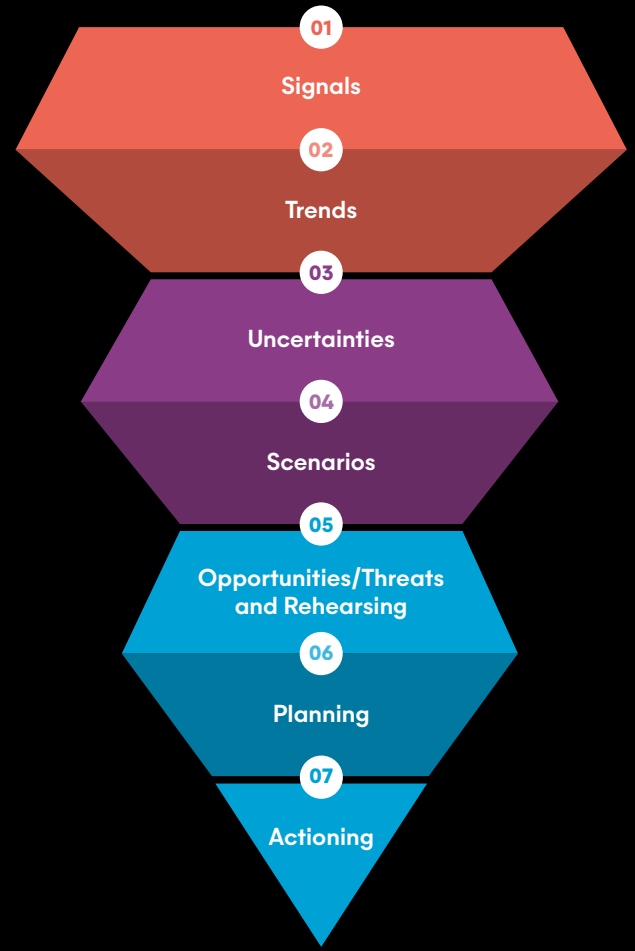
GLOBAL MACRO SCENARIOS

What is THE future?



STRATEGIC

What is YOUR ORG'S future?



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ABOUT FUTURE TODAY INSTITUTE

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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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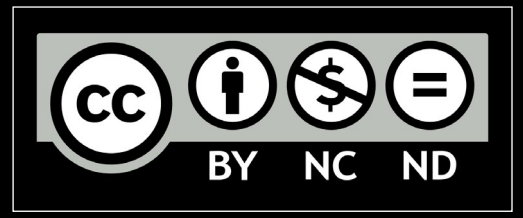
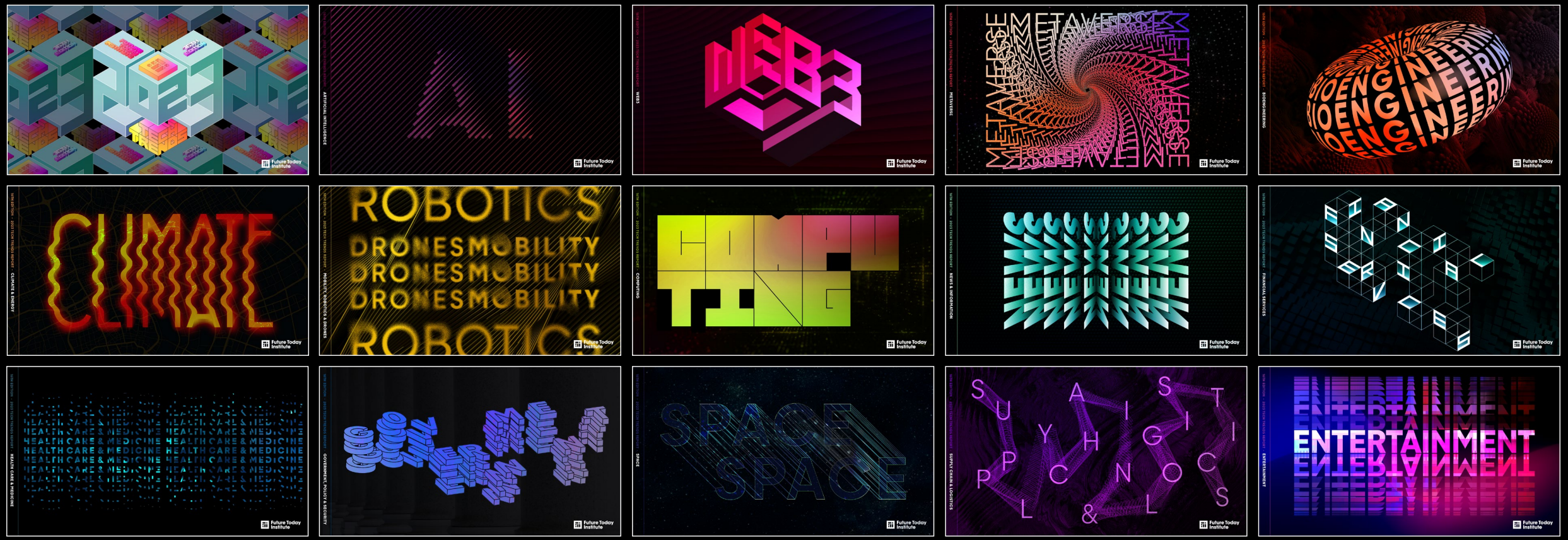


FUTURE TODAY INSTITUTE'S 2023 TECH TREND REPORT

Our 2023 edition includes nearly 700 trends, which are published individually in 14 volumes and as one comprehensive report with all trends included.



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2022
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TECH TRENDS
16TH EDITION
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