14th Annual Edition

2021
Tech Trends
Report

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

- **New Realities**
- **Synthetic Media**
- **News**
- **Information**

Future Today Institute

Overview

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

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

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

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

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

Amy Webb

Founder
The Future Today Institute

Macro Forces and Emerging Trends

For nearly two decades, the Future Today Institute has meticulously researched macro forces of change and the emerging trends that result. Our focus: understanding how these forces and trends will shape our futures. Our 14th annual Tech Trends Report identifies new opportunities for growth and potential collaborations in and adjacent to your business. We also highlight emerging or atypical threats across most industries, including all levels of government. For those in creative fields, you will find a wealth of new ideas that will spark your imagination.

Our framework organizes nearly 500 trends into 12 clear categories.

Within those categories are specific use cases and recommendations for key roles in many organizations: strategy, innovation, R&D, and risk.

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00 01 02 03 04 **05** 06 07 08 09 10 11 12   Health, Medical, Wearables

6 — Watch Closely | **Informs Strategy** | Act Now

1ST YEAR ON THE LIST —**1**

Doctorless Exams

AliveCor's personal EKG monitoring system.

KEY INSIGHT —**2**

Advancements in diagnostic testing and remote monitoring, supported by cloud computing, machine learning, and low-cost technology are upending traditional doctor visits. Patient data are triaged by algorithm, rather than human doctors alone.

EXAMPLES —**3**

Smartphones and smartwatches now take blood pressure readings and perform electrocardiograms, using apps approved by the U.S. Food and Drug Administration. Phones don't just record data; they interpret it. People who wear an Apple Watch know that an unusually high or low heart rate or irregular rhythm may suggest atrial fibrillation. The VROR system, a VR-based eye exam, emulates an eye doctor's ultra-widefield imaging machine but within a compact headset. Data are sent to a mobile app for an understanding of a patient's optic nerve health. StethIO is a mobile stethoscope that uses a smartphone to capture, decode and analyze heart sounds. AliveCor is an FDA-Cleared wireless personal EKG that connects to a phone. Butterfly iQ is a portable ultrasound device that delivers a 2D image. The ParatusPerio Test analyzes different bacteria and sources of inflammation in a patient's mouth.

DISRUPTIVE IMPACT —**4**

Continual monitoring helps patients know their baseline vital stats and track any changes. This disrupts traditional healthcare in a few ways. First, with continual monitoring, patients are more likely to intercept an emerging problem in advance and seek out care. For example, if a patient's smartwatch warns of atrial fibrillation, they can call their doctor for next steps. This reduces strain on emergency departments. It also unlocks new opportunities for healthcare systems and insurers willing to use those data and to make medical records systems interoperable. Financial forecasting that harnesses real-time data could be algorithmically recalibrated, and more accurately assess risk. But connected devices aren't accessible to everyone, which means that a new digital divide could be on the horizon, further reducing health equity in many communities.

EMERGING PLAYERS —**5**

- The Clue period tracking app
- Apple Health
- StethIO
- Healthy.io
- Paratus Diagnostics
- Butterfly Network
- AliveCor

59

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Each trend offers six important insights.

1. Years on the List

We track longitudinal tech and science trends. This measurement indicates how long we have followed the trend and its progression.

2. Key Insight

Concise description of this trend that can be easily understood and repeated to others.

3. Examples

Real-world use cases, some of which should be familiar to you.

4. Disruptive Impact

The implications of this trend on your business, government, or society.

5. Emerging Players

Individuals, research teams, startups, and other organizations emerging in this space.

6. Action Scale

FTI's analysis of what action your organization should take. Fields include:

Watch Closely

Mounting evidence and data, but more maturity is needed. Use it to inform your vision, planning, and research.

Informs Strategy

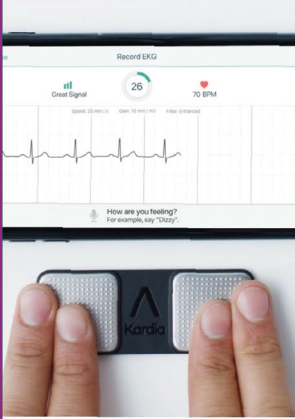Strong evidence and data. Longer-term uncertainties remain. Use it to inform your strategic planning.

Act Now

Ample evidence and data. This trend is already mature and requires action.

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Macro Forces and Emerging Trends

Scenarios Describe Plausible Outcomes

You will find scenarios imagining future worlds as trends evolve and converge. Scenarios offer a fresh perspective on trends and often challenge your deeply held beliefs. They prompt you to consider high-impact, high-uncertainty situations using signals available today.

1. Headline

A short description offering you a glimpse into future changes.

2. Temporal and Emotive Tags

A label explaining both when in the future this scenario is set and whether it is optimistic, neutral, pessimistic, or catastrophic.

3. Narrative

The descriptive elements of our imagined world, including the developments leading us to this point in our future history.

Scenario sources: The Future Today Institute uses a wide array of qualitative and quantitative data to create our scenarios. Some of our typical sources include patent filings, academic preprint servers, archival research, policy briefings, conference papers, data sets, structured interviews with experts, conversations with kids, critical design, and speculative fiction.

Self-Repairing Infrastructure — 1

Mid-future optimistic scenario — 2

Self-repairing materials transform the environments we inhabit. Our cities are made with concrete that fixes its own cracks, glass that seals if a window shatters and metals that contain microcapsules that release when they erode. Some materials are made of smart polymers while others mimic biology. These new materials change how architects design buildings and how governments engage in city planning. Retrofitting buildings with self-repairing materials creates new opportunities for the construction industry while stimulating economic growth. — 3

Scenarios

New Realities, Synthetic Media, News & Information Summary

+ As current forms of digitally mediated reality evolve and new forms emerge, they are poised to merge along a virtuality-reality spectrum.

+ Diminished reality, or DR, is a form of augmented reality focused on suppressing existing elements of our physical environment, rather than introducing new digital elements to it. DR represents a unique and extensive range of AR applications.

+ The shift from hands-on to heads-up is upon us, marked by the gradual transition from smartphones to smart eyewear.

+ With advancements in spatial internet, and the impending spread of 5G and smart eyewear, the prospect of a metaverse—a persistent, shared, digitally mediated realm that layers into the physical world—is coming into focus.

+ Smart eyewear will rely in part on advanced voice technology, so expect investment and advancements in natural language processing and generation, and emotive recognition.

+ The combined augmented and virtual reality market is estimated to be valued in the hundreds of billions of dollars within the next decade.

+ Synthetic media will become an integral part of our future XR experiences.

+ In the wrong hands, synthetic media can be a powerful and dangerous tool in spreading misinformation and disinformation.

+ As margins continue to shrink in news media, industry consolidation continues, at the expense of journalistic integrity.

+ News outlets are encountering competition well beyond their industry as the subscription economy matures and an ever-growing list of companies vie for the attention, time, and money of an overstimulated audience.

> "
>
> I do think that a significant portion of the population of developed countries, and eventually all countries, will have AR experiences every day, almost like eating three meals a day. It will become that much a part of you.
>
> " — Apple CEO Tim Cook

New Realities

Keeping Track of New Realities

Technology now blends the physical and virtual worlds.

As a constellation of technologies including smart eyewear, game engines, natural language processing and generation, volumetric video, and haptics continues to evolve, it is critical that we draw distinctions between the various digitally mediated realities that span the reality-virtuality spectrum. With AR, VR, MR, XR, and DR—and more R's inevitably on the way—reviewing their definitions and differences is the first step toward better understanding the future of the field.

AR vs. VR

Though both can be experienced via smart glasses or head-mounted displays, augmented reality (AR) and virtual reality (VR) are fundamentally different, and should be treated as such. AR makes digital alterations or additions to your existing environment, but you generally remain oriented to your physical surroundings. VR immerses you fully in a virtual environment, one that is either artificially generated or emulates real-world surroundings other than your own. While they may share hardware, AR and VR each have unique applications, with enterprise and consumer use cases for AR eclipsing those for VR at present.

MR vs. XR

Mixed reality (MR) anchors virtual elements to corresponding physical elements in your environment—you can still physically interact with objects and surfaces, but their appearance and reactivity may be virtually altered or enhanced. MR experiences do not take place fully in the physical nor the virtual world, but in a hybrid of the two. Extended reality (XR) is more of an umbrella term that spans the reality-virtuality continuum, including AR, MR, and VR. XR sometimes overlaps with varying definitions of the virtuality-reality spectrum, spatial computing, or Web 3.0, and the so-called metaverse.

DR is AR
(but not the other way around)

Diminished reality (DR) is not fully immersive, leaving you anchored in your physical environment but with certain visuals, sounds, or other sensory elements suppressed. Thus, all DR is typically considered a subset of AR—that does not mean, however, that all AR is DR.

1ST YEAR ON THE LIST

Diminished Reality
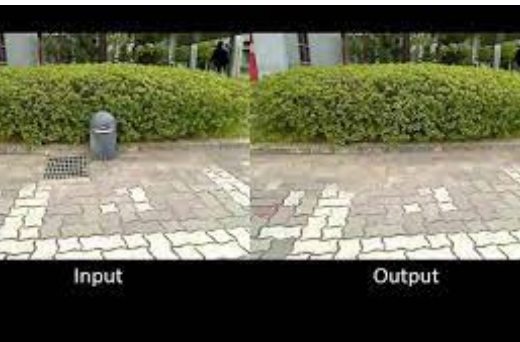
Diminished reality has the power to remove objects from view, seamlessly filling in backgrounds to mask the objects' absence.

KEY INSIGHT

Diminished reality (DR) is the field of AR that focuses on virtually masking, reducing, or suppressing features of one's environment. As smart glasses proliferate and AR becomes commonplace over the next decade, DR presents an opportunity to virtually shape our reality rather than simply build on top of it.

EXAMPLES

DR has existed in some form for over a decade, with one of the most ubiquitous examples being noise-canceling head-phones. But as the technology matures and is developed for the audiovisual applications of smart eyewear, it will allow users to target specific stimuli to suppress, isolating a specific speaker's words and appearance in a crowded room, or removing all advertising from view during a walk through the city center. But there are also therapeutic applications for those with unique sensitivities, such as for those suffering from PTSD. One study published by the Institute of Electrical and Electronics Engineers outlines a series of experimental workshops that used DR to assist individuals on the autism spectrum "who are adversely affected by continuously changing surroundings or distracting visual incidents."

DISRUPTIVE IMPACT

Diminished reality forces us to rethink how digital mediation can shape our surroundings by subtractive rather than additive means, improving quality of life for a broad range of users, but not without risks.

EMERGING PLAYERS

- Amazon Sumerian
- Apple's ARKit
- Google's ARCore
- Vuforia Engine

10

4TH YEAR ON THE LIST

Smart Eyewear and Head-Mounted Displays

The first generation of smart eyewear resembles traditional glasses, but future iterations will incorporate the technology into something akin to a contact lens.

KEY INSIGHT

Smart eyewear and head-mounted displays (HMDs) are already on the market; as the devices spread, generating more real-world data with which to update and fine-tune their hardware and operating systems, they are strongly positioned to replace smartphones as the primary personal device.

EXAMPLES

The transition from hands-on to heads-up mobile computing has begun, with everyday smart eyewear trickling into the consumer market. Amazon's Echo Frames, which were quietly made available to the public at the end of 2020, prove that smart glasses can have "dumb" lenses—the tech in these frames is purely auditory (they have an on-board Alexa voice assistant), using bone conduction technology rather than in-ear components. The audio-first approach is a clever way to ease smart eyewear into the market, avoiding the privacy concerns surrounding video-enabled products like the conspicuous—and widely criticized—original Google Glass. It also gives manufacturers more time to engineer the complex smart lens systems that will eventually support XR applications. Watch for sleeker but simpler smart eyewear devices and bulkier but more powerful HMDs like Facebook's Oculus Quest and Microsoft's HoloLens to inch closer to one another in terms of capabilities and form factor.

DISRUPTIVE IMPACT

Smart eyewear is expected to upend industries and interfaces designed for the smartphone by offering a more versatile hands-free alternative to the trusted mobile device. HMDs, on the other hand, have already begun to reshape enterprise solutions, from the field to the factory floor. Current smart eyewear, often designed to resemble recognizable traditional eyeglasses with simple but useful connected features, is meant to seamlessly blend into our everyday lives and facilitate daily activities. HMDs, which offer more robust functionality but are too cumbersome and restrictive for casual use on the go, are more commonly used in controlled workplace environments, or for mostly stationary entertainment and gaming. As smart eyewear adds more advanced features, and HMDs become more lightweight and comfortable, the two closely related technologies may begin to converge.

EMERGING PLAYERS

- Amazon's Echo Frames
- Apple's forthcoming smart eyewear product
- Epson Moverio
- Facebook's Oculus Quest 2
- Microsoft's HoloLens 2
- Solos
- Snap Spectacles 3
- Vue
- Vuzix Blade

4TH YEAR ON THE LIST

AR for the Enterprise

Microsoft's HoloLens 2 was designed specifically with business solutions in mind.

KEY INSIGHT

From factory floors to virtual meeting rooms, AR has a broad range of business applications, fueling accelerated investment and growth in the field, while VR takes longer to mature.

EXAMPLES

Microsoft's HoloLens 2 head-mounted display was designed specifically with business solutions in mind, incorporating cloud and AI functionality, interoperability with industry partners, and a suite of developer tools. The device has already been adapted for the U.S. Army, with thermal imaging and night vision among its many advanced capabilities. Smart eyewear and HMD maker Nreal has announced an Android-compatible "all in one" enterprise headset that looks more like a helmet than a pair of glasses, with on-board edge computing capabilities. The uses of these business-focused headsets are wide-ranging, encompassing everything from monitoring supply chains and complex equipment via digital twins, to hosting remote meetings in 3D, to providing guided AR tutorials as part of workplace training.

DISRUPTIVE IMPACT

Companies of all sizes and industries should be asking themselves where AR can be implemented to streamline and enhance functions and processes throughout the organization. AR devices are now being offered as part of a larger ecosystem, compatible with third-party operating systems and developer kits that allow smaller companies to plug in to existing systems, while bigger companies can design and customize their own.
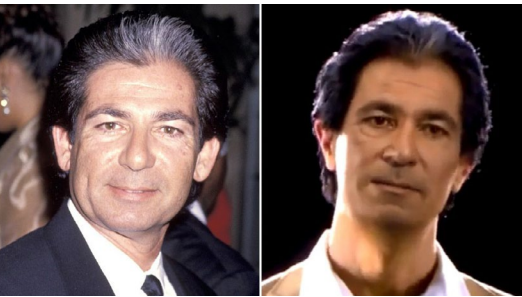
EMERGING PLAYERS

- CAE
- GIGXR
- Hevolus
- Kognitiv Spark
- Medivis
- Nreal
- PTC
- Spatial
- Trimble

7TH YEAR ON THE LIST

Holograms

Prominent attorney Robert Kardashian (left), who passed away in 2003, was re-created in holographic form (right) by production house Kaleida in 2020 as a birthday gift for his daughter Kim.

Image Credit: GETTY IMAGES/@KIMKARDASHIAN

KEY INSIGHT

Holograms are light field recordings that, when reproduced, can appear as static or dynamic three-dimensional visuals. The term is also more generally applied to any image that is rendered to appear in 3D.

EXAMPLES

In December 2020, Netflix launched an AR hologram tool ahead of releasing the George Clooney movie "The Midnight Sky." It let people record and upload a short video message and see it transformed into AR holograms. Blank XR is developing a concert platform that would allow fans to engage with musicians' holograms via a mixed-reality application. Los Angeles startup Portl launched phone booth-sized boxes that can project a real-time, full-size holographic likeness of a person or character. Holograms have been key to successful concert tours featuring bygone stars like Roy Orbison and Frank Zappa, and will soon allow production companies to draw popular synthetic media influencers like Lil Miquela and artists like Japanese act Hatsune Miku out of our screens and into our spatial environment.

DISRUPTIVE IMPACT

The accurate digital reproduction of faces, bodies, and other complex structures in dynamic 3D form is critical to the evolution of augmented and virtual reality. As smart eyewear edges out the smartphone as our primary personal device, holograms, variously combined with deepfake technology and synthetic media, may soon inhabit our everyday environments. They'll represent a range of artificially generated characters, celebrity stand-ins, brand spokespeople, historical figures, and lost loved ones. In the medical field, holographic mapping can provide doctors with a 360-degree view of a patient's internal organs, vessels, bones, and tissue, which can assist with diagnostics and surgeries, with multiple apps already approved by the U.S. Food and Drug Administration. As it evolves, this technology could be used in remote workplace training and collaboration. Expect to hear more about holograms as resolution, volumetrics, and depth of field improve, and as 5G fuels the level of high-bandwidth instantaneous data transfer needed for lifelike holographic streaming.

EMERGING PLAYERS

- Blank XR
- Netflix
- Portl
- Kaleida
- Eyellusion
- Base Hologram Productions
- Hologram USA
- EchoPixel
- OpenSight
- Crypton Future Media

Eco-Sight

Near-future optimistic scenario

There's more to reality than what meets the human eye. As we extend technology past the limits of our senses, we create filters that allow us to see through the eyes of other species. Earth looks like a different planet. To the mantis shrimp, the ocean is an aurora borealis of previously unimagined colors. Birds look brighter and more opulent when we finally see them through their own eyes. Mushrooms littered across the forest floor are revealed as the various fruiting bodies of one unified underground organism. These eco-sense experiences make their way into school curricula, corporate retreats, therapeutic programs, environmental policymaking, and the art world. The more time we spend using the filters to augment our senses, the more empathy we develop for the natural world, seeing nature as it sees itself. These experiences make us more life-centric, motivating us to nurture and protect our planet.

Scenarios

1ST YEAR ON THE LIST

Spatial Displays
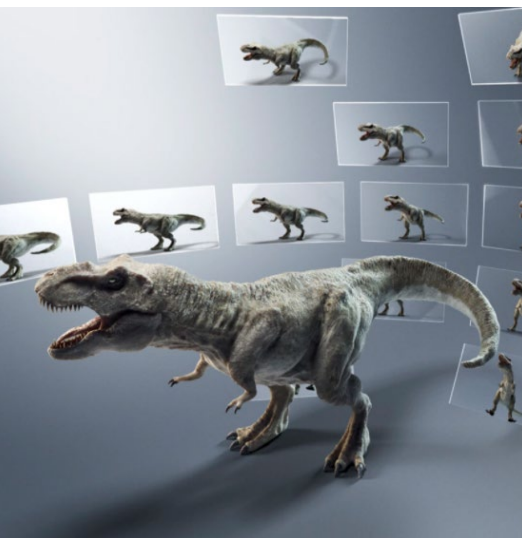
Sony's Spatial Reality Display follows eye movement down to the millisecond.

KEY INSIGHT

Holographic displays allow content creators to see their digital designs in physical space.

EXAMPLES

Spatial displays offer the magic of virtual reality without having to strap on a head-mounted display. Instead, a flat screen projects objects in what looks like a hyper-realistic, three-dimensional diorama. Spatial displays use high-speed face and eye-tracking cameras to always detect the position of the viewer's eyes in real time. A video generation algorithm responds to the viewer's eyes, while tiny lenses deliver stereoscopic images to each eye. Sony's Spatial Reality Display debuted last fall with a dedicated software development kit supporting Unity and Unreal Engine 4.

DISRUPTIVE IMPACT

For now, this technology is aimed at designers, architects, and marketers. But as spatial displays improve and mature, they will change how we watch movies, test drive vehicles, and attend board meetings. Doctors will show their patients what's going on inside their bodies, and history teachers will take students on tours of ancient ruins.

EMERGING PLAYERS

- Sony
- Intel
- Unity
- Unreal Engine

New Realities Trends

Australia-based Imagine Room operates the country's first Mixed Reality Capture Studio.

360° Video

360-degree video is created with a special camera rig designed to capture omni-directional footage. Once the video is rendered, viewers can rotate their point of view using a mouse, touch-screen, or motion-control gesture to explore the recorded scene. The format offers a more immersive and active viewing experience for entertainment, documentary, and news than traditional video, but one that can still be viewed through standard mediums like laptop and mobile device screens. It is a relatively simple and low-cost alternative to the total immersion of more advanced forms of virtual reality.

Volumetric Video

A pivotal technology for developing XR experiences, volumetric video is the capture of a space, figure, or event in 3D. The resulting video can then be viewed either on a screen or XR device. While 360-degree video allows viewers to rotate their perspective and view the full scope of their surroundings from a fixed point, volumetric video allows viewers to pivot around their subject viewing it with depth, and from all angles. Microsoft's Mixed Reality Capture Studios are an international network of certified facilities for capturing volumetric video intended for MR applications. Once smart eyewear is the norm, we will come to expect content to be experienced volumetrically, rather than the flat perspective offered by smartphone, tablet, and desktop screens.

Spatial Audio

Just like volumetric video gives perspective and depth to visual content, spatial audio is broadcast in such a way that the listener interprets the sounds as occupying various spaces in their environment. The latest editions of Apple's AirPods feature spatial audio technology—when it is activated, sounds are perceived in relation to the listener's positioning as well as the positioning of the source device. For example, if you're watching an action film on your phone and you turn your back to it, an explosion in the film would then be heard from behind you, rather than before you. Similarly, when you move the phone but keep your head still, the auditory perspective shifts with the positioning of the device. This technology will be central to creating lifelike sensory experiences in XR.

WebAR/WebVR

The majority of AR and VR experiences available today require users to download an app to their device, but WebAR and WebVR are part of a burgeoning field in which AR and VR experiences are accessible directly through a browser. This successfully sidesteps the data storage limits and device compatibility issues that might hinder an app-based experience, effectively helping the AR or VR content reach a broader audience more efficiently. The field is still in its infancy, but promises to create a new paradigm for AR and VR that is more inclusive and immediately available.

The Metaverse

A term originally coined by Neal Stephenson in his iconic 1992 sci-fi novel "Snow Crash," the metaverse refers to an all-encompassing shared virtual realm. While definitions vary, and some have strayed from the novel's depiction of the concept, today the metaverse is often described as persistent—meaning its collective network of 3D virtual spaces cannot be turned on or off, but exists continuously—and shared—meaning various users can access it freely and interact within it. By most definitions, the metaverse encompasses all AR, virtual realms, and the internet. While the concept can be difficult to grasp at the moment, it is likely to come into clearer focus as AR and VR platforms proliferate, and virtuality becomes a regular, if not constant, part of our everyday lives.

Expert Insight

The Future of Live Entertainment

Corey Johnson

CEO/Partner,
Production Club

Live music and entertainment will never be the same. Where less than two years ago live-streaming and virtual events were the odd stepchild of the live events industry, this segment not only became relevant but entirely supplanted the traditional live event and entertainment industries in 2020. The pandemic triggered a rapid shift of focus, the creation of new business paradigms, and a series of innovations that will revolutionize events and create an entirely new type of live experience in the future. This

new type of hybrid entertainment will combine the best of in-person live events, broadcast, interactive digital media, and real-time game environments.

Technology in events and live entertainment

For the past decade, digital technologies have had a growing influence on the live music and entertainment industries. Technologies such as XR (extended reality), AR (augmented reality), and VR (virtual reality) have been developed and touted as revolutionary. Low-cost, low-power LEDs have transformed lighting technology and the availability of higher-quality, higher-resolution displays have cemented the role of video and visuals as an essential part of the live experience. Further, real-time game engines such as Unreal and Unity have gone from the realm of experimentation and innovation into founda-

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So what will events of the future look like? No one knows exactly, but the virtual event genie is not going back in the bottle.

tional building blocks and tools for creating the live environment.

However, until recently the applications of these new technologies has been primarily in support of the in-person, physical live event experience. Technology has been used to create video elements, add spectacle and visual intrigue, or more deeply embed brands and advertisers into the event. All of this changed in 2020. COVID-19 not only made in-person live events challenging, but impossible to be done safely and at any viable economic scale. As such, live streaming and virtual event platforms went from the periphery to the center of the action.

At the start of 2020, live-streaming and virtual event platforms were more-or-less irrelevant as far as the public was concerned, but by mid-year they were the only way to

gather and had entirely replaced live concerts, conferences, and entertainment worldwide. Twitch, for example, was regarded as a fringe streaming platform where gamers could gather and watch each other play. Discord was the same, existing as a communication tool for small communities. Even the top enterprise players such as Zoom or Skype were primarily viewed as business tools, certainly not as technology platforms replacing any and all group gathering and socialization at global scale.

Now in 2021, the industry still finds itself contending with significant uncertainty. Festivals such as Coachella have been canceled for the second year in a row, industry giant Live Nation's revenue dropped 95%, and the timeline and comeback of concerts is unknown and will be dictated by the success (or failure) of vaccines.

So what will events of the future look like? No one knows exactly, but the virtual event genie is not going back in the bottle. What was once an after-thought is now the focus of an entire industry. This year, 2021, will be full of innovation. It will include new companies and platforms that have not previously existed, next-generation XR performances and awards shows such as MTV's VMA Awards, and new initiatives from incumbents, such as Sony, which is building an in-house studio dedicated solely to creating these immersive at-home experiences. With Travis Scott's Fortnite performance live-streamed to more than 12 million simultaneous users and an entire generation of youth spending their social time in Roblox—which is valued at $30 billion with 150 million monthly active users—the forthcoming shifts in the industry look to be tectonic in scale.

" "

It is clear that technology's impact on live events and entertainment is still in a nascent phase. There is much more to come.

Looking forward

At Production Club, we believe that the future is not about whether events will be physical or virtual. It is highly likely that the innovation will occur simultaneously in both physical and virtual mediums.

We are calling these hybrids "Collective Experiences." This new type of event will happen all at once in physical venues, on web-based interactive live-streams, and on virtual avatar-based game platforms. These events will not be constrained by physical location or time in the same way that events were prior to 2020. Technology will continue to accelerate and empower this transformation with a far greater emphasis on the virtual medium, as audiences wake up to its possibilities, efficiency, and offerings. Further, as gaming and tech companies explore ideas like the metaverse as depicted in science fiction like "Snow Crash" and "Ready Player One," it is clear that technology's impact on live events and entertainment is still in a nascent phase. There is much more to come.

Covid has reinforced and solidified the fact that humans have a fundamental and irreplaceable desire to gather, communicate, socialize, and be entertained in groups large and small. In the coming years, technology must be developed to support, enhance, and accelerate collective experiences by offering more quality, diversity, and accessible live entertainment for all. Ultimately it's not about the technology itself but how it is utilized to bring us together that matters.

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Corey Johnson leads Production Club's overall direction and focus, working across the creative and production spectra.

Synthetic Media & Content

2ND YEAR ON THE LIST

Synthetic Media and Content

Chinese virtual influencer Ling debuted in May 2020.

KEY INSIGHT

Synthetic media consists of algorithmically generated digital content, including audio, video, deepfakes, virtual characters and environments, and more. The technology will become an integral aspect of future XR experiences.

EXAMPLES

Synthetic media is created using artificial intelligence. Algorithms use an initial set of data to learn—people, voices, photos, objects, motions, videos, text, and other types of media. The end result is realistic-looking and realistic-sounding artificial digital content. Voice clones, voice skins, unique gestures, photos, and interactive bots are all part of the ecosystem. Synthetic media can be used for practical reasons, such as generating characters in animated movies or acting as a stand-in for live action movies. Synthetic media can automate dubbing in foreign languages on video chats and fill in the blanks when video call frames are dropped because of low bandwidth issues. Imagine an entirely new genre of soap opera, where AI systems learn from your digital behavior, biometrics, and personal data, and use details from your personal life for the storylines of synthetic characters. In an ultimate expression of a "reality show," synthetic characters would play to an audience of exactly one: you.

**DISRUPTIVE IMPACT**

Watch for synthetic media to appear more frequently in 2021, representing new opportunities and risks for businesses, and reshaping the entertainment, service, and communications landscape.

EMERGING PLAYERS

- Samsung Next
- Loudly
- Endel
- Replica Studios
- Lovo
- Modulate
- Rephrase.ai
- Synthesia
- Alethea.ai
- Carv3d
- Animatico
- Narrativa
- DeepNatural
- Baidu Research

Synthetic Media Technologies
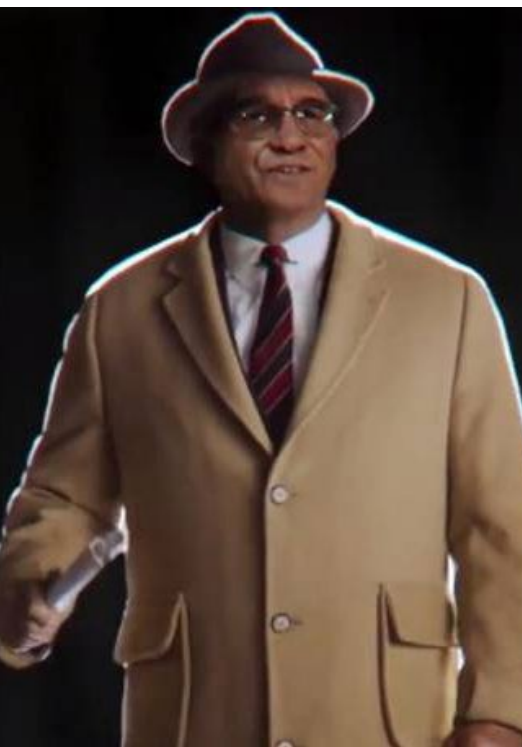
The 2021 Super Bowl aired a commercial featuring a synthesized Vince Lombardi.

Speech Synthesis

Also known as "synthetic speech" or "text-to-speech technology," speech synthesis mimics real human voices and deploys them to various interfaces. With enough data and training, a speech synthesis system can learn the spectral frequency of anyone's voice and produce someone's digital voiceprint. One company, Synthesia, uses this technology to dub people through automated facial reanimation. This will be especially useful for movies with wide, international releases. Actors' facial expressions and mouths can be reformatted to ensure local languages are synchronized correctly.

Modulating Custom Voices

Generative algorithms are creating synthetic voices that sound just like the original, and those voices can be modulated to the exact pitch and tone desired. The AI learns over time to recognize not only intonation, but also emotional cadences. Replica Studios, Lovo, Voicemod, Resem-

ble Ai, and DeepZen synthesize voices for a host of purposes. For example, you can fake a conversation between yourself and your favorite celebrity, provided there are enough publicly available audio files of that celebrity to build a dataset. Soon, the technology will be able to match and rapidly deploy synthetic voices personalized for every consumer. If you loved "Daria" as a kid, you might hear Daria Morgendorffer's voice (or Jane Lane's) during a car commercial, while your spouse might instead hear Phil and Lil's mom from "Rugrats." We should remember that in this era of misinformation, synthetic voices might also be used to trick unwitting consumers.

Deep Behaviors and Predictive Machine Vision

Researchers at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) trained computers to not only recognize what's in a video but to predict what humans will do next. Trained on

YouTube videos and TV shows such as "The Office" and "Desperate Housewives," a computer system can now predict whether two people are likely to hug, kiss, shake hands, or slap a high five. This research will someday enable robots to more easily navigate human environments—and to interact with humans by taking cues from our body language. It could also be used in retail environments, while we're operating machinery or while we're in classrooms learning.

Generative Algorithms for Voice, Sound, and Video

A team at University of California, Berkeley, created software that can transfer the movements of one person in a video to someone in another video automatically using a generative adversarial network. For some time, we've been training computers to watch videos and predict corresponding sounds in our physical world. For example, researchers at MIT's CSAIL experimented to learn whether a computer could accurately predict

what sound is generated when a wooden drumstick taps a couch, a pile of leaves, or a glass windowpane. The focus of this research is to help systems understand how objects interact with each other in the physical realm.

Mapped Synthetic Environments

Companies are now mapping the real world to generate synthetic digital twins. Amazon has been studying Snohomish County in Washington, building realistic simulations of the region's roads, buildings, and traffic. Its maps are reported to be accurate down to the centimeter, precisely tracking subtle gradients in pavement and noting unique markings on sidewalks. Amazon fused maps and 3D data to build synthetic versions of the county to test delivery drones. These kinds of virtual environments will be necessary as the company moves drones from research labs into the mainstream. Amazon tested its Scout delivery robot in the real world, having trained it in the synthetic environment.

Synthetic Media and Society

Frank is an artificial person from Samsung.

Live Portraits

In a new application of synthetic media, Israeli startup D-ID used its face recognition technology to generate live portraits from old photos. Members of MyHeritage, a genealogy platform, could upload old family photos or animate those already in the platform's database. The result: live portraits, reminiscent of "Harry Potter." The technology maps a digital picture to an AI system that renders smiling, blinking, and head movements in a short video.

Synth-pop Makes a Comeback

Synthetic media will give rise to an entirely new kind of celebrity in the 21st century: synthetic pop stars. It also affords a host of opportunities to make and save money. Already there are a number of synthetic pop stars with very large fan bases. Lil Miquela is a sort of Beyonce of synthetic stars, with 3 million followers on Instagram as of the start of this year.

She is a model for brands like Prada and Calvin Klein, a musician with popular tracks on Spotify, and a paid brand ambassador for enormous, global companies like Samsung. And she has friends: Bermuda, a rule-breaking bad girl model/influencer and Blawko, a Los Angeles–based guy who likes fast cars and Absolut vodka, and is never without his trademark face scarf covering his nose and mouth. In many ways, these stars are the antidote to teen stars like Lindsay Lohan and Shia LeBeouf who, for one reason or another, stray from their carefully crafted public images and cause headaches for their agents, managers, and the brands or projects they represent. Synthetic stars don't sleep. They don't eat. They never get tired, even if they're pushed 24 hours a day. They don't drink alcohol or use drugs, would never say anything off-message, and their mug shots would never go viral. (Unless it was planned, of course. Over the summer, Bermuda posted her own mugshot on Instagram to "get ahead"

of the press.) While Bermuda and Blawko aren't programmable yet, China's AI news anchors are. China's state news agency Xinhua employs AI news anchors Xin Xiaomeng, Qui Hao, and Xin Xiaohao, who appear in videos and also write stories for the agency.

Simulating Human Experiences

What if you could interact with a simulated person to learn from them or practice management techniques? Would you invite a synth to a dinner party? Samsung's Technology and Advanced Research Labs (STAR Labs) thinks the answer is yes. It developed Neon, "a computationally created virtual being that looks and behaves like a real human, with the ability to show emotions and intelligence." Neons aren't intended as a stand-in for the internet. They were built to hang out with you. U.S.-based startup Talespin built synths in virtual reality to teach people "soft" management skills, including how to

encourage team members or how to fire someone with empathy and compassion. Canadian startup TwentyBN built a synthetic sales associate to cheerfully interact with customers—and convince them to spend more money.

Synthetic Voice Fraud

Synthesized media has a known problem area: It can be used by malicious actors to mislead people, to trick voice authentication systems, and to create forged audio recordings. Voice fraud costs U.S. businesses with call centers $14 billion last year alone, according to a study by call center software maker Pindrop. Google has been working on a synthetic speech dataset as part of the ASVspoof Challenge, which is an open-source, global initiative designed to help develop countermeasures to fight spoofed speech. Researchers hope that the challenge will lead to more secure synthetic voice content.

Synthetic Media and Society

Synthetic Sex Tapes

Natalie Portman, Emma Watson, Taylor Swift, and Daisy Ridley—smart, talented artists—began "appearing" in adult videos in late 2018. Convincing short clips were made using deepfake techniques and soon went viral on Reddit. Not too long after, another Reddit user published a mobile application allowing anyone to make their own porn deepfakes. This poses a particular problem for public figures, because right now there isn't an easy way for the average person to tell what's real and what's fake. Photos and videos can spread through social networks and online without much protection for those victimized. In the absence of digital tools to spot fakes, we're left relying on critical thinking and common sense.

Synthetic Property Rights and Legal Protections

The video game "Call of Duty: Modern Warfare" was designed with brutal realism. Players enter lifelike combat situations and must decide whether to shoot synthetic civilians. Where do we draw the lines between disclosure and pure fantasy? Parody for laughs and deepfakes for harm? What happens when synthetic content seems so real that the psychological implications are intense and profound? What if someone generates synthetic environments that mirror real-world situations and real people? No existing laws or regulations govern synthetic content, although some people suggest adapting current laws, such as those covering libel, defamation, identity fraud, or impersonating a government official.

Using Synthetic Media to Get Around Copyright Laws

In many countries it is illegal to plagiarize someone's original content. You might remember the 1989 pop-rap crossover hit "Ice Ice Baby" by Vanilla Ice. He sampled David Bowie and Queen's collaboration "Under Pressure" (you know the base line hook: da-da-da---da-da-da-dum) but didn't get permission first. He tried to get around copyright law saying that he added a beat between notes (Ice's version: da-da-da...da-da-da-dum, DA---da-da-da---da-da-da-dum) and made it a distinctly different song. The case settled out of court, but it shined a light on how U.S. copyright laws were created to protect the financial—not creative—interests of artists. What if someone created a slightly altered copy of you for promotional commercials? For example, if your likeness was edited to include facial hair and a pair of glasses you don't have in real life, and then used without your permission—would those details eliminate the legal requirement for consent?

Synthetic Media Marketplaces

We already got a taste of what our future synth media marketplaces will look like. In 2018. a subreddit dedicated to publishing deepfakes morphed into a makeshift marketplace. Users were volunteering to create deepfake videos of celebrities, coworkers, family members, neighbors, and enemies in exchange for crypto-currency. In the near future, marketplaces to commission, buy, and sell synthetic media, as well as their attributes, will be visible on the dark social web.

Truth Decay in an Era of Synthetic Media

In 2021, we expect to see synthetic media technologies further commercialized and made widely available. But without the infrastructure in place to help consumers distinguish between synths and humans, the likelihood of misinformation campaigns remains high. Synthetic media could be weaponized by governments, activist groups, and individuals, and could be treated the same as all other internet content, showing up in search results, on our smart speakers as audio content, on our connected TVs, in our inboxes, and throughout social media. Synthetic media can be particularly inflammatory in the political realm, where both sides of a polarized public are motivated by social media algorithms to share and engage with sensationalized content without necessarily verifying its authenticity.

News & Information

Expert Insight

How the News Industry Must Evolve to Fit into Daily Life

Ebony Reed

New Audiences Chief,
Wall Street Journal

Audiences have developed new behaviors and habits as a result of the global pandemic. At the same time, we are on the cusp of a revolutionary opportunity to transform news experiences with faster internet speeds through the eventual mass adoption of 5G, which is still in its early days. These changes—behavioral, societal, and technical—mean we are better positioned to create news that fits more seamlessly into daily life. It also means we have to solve problems for users and help them verify the accuracy of the information they consume.

News + e-commerce

More people are on their devices—like computers and smartphones—and not just for information consumption, work, and entertainment. A growing number of people—more than 200 million in the United States—are shopping and living online. We need to integrate news into the experiences and activities that people are already doing. We should consider doing this on our owned and operated platforms. This will also involve reassessing the actions we allow audiences to take on news platforms.

Some innovators and academics, including me, had proposed that smart homes offered new plat-

forms for journalism. But we've found the masses still consume digital news mainly on computers and smartphones. While offering products for purchase on news sites isn't a new concept, we now have a larger base of people who, as a result of the pandemic, may be open to buying or even expecting it. We know that allowing people to take actions on our platforms can create a stickier experience and help reduce audience churn, and we must find ways to continue to leverage this trend.

Empowering audiences

News literacy initiatives need to offer more two-way interaction with audiences and empower them to determine if information is trustworthy, accurate,and from a reliable source. This is an essential public service. Clear plans and strategies are needed to show audiences how to use technology to

trace the provenance of news and information. Some news companies define words and link to previous coverage to offer more transparency, but not enough initiatives show audiences what to question, how to verify information, or how to track story developments on their own. Is it worthwhile to experiment with blockchain technology or use traditional docs to help audiences track news stories? Will citizens who can track changes in news begin to trust journalists more? We need to focus on how to empower audiences as we create news literacy projects.

More immersive experiences

As 5G gains adoption and creates faster and more stable connections (even if it takes a decade to fully take hold because users need to upgrade devices), we are already asking how to build more immersive news experiences. This

is a unique opportunity to bring audiences into actual news events. How would it have felt to experience, in almost real time, all of the marches for equality and social justice across the world during the summer of 2020? How will the masses react when they can regularly experience news, not just read, listen, or view it? And how will that impact our real-time conversations, opinions and lived experiences when we can all experience—not just watch—certain events in near real time together?

Service journalism

Offering audiences services and utility is another way we can connect with and help them. People want to know how to write a standout cover letter, write a resume, and grow their money. Others may want to know how to lose pandemic pounds. We need to create content answering audiences' immedi-

ate questions and help them solve challenges they are facing. We can already see what audiences want to know based on what they search for online and by asking them to tell us. As we think about growing the community around journalism, how we help people should remain a core focus. This is also a unique strength that positions news organizations to have a lasting impact with audiences. After all, don't you recall the last time someone helped you?

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Ebony Reed is New Audiences Chief at the Wall Street Journal, a member of the strategy team and leading efforts to expand the Journal's reach. Prior to joining the Journal, she was director of innovation at the Donald W. Reynolds Journalism Institute and an associate professor at the Missouri School of Journalism.

2ND YEAR ON THE LIST

Cancel Culture and Accountability Politics

Social media has created supercharged cycles of outrage, boycott, and backlash.

KEY INSIGHT

Powerful people frequently dismiss justified protest and credible accusations as "cancel culture" to evade consequences for their actions. On the other hand, certain "cancellation" campaigns, waged via social platforms but with real-world repercussions, are misguided or vindictive attempts to discredit or exploit those in the spotlight.

EXAMPLES

"Canceling" can come in many forms: calling out, deplatforming, censoring, boycotting. It can happen to celebrities, but private figures can get caught up, too. New York resident Amy Cooper, for example, faced criminal charges after being filmed calling 911 to falsely accuse and harass a Black man, and she was also fired from her investment firm after public outcry and viral bad press. Online vigilantism is sometimes the only way to hold people accountable in a world that doesn't always achieve justice through traditional means, but not every call for sanctions is equal in scope or stakes. YouTube personalities have attempted to cancel each other over personal slights. Former President Barack Obama is one of many voices pushing back against the culture of calling people out online. "The world is messy; there are ambiguities," he said last year. "People who do really good stuff have flaws."

DISRUPTIVE IMPACT

Every day we create a robust, lasting record of our lives thanks to the proliferation of connected devices and cheap data storage. As social norms evolve, those records will memorialize choices, messages, and actions that don't necessarily sync with our future selves, or our future culture, providing ample fodder for character assissination. As a society, the question is whether we will let those who transgress learn from their mistakes: What can someone do to repent when they do harm? What past acts are irredeemable? And who gets to decide when atonement is complete? The person or community who was violated? The transgressor? Their allies online?

EMERGING PLAYERS

- Electronic Frontier Foundation
- Rep. Matt Gaetz (R-Fla.)
- Rep. Marjorie Taylor Greene (R-Ga.)
- Facebook
- YouTube
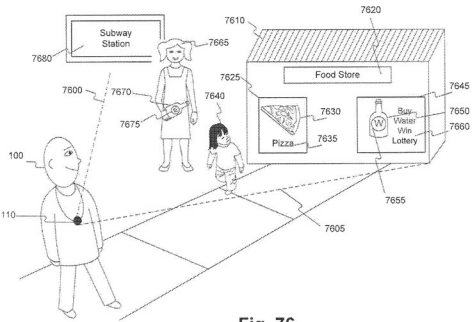- Twitter

1ST YEAR ON THE LIST

Sensory Journalism

Fig. 76

The OrCam MyEye has patents that describe "lifelogging"—storing details about what individuals have done, where they've been, and who they've met for recall later.

KEY INSIGHT

Wearable devices will change everything we know about user interaction. Glasses, headphones, and other wearables will integrate directly with a user's sense of sight, hearing, and touch. Instead of developing media for a particular screen size, storytellers are going to need to optimize for individual users' senses.

EXAMPLES

The OrCam MyEye, a small camera that clips onto any pair of glasses, is a simple wearable device that recognizes what it "sees" and describes it to the wearer. It's ideal for helping visually impaired people interact with the world around them, such as hearing a menu read aloud. But OrCam's aspirations are much bigger: Patent filings describe methods for "lifelogging"—storing details about what an individual has done, where they've been, and who they've met for recall later. Facebook's Project Aria is building wearable devices and testing them in the real world with hopes of defining what is useful, meaningful, and relevant when a device integrates with a user's senses. This is a seismic shift for storytellers: Experiences won't be constrained by the size of a screen or the shape of a device, but will be bespoke to each user.

DISRUPTIVE IMPACT

Storytelling that integrates with a user's perception could foster empathy and unlock new ways to understand the world—but it could also be manipulated to create sensory clickbait. Journalists will need to find new ways to deliver the news, but they must hold tech companies accountable as this technology develops. There is essential reporting to be done on how wearable devices will be compatible with different types of bodies. Will sensory integration work equally well for people of all genders? People of color? People with disabilities?

EMERGING PLAYERS

- OrCam
- Facebook Project Aria

2ND YEAR ON THE LIST

Geography Reshapes the Virtual World

New York legislators passed laws now governing how content can be published and shared in the state.

KEY INSIGHT

In the internet's first two decades, information crossed borders freely. Now local, state, and national governments are creating a complex patchwork of regulation that assigns internet users (and their data) different rights in different places.

EXAMPLES

The California Consumer Privacy Act (CCPA) gives Californians the power to stop businesses from selling their personal information and a GDPR-style right to have information deleted. Businesses that serve Californians—even if they're not based in the state—are required to be compliant as of January. Washington passed a law strengthening the definition of personally identifiable information in the state and shortening the window companies have to notify consumers and the state attorney general after a data breach. In New York, legislators passed the Stop Hacks and Improve Electronic Data Security Act to increase the types of personal information covered by the state's data breach reporting law. New laws will give real meaning to the physical geography of where a user accesses the internet, and of where the companies involved are located.

DISRUPTIVE IMPACT

CCPA and the other state laws on the horizon will impact ad targeting, but watch for major changes in any business that depends on knowing its consumers, like subscription marketing. Without coordinated effort, geographic differences in rights and expectations will continue to proliferate. This could change the economics and operating model for companies that serve customers across international borders (or even across state lines in the U.S.). Established tech platforms and multinational organizations will have the scale to account for that kind of regulatory complexity, but new entrants may find it hard to serve—and monetize—audiences in multiple jurisdictions.

EMERGING PLAYERS

- European Union
- U.S. Federal Communications Commission

Rx

Prescription Medical

TAKE ONE TABLET BY MOUTH EVERY DAY

Refills 4 times

Another

Reality Prescriptions

Near-future pessimistic scenario

The more time we spend in virtual worlds, the more we lose touch with reality. It's not our fault. These virtual worlds are designed to keep us plugged in with strategically timed dopamine hits. Doctors and mental health experts raise the alarm as they witness the side effects of digital addictions and overdose symptoms. Too many people are losing sleep, straining their bodies, and neglecting loved ones. To combat the rising digital addiction epidemic, health care practitioners begin to prescribe doses of reality. Once recorded in your digital health records, these reality prescriptions commandeer your devices. Restricted usage, diminished potency, and even full-on lockouts limit or prevent your time online. But addictions are hard to overcome, and some patients resort to contraband and DIY devices to get their fix. Reality rehab might be the only solution, but the digital dope keeps beckoning addicts away.

Scenarios

2ND YEAR ON THE LIST

The End of Attention Metrics

Brand safety and ad fraud protection will be top advertiser priorities in 2021.

KEY INSIGHT

The attention economy, which spawned listicles and tweet roundups, isn't as easily measured as previously thought. Measuring how con-sumers allocate their attention depends on how you count—and who is counting.

EXAMPLES

Researchers estimate that more than half of web traffic is fake. Fraudulent traffic is generated by bots that can fake clicks and by click farms in which a single user can interact across scores of devices simulta-neously. Nevertheless, vast portions of the digital economy are built around quanti-fying how users consume media online.

Beyond different ways of counting, there's also outright fraud online. Schemes to manipulate metrics follow the money: MadHive, a digital TV advertis-ing company, estimates that 20% of video ad requests are fake. This is a serious problem for both publishers that rely on ad revenue and for advertisers that need to satisfy client metrics.

DISRUPTIVE IMPACT

As mainstream browsers increasingly block third-party tracking cookies by default, it will be harder to connect in-dividuals to their actions across the web. Digital marketers and advertisers must find new ways to quantify the impact of their work—and to ensure that their partners trust their metrics.

EMERGING PLAYERS

- Google Analytics
- Chartbeat
- Facebook
- Interactive Advertising Bureau

6TH YEAR ON THE LIST

Digital Frailty

Patrick Soon-Shiong bought the Los Angeles Times in 2018. The Wall Street Journal reported that Soon-Shiong was trying to sell the company in February 2021.

KEY INSIGHT

Digital frailty is when digital assets are impermanent or easily compromised by technical glitches.

EXAMPLES

Digital frailty is evolving from a flaw into a feature: This trend emerged as media was erased from the web because old sites were no longer maintained. It's still problematic when information with archival value is lost, but more systems are being designed to encode impermanence as users adapt ephemeral tools like Instagram stories or messages that expire within a set time frame. There's also risk when organizations turn to external tools or services to manage their prominent programming. Storify was a popular tool for aggregating social media posts around a major news event. A team of journalists working for Reported.ly, a now defunct experiment run by First Look Media, won a 2015 Online Journalism Award for reporting on the shooting at Charlie Hebdo magazine in real time. All that reporting lived on Storify but was lost when the platform shut down in 2018.

DISRUPTIVE IMPACT

Sometimes new technology obviates the old before anyone has had a chance to convert files or develop archives. The Internet Archive and others try to create snapshots in time, but the services can struggle with dynamic sites that heavily rely on JavaScript. While there's archival value to the files we post online, users are increasingly choosing ephemeral formats to share via Instagram Stories and Snap. How will future societies learn from the past if they cannot study the first draft of our present history? Do we have an obligation to preserve the digital conversations shaping society? Should we be working harder to ensure that digital archives aren't lost?

As we develop expectations for what should be archived, we must consider the risks of creating an indelible record: What should happen to posts shared by minors to social networks or student assignments posted to a school's digital portal? Do young people have the right to a blank slate when they reach adulthood, or should they be held accountable for ideas they try on for size on the way to maturity?

EMERGING PLAYERS

- Internet Archive
- Amazon Web Services
- Microsoft Azure
- Google Cloud

2ND YEAR ON THE LIST

Sensitive Content Warnings

Some episodes of "The Muppet Show" now come with sensitive content warnings.

KEY INSIGHT

Sensitive content warnings now appear regularly, as a way signaling that the information about to be conveyed may upset or aggravate certain readers, viewers, or listeners.

EXAMPLES

Several companies, including Disney and Dr. Seuss Enterprises, are assessing archival content for representations of culture, religion, gender, and ethnicity. As of February 2021, several Dr. Seuss books, which depict racist imagery will no longer be published. A 2019 survey of Seuss' works found that just 2% of human characters were people of color, they never had dialogue, and they were likened to servants or animals. Dr. Seuss Enterprises said that the books—published in the 1930s to the late 1970s—"portray people in ways that are hurtful and wrong." On the Disney+ streaming service, several episodes of "The Muppet Show" now include warnings that episodes contain outdated cultural depictions. Similar disclaimers precede streams of "Lady and the Tramp," "The Jungle Book," "The Aristocats," "Dumbo," "Peter Pan," and "Swiss Family Robinson."

DISRUPTIVE IMPACT

Signposting sensitive content, or removing it completely, will continue this year, sparking controversy and debate about cancel culture. A cultural shift is underway in the U.S. that will result in permanent changes.

EMERGING PLAYERS

• American Association of University Professors

• Modern Language Association

• National Coalition Against Censorship

4TH YEAR ON THE LIST

New Search Interfaces

Audioburst wants to be the Google of radio.

KEY INSIGHT

Most people still find the majority of information they consume through search, and indexing new content types for wearable and spoken interfaces is proving challenging.

EXAMPLES

The line between old-fashioned webpages and new forms of content—from Instagram chats to Alexa conversations to mixed reality characters—is blurring. Companies like Trint help publishers transcribe audio to make it more searchable by traditional crawlers, while other startups like Audioburst are trying to use technology to actually "listen" to data previously locked into a waveform and make these units of audio more navigable. Audioburst's technology ingests and analyzes audio and uses natural language processing to understand its contents, contextualize it, and make it all searchable.

DISRUPTIVE IMPACT

It will be a while before we have a universal search agent that crawls through conversations, games, and mixed reality content for the information we seek. Until then, voice search optimization (VSO) will emerge as a way of surfacing relevant content on spoken interfaces. Spatial computing is in its infancy today, but soon consumers might expect to be served only stories relevant to what they are viewing through smart glasses. Searches based on conversation or what a user is looking at will be highly contextual, requiring sophisticated algorithms to anticipate the intent of a query and the relevancy of results.

EMERGING PLAYERS

- Trint
- SpokenLayer
- Audioburst
- Listen Notes
- Snap

Expert Insight

New Horizons in Book Publishing

Maja Thomas

Chief Innovation Officer,
Hachette Livre

My team is always asking how the Hachette Group, an international publisher, can become the most innovative provider of reading and learning. We research how new technologies, partnerships, or business models could expand our reach in an increasingly competitive attention economy.

For most of our proof of concepts, we work with partners large and small to create new experiences and test them with readers. Alternately, we will build our own

technology, such a proprietary trend detection tool for identifying various signals on the internet that we use to spot talent and to inform demand-driven book creation.

Our company, Hachette, has widely gained expertise by bringing start-ups in house and learning from them. We've welcomed entrepreneurs specializing in digital-first publishing, the creation of board games and mobile games, brain training applications, and educational games.

Today, as we look forward in 2021, we identified several strategic publishing opportunities. One of them: the chance to reach and engage younger readers, who have come to expect some level of interactivity and agency from entertainment activities. TikTok, Roblox, and Fortnite has shown how people love to shape and share their experiences with friends and co-creators.

> We've harnessed augmented reality to give readers the ability to scan the front and back covers of Orbit science fiction books and magically animate the covers or unlock a special video in which authors seem to speak directly to them.

We've harnessed augmented reality to give readers the ability to scan the front and back covers of Orbit science fiction books and magically animate the covers or unlock a special video in which authors seem to speak directly to them. Similarly, our educational publishers created ways for students to manipulate 3D objects in a textbook, and our travel guide divisions created an augmented reality treasure hunt among monuments in Paris that leverages the content and expertise usually locked in a book while the consumer is out "in the wild."

We've incubated startups that offer new forms of content creation, such as a collaborative writing platform that allowed authors to react together to pandemic isolation and provided a writing contest for high school students to connect while they were socially distanced.

We also strive to connect to readers on the platforms they haunt: creating chatbots of characters on social media platforms, teasing new book titles on TikTok, or promoting paid newsletters from authors to their most avid fans who opted in to receive exclusive offers.

We also believe that consumers will increasingly adopt the audio interface, and that it is leading the way to ambient commuting. By adapting books that have already been published, we've re-imagined stories that can work on smart speakers by using voice activations to let a child choose their own adventure, just by speaking a wish out loud.

Hodder Studio has created audio originals—also known as active audiobooks—that encourage listeners to garden or cook as they listen. They've published *Seeds from Scratch* and *Breaking Eggs* for people that want expert audio

companions guiding them along as they learn.

Many of Hachette imprints have also created podcasts to promote books, genres, imprints, and authors. The early enthusiasm around Clubhouse, the audio chat social network, shows that the connections that can be made using the human voice are just starting to be more fully explored.

We believe that data aggregation and analysis, as well as AI, will continue to play a big role in publishing in the near future.

Data is key to understanding who our readers are and what they enjoy and what they want. Reader analytics, then, has been the focus of many of our efforts. We've set up online communities where we can A/B test covers, titles, and descriptions, and measure engagement by time spent reading, completion rates, and qualitative surveys.

> By adapting books that have already been published, we've re-imagined stories that can work on smart speakers by using voice activations to let a child choose their own adventure, just by speaking a wish out loud.

We've designed experiments that analyze visual "heat maps" showing where the human eye goes on covers and marketing materials, and data aggregation (and AI) to identify cover trends in upcoming publishing seasons.

Even fine-grained data about what is *in* our books is also sometimes surprisingly hard to access. That has led us to create a "tagging factory" in France to enhance the metadata around titles, word clouds extracted from full texts in the U.S., and book recommendations created using "verbal DNA" patterns in books.

We should soon be able to use AI to alert a publicity team to focus on a book from Hachette's enormous backlist that is newly relevant due to a news event.

In the future, artificial intelligence will push publishing to evolve even further.

GPT-3 has just begun to show us how autogenerated text may be able to extend story worlds and allow personalization or customization at scale. Although AI and data will never replace the creativity of writers or the expertise of publishers, they can be used as powerful tools by those that understand their capabilities.

As sales continue to move online and digital formats gain traction, new platforms will arise to support authors, independent booksellers, and publishers—and to entice new readers.

All-you-can-eat subscription models, we think, make no sense for books—a long format with deep engagement and commitment that isn't usually bingeable. However, expert curation, early access, and exclusive content can distinguish subscription services offered by publishers. One example is the

Feminist book box being offered by Hachette UK, which curates books from across 10 different imprints.

As the transformation of our business and our lives continues, Hachette will continue to bring delightful stories and useful information to people in formats both traditional and new.

**

Hachette Livre is an international publisher with a huge variety of publishing segments, and as the director of the Hachette Innovation Program Maja Thomas works to accelerate the company's digital transformation by testing and applying experimental concepts, prototyping new solutions, and spreading a culture of innovation.

7TH YEAR ON THE LIST

Journalism-as-a-service

KEY INSIGHT

On the fringes, news organizations are beginning to provide journalism as a service, rather than as traditional news products. This model could help develop new funding streams for cash strapped media companies—but without care, it could also erode trust in an organization's core reporting.

In January, Rolling Stone announced that it would let "thought leaders" pay $2,000 for the privilege of writing for the magazine's website.

EXAMPLES

"Journalism as a service" lets news organizations sell on-demand access to the components of their reporting, rather than just the finished product. The clearest example to date comes from ProPublica, which launched a platform for selling data. Journalists compiled and processed the records for their reporting, but the information has uses in other domains. The Markup, a nonprofit journalism outlet reporting on the tech industry, has concentrated on building tools like Blacklight, which lets users see how websites track them, and Simple Search, which shows how paid advertisements influence Google search results. While those tools are distributed for free, they show how journalism could re-orient toward product development. In January, Rolling Stone showed how this trend might go wrong, announcing that it would let "thought leaders" pay $2,000 for the privilege of writing for the magazine's website.

DISRUPTIVE IMPACT

The practice of journalism is more than the published report: The best reporters create an enormous corpus of data as they work. Finding ways to realize additional value from that work could benefit everyone working in the knowledge economy—universities, legal startups, data science companies, businesses, hospitals, and even tech giants. Because journalists are trained to seek out information that challenges their assumptions, the datasets they assemble might help correct for the bias that exists in machine learning today. News deployed as a service includes different kinds of artifacts: news stories; APIs; databases; calendar plug-ins for upcoming news events; systems that can automatically generate reports using the news org's archives, and more. As those tools are transferred from the newsroom to the business side, however, there is the risk that journalistic ethics are lost, threatening to tarnish an entire organization's reputation.
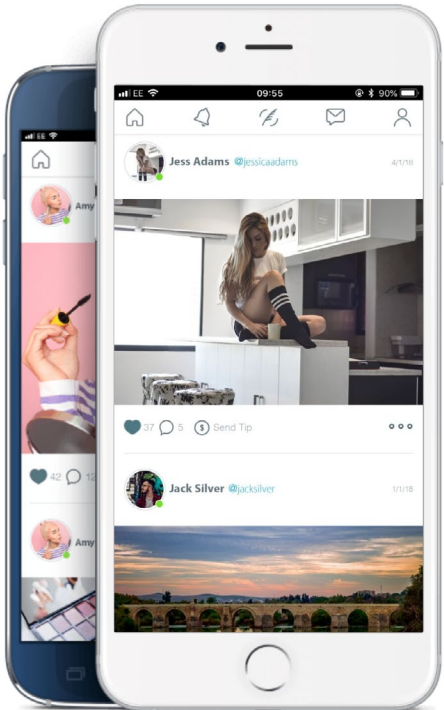
EMERGING PLAYERS

- PRX
- The Information
- MIT Media Lab
- ProPublica
- The Markup
- Rolling Stone

7TH YEAR ON THE LIST

One-to-Few Networks

OnlyFans expanded the range of monetization for influencers, letting them profit from exclusive experiences and other offerings.

KEY INSIGHT

Technology is lowering the barrier for creators to build a direct connection to their audience. Low-cost tools to produce newsletters, podcasts, and niche experiences allow individuals to create personal media brands. One-to-few networks, however, can be a powerful vector for disinformation and misinformation because they lack the editorial safeguards that protect traditional media.

EXAMPLES

Online publishing platform Substack lured big names like tech journalist Casey Newton and political columnists Matt Taibbi and Andrew Sullivan away from traditional gigs last year. Substack also gave Glenn Greenwald an outlet when he quit The Intercept, the national security journalism outlet he helped build, in an act of anti-censorship protest. (According to his editors, he was trying to publish without evidence.) Greenwald has the name recognition to thrive on Substack, but he has a track record of grandiose claims, and is now free to publish without oversight. Not all niche networks are high-tech: Last year, Wired reported on anti-vax propaganda spreading throughout insular ultra-Orthodox Jewish communities in Brooklyn via conference calls. WhatsApp encountered a similar problem in 2018, when rumors about child kidnapping spread quickly across rural India leading to a series of mob lynchings, and more recently with the spread of COVID-19 misinformation.

DISRUPTIVE IMPACT

It's easier than ever for influencers to get paid for their work—and there's growing evidence that consumers will pay creators directly. Services like Substack and Revue offer tools to launch a subscription newsletter, and Twitch can turn a video game habit into a streaming video business. These platforms are also broadening the definition of what influencers can get paid for: Patreon has been used to fund community organizing and anti-racism projects, while OnlyFans enables creators to monetize their influence through softcore pornography. Some streamers can make a meaningful income, but only by streaming nearly constantly throughout the day, without any time off. Unless the influencer economy evolves to provide paid time off or other benefits, it will be hard for creators to participate in a sustainable manner. Ultimately, all informal networks satisfy a basic human need to connect, but they can also isolate niche communities by amplifying unverified ideas within the group.

EMERGING PLAYERS

- Substack
- OnlyFans
- Twitch
- Zello
- Patreon

6TH YEAR ON THE LIST

Media Consolidation

Chatham Asset Management, a hedge fund with extensive publishing interests, acquired newspaper chain McClatchy out of bankruptcy.

KEY INSIGHT

Consolidation continues as media companies try to overcome shrinking margins on ad-supported media. This trend is now spreading from legacy media giants to digital upstarts that need to justify years-old investments that fueled their growth. Concentration of ownership into the hands of a small group of conglomerates threatens diversity in the press and on the airwaves.

EXAMPLES

Media consolidation is coming for digital upstarts. After several years of increasing consolidation among legacy publishers, 2020 saw a handful of landmark deals in news media. BuzzFeed and HuffPost merged in November, bringing together two of the biggest names in digital publishing. Like similar deals in legacy media, the tie-up aimed to generate efficiencies and a bigger scale for selling advertising. The concentration of legacy news publishers continued as McClatchy, a 163-year-old newspaper chain, emerged from bankruptcy under the ownership of hedge fund Chatham Asset Management, which owns one of Canada's largest newspaper companies as well as the publisher of The National Enquirer. Chatham beat out Alden Global Capital, another hedge fund. Both funds have a track record for cutbacks at the newspapers they own—one of the reasons that media consolidation is generally associated with weaker local news coverage.

DISRUPTIVE IMPACT

The U.S. Federal Communications Commission's policy of deregulation under Chair Ajit Pai accelerated the pace—and benefits—of consolidation for legacy companies. But Pai left the FCC on January 20, 2021, and President Joe Biden will appoint a Democratic majority to the panel. Watch for major swings on key regulations like net neutrality, and for disruptions to news coverage in regions with recently consolidated newspapers. Because nearly every major newspaper chain in the United States has seen some consolidation in the last year, this trend will likely impact your region if you live in the U.S.

EMERGING PLAYERS

- Vox Media
- BuzzFeed
- Chatham Asset Management
- Alden Global Capital
- Sinclair Broadcast Group
- Center for Innovation and Sustainability In Local Media at the University of North Carolina, Chapel Hill
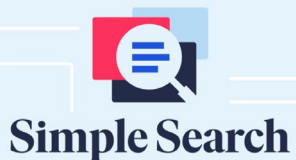
7TH YEAR ON THE LIST

I-Teams for Algorithms and Data

The Markup built a browser extension called Simple Search that helps users differentiate between "traditional" search results and ads or other results.

KEY INSIGHT

The best journalism reveals hidden truths and keeps those in power accountable to the public. Increasingly, that means unpacking how algorithms and big data shape our world. News organizations need specialized reporters with the technical skills to understand how technology operates in the world, and to explain it to a nontechnical audience.

EXAMPLES

The Markup, a news website focused on the societal impacts of big tech and algorithms, began publishing in 2020. The startup distinguished itself with publishing tools like Blacklight, a real-time privacy inspector, and Simple Search, a browser add-on that removes sponsored search results. Like the Online Political Ads Transparency Project, a New York University initiative that aims to expose how political Facebook ads targeted different users, The Markup's tools are meant to make it easier for laypeople to see how they are tracked and targeted online. The New York Times Visual Investigations unit made a splash in January 2020, using crowdsourced video to re-create the exact moment that an Iranian missile shot down a Ukranian airplane. That report required fusing multiple disciplines to synthesize a conclusion that undercut the Iranian Air Force's original narrative about what had happened.

DISRUPTIVE IMPACT

News organizations need reporters who can work collaboratively in teams with diverse skills, from explaining technical concepts and reverse engineering code to developing sources and processing geospatial information. As technology advances, it is harder for laypeople to understand how systems function—even as those systems become more deeply embedded in the fabric of our society. Understanding where information comes from, how it spreads, and the impact it has—not to mention explaining the outcomes of algorithmic decision-making—are central responsibilities for journalists who wish to hold powerful systems accountable. Investigating algorithms has never been more important than it is now.

EMERGING PLAYERS

- The Markup
- Bellingcat
- Washington Post computational journalism team
- New York Times visual investigations team
- Tow Center for Digital Journalism at Columbia University
- Computational Journalism Lab at Northwestern University
- Online Political Ads Transparency Project at New York University

2ND YEAR ON THE LIST

The Subscription Economy Matures

Video games like Fortnite create an ecosystem of rewards that entices users to spend.

KEY INSIGHT

A proliferation of content competes for audiences' time and money, opening new opportunities for media companies while also risking that the abundance of subscription options could overwhelm consumers' willingness (or ability) to pay. Without entrepreneurial thinking and business model innovation, news organizations may not keep up with emerging media.

EXAMPLES

Whether it's subscriptions, memberships, or donations, we're living in the age of audience revenue. But the subscription economy is bigger than news paywalls, streaming video services, and direct-to-consumer offerings: Soon, more consumers will be asked to pay for virtual fashion, XR experiences, and gaming. Software-as-a-service companies like Piano and Pelcro make launching a subscription or membership program relatively easy. Keeping subscribers is harder: Subscription service platform Zuora reports that media businesses have an average annualized churn rate of nearly 34%, the highest of any sector studied, and on-demand streaming services face even higher rates of subscriber loss than news media, according to The Information. Meanwhile we're living through the first major recession since the launch of most digital subscription programs, with consumer spending on "other services" such as subscriptions dropping 17% in the second quarter of 2020, and remaining far below pre-pandemic levels into 2021.

DISRUPTIVE IMPACT

Every subscription business has a broad set of competitors. Local newspapers, for example, aren't just competing against The Washington Post and The New York Times—they're competing for time and share of wallet with every other audience-funded business. To track the future of subscriptions, watch gaming platforms like Fortnite, which is free but boasts an ecosystem of in-game purchases that successfully entices users to spend—how many news subscriptions can honestly say the same? The growth of the subscription economy also raises important questions around access and equity. As Heather Bryant, a respected journalist, observed on Twitter during the U.S. presidential election: "Arguably one of the most critical events in the modern history of this country is happening with the election right now and most of the contextual analysis is behind registration boxes and paywalls while all the misinformation and conspiracies are a free, easily accessed buffet."

EMERGING PLAYERS

• Fortnite
• Roblox
• The Membership Puzzle Project
• Scroll

7TH YEAR ON THE LIST

Trust in Media

Trust in media is at an all time low.

KEY INSIGHT

The spread of misinformation will continue until platforms and news organizations adopt norms and standards for accountability and trust.

EXAMPLES

A healthy dose of skepticism makes for a strong electorate. But deepfakes, intentionally misleading stories, and salacious content posted by political operatives, hackers, and foreign governments have led to increased calls for new methods to rebuild our trust in the media. In February 2021, Twitter said that it would apply labels to tweets containing misleading information about COVID-19 vaccines, and while Facebook said that it would ban vaccine misinformation, the platform struggled to manage a deluge of fake health data and conspiracy theories.

DISRUPTIVE IMPACT

Edelman's annual trust barometer revealed a sobering reality in America: for the first time, trust in traditional media dropped below 50%. Trust in social media hit an all-time low of 27%. The study found that 58% of Americans think that "most news organizations are more concerned with supporting an ideology or political position than with informing the public." When Edelman re-polled Americans after the 2021 inauguration of President Biden, the numbers had deteriorated further: only 18% of Republicans said that they trust traditional media. As platforms come under increased scrutiny this year for issues related to antitrust, we expect to see demands for transparency and traceability.

EMERGING PLAYERS

- Google
- Facebook
- Twitter

44

6TH YEAR ON THE LIST

The First Amendment in a Digital Age

Federal courts are divided on how the First Amendment applies to social media.

KEY INSIGHT

The First Amendment shapes how platforms and publishers think about the design, development, and implications of content distribution. First Amendment legal protections are broad in scope but limited in geography; they only apply in the United States.

EXAMPLES

Constitutional law often lags behind technology, taking time to adapt and evolve as historic concepts are applied to new situations. In the past year, platforms have removed individual posts and in some cases deleted the accounts of people posting hate speech, intentionally misleading information, or calls for violent attacks. In 2021, Amazon Web Services removed far-right social network Parler from the cloud in the wake of the attack on the U.S. Capitol. Social media sites aren't modern-day public squares: Tech companies set the rules and shut off megaphones. While the First Amendment's protections in the U.S. are generally broad, its scope is limited in an interconnected world.

DISRUPTIVE IMPACT

This year, First Amendment rights and protections from Section 230 of the Communications Decency Act will be debated, though we may not see any concrete decisions. Brands, news organizations, political movements, and big tech companies will continue to face challenges.

EMERGING PLAYERS

- American Civil Liberties Union
- Electronic Frontier Foundation
- U.S. Federal Communications Commission
- Knight First Amendment Institute at Columbia University

AutoINcorrecting History

Near-future catastrophic scenario

We marvel at how simplistic the deepfakes of 2021 were. What began as a curiosity to see our ancestors move and speak quickly morphed into a new breed of deceptive technology designed to cancel cancel culture. We've resurrected people and put words in their mouths, edited their personalities, our relationships with them, and ultimately clouded our memories of the lives they lived. We are told that politicians caused great harm—but now, we can't remember what it was, or why people were so mad at the time. With their digital extensions scrubbed, they all seem like rational, likable people.

Scenarios

46

Application

STRATEGY

The multiverse, along with shifts in content distribution, will eventually affect an organization's reputation, its messaging, and some of the regulatory protections under which it operates. Chief strategy officers should engage more closely with others in the C-suite, especially chief technology officers, chief marketing officers, and chief innovation officers to develop a longer-term strategy and vision for the organization.

INNOVATION

Synthetic media and content can be used for new product ideation, to test designs, and to help anticipate what's on the horizon. Given the complexity of new media technologies, chief innovation officers must consider alternative uses of what their teams develop: Once a product hits the marketplace, it could be used to spread misinformation or cause harm.

R & D

Synthetic media can be additive to the traditional R&D process. Teams making use of digital twins, experimental digital extensions, and other forms of new media can accelerate vital research, especially in urban planning, mobility, and health-related fields. For those working in creative industries, a transformation is underway, which will unlock new business opportunities and shape the future of media and entertainment.

RISK

We are entering a new, and very complicated, field of intellectual property law. This leads to thorny questions about an organization's legal rights to the content it builds and licenses. Chief risk officers should explore dimensions of intellectual property in an age of augmented media. There are longer-range implications to consider, including brand safety and consumer trust.

Key Questions

We recommend using this report to support your strategic foresight activity in the coming year. Every executive team should begin by asking these questions:

1

How will new media technologies improve our operations?

Our manufacturing processes?

Our product lines?

2

What aspects of our business could be disrupted by synthetic media or shifting news models?

Are we adequately planning for the longer term?

What assumptions must hold true for our current strategy to succeed?

3

How will our employees and customers find information in the future?

How might new paradigms be used to our organization's advantage, or to our detriment?

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- What scenarios describe our futures?

- What's happening outside my industry that I should know?

- What companies, startups, and partners make up our future value network?

- What new products, services, or businesses should we build?

- Which tech trends should we monitor? When should we act?

- How can we build an early warning system to see the next disruptive event?

- How do we reduce uncertainty about our futures?

We support executive leaders and their teams.

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

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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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