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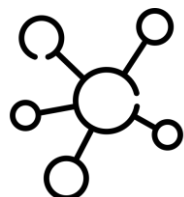
Productivity Boom



Wonder Drug?



Immortality?



Multimodal AI



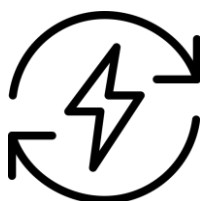
Show Me the
Money!



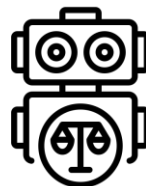
Smart Chemo



Munis in Motion



Energy Transition



Ethical AI



Wonder Drug? (GLP-1s)

Obesity is one of the most significant health challenges around the world. Biopharma company Novo Nordisk estimates more than 750 million people globally are living with obesity, which not only contributes to higher mortality, but also to more than 200 related health complications. Weight management drugs have been studied for decades with very little success until Novo Nordisk launched its GLP-1 (glucagon-like peptide-1) drug, Ozempic, for Type 2 diabetes in 2021. This class of drugs limits the amount of sugar that the liver releases into the bloodstream and slows down how long food stays in the stomach. GLP-1 drugs contribute to weight loss by suppressing appetite and making you feel full sooner when you eat. Ozempic and other approved GLP-1 drugs such as Wegovy (Novo Nordisk) and Mounjaro (Eli Lilly) are seeing patients typically lose 15-22.5% of their body weight.

While losing weight is a great benefit of using these drugs, recent studies show health benefits outside of diabetes and weight management. Most notably was the SELECT trial in August 2023 which demonstrated that patients on Wegovy had a 20% lower incidence of heart attack, stroke, or death from heart disease. Other benefits that patients observe include a reduction in addictive behaviors from alcohol to smoking to even nail biting. The promise of a wonder drug such as GLP-1 could dramatically change the healthcare landscape and society as a whole, potentially making as much as 70% of the U.S. population healthier and significantly more productive.

Long-term studies of GLP-1s are ongoing regarding potential negative side-effects, and there remain major issues regarding the cost and affordability of such drugs. While cost is indeed a factor, GLP-1s could have a transformative impact on our society and economy beyond just losing a few pounds.



Multimodal AI

In November of 2022, [ChatGPT \(Trends 2023\)](#) captured the imagination of the public and offered a glimpse of what was possible with generative artificial intelligence (GenAI). Since then, it has been a race to invest and gain advantage. While the viral “blue duck” video introducing Gemini by Google DeepMind risked overselling the technology, multimodal AI will be an important evolution for artificial intelligence. Multimodal AI is artificial intelligence that combines multiple types (or modes) of data input that make it possible to generate more insightful or nuanced conclusions about real-world questions. Until now, most AI systems have been unimodal, designed and trained to work with one type of data exclusively and tuned for that modality. For example, the original ChatGPT uses natural language processing (NLP) algorithms to extract meaning from text content and produce a text-only output. Multimodal AI, instead, accepts and processes data from multiple sources, including images, video, speech, sound, as well as code and text. Multiple inputs allow for a more detailed, refined assessment of a particular environment or given situation. A multimodal NLP, for example, may identify signs of emotion in a user’s voice and combine that with facial expressions to better interpret a query and tailor a proper response. In this way, multimodal AI more closely resembles human perception.

Multimodal AI will be central to the development of autonomous vehicles ([Passenger Economy, Trends 2018](#)) and robotics ([Rise of the Machines, Trends 2014](#)) that need to interact with real-world environments. Multimodal AI uses data from cameras, microphones, GPS, radar, LiDAR, and a host of other sensors to better understand and more successfully interact with its surroundings. Likewise, multimodal AI will enable more effective and intuitive human-computer interaction through the use of sensors and wearables ([XR, Trends 2023](#)) that may even extend to the [Metaverse \(Trends 2022\)](#).



Smart Chemo (ADCs)

The idea of targeted chemotherapy was first conceptualized by a German scientist, Paul Ehrlich, over a century ago. He imagined it could be possible to kill specific harmful microbes or unwanted cells, with what he would call a “magic bullet”, without harming the body itself. His discovery of Salvarsan for the treatment of syphilis in 1909 is considered his first “magic bullet” and led to the foundation of the concept of chemotherapy, a term he also coined.

Antibody-drug conjugates (ADCs) are a rapidly emerging class of therapeutic agents that combine the highly specific targeting of monoclonal antibodies (mAbs) with the lethal effect of cytotoxic cellular poison. Cancer researchers today develop these “smart bomb” ADCs to target tumors with drugs while leaving healthy body cells intact. With such treatment, patients will suffer fewer side-effects from the toxic drugs used in chemotherapy. The first ADC drug, called Mylotarg (gemtuzumab ozogamicin), was approved by the FDA in 2000 for a form of leukemia. However, it has taken 10-20 years to perfect the construction of the “biological smart bomb” to better enable it to target common solid tumors which are more complex and difficult to penetrate. As the technology advances further, the promise of [Precision Medicine \(Trends 2016\)](#) and personalized ADCs may be a possibility in the future. Morgan Stanley Research thinks this could be more than a \$140B market over the long term, up from a \$5B base in 2022, making ADCs one of the biggest growth areas across Global Biopharma. Large-cap biopharma companies are increasingly aware of the enormous potential for ADC drugs, accelerating investment for “smart chemo” and actively deploying more capital, as illustrated by Pfizer’s recently announced \$43B acquisition of Seagen in 2023.



Energy Transition

In response to climate risk and mounting social pressure for sustainability, energy production is undergoing a dramatic transition to replace fossil fuels with renewable energy sources such as wind, solar, hydro, and nuclear. Net Zero initiatives are calling on governments, companies, and other organizations to commit to becoming carbon neutral by the year 2050. Wind and solar sources are leading electrification efforts by growing capacity and improving efficiency, fast becoming cheaper than fossil fuel alternatives. The term “electrification” refers to technologies adopting electricity as an energy source as opposed to fossil fuels - for example, electric vehicles.

In previous trends, [Solid-State Batteries \(Trends 2021\)](#) and [Picogrids \(Trends 2018\)](#) we’ve highlighted how advancements in technology are shaping the future of energy. Perhaps the pinnacular energy source for the future is nuclear fusion, providing virtually limitless clean power. Unlike fission, fusion is two atoms slamming together to make one heavier atom, resulting in large amounts of energy. Recent breakthroughs in nuclear fusion mark a significant step in being able to replicate the power of stars. In theory, nuclear fusion produces significantly more power than fission without producing radioactive waste, a major drawback to current nuclear energy production. Last December, the National Ignition Facility (NIF) achieved a decades-long goal of “ignition”, the process where a fusion reaction expels more energy than was originally input, resulting in a net energy gain. Since then, the process has been replicated several times with significant improvements to efficiency, able to produce 3.88 megajoules of energy from 2 megajoules of energy input, about as much energy as 1.5 pounds of TNT. However, utilizing nuclear fusion for grid scale energy production is still likely years, if not decades, away.



Productivity Boom

We have written previously about [Unproductive People \(Trends 2023\)](#) and other disturbing trends that have weighed on productivity, such as “quiet quitting” in the U.S., “lying flat” in China, [Great Resignation \(Trends 2022\)](#), [Playing with FIRE \(Trends 2019\)](#), and the tragic epidemic of addiction. Productivity growth in the U.S. has stagnated to just 1.2% per year on average over the past decade, despite many technological innovations over the same period. Perhaps advancements like smartphones and social media may have distracted workers and spurred more consumption of content than production of goods and services. However, [Multimodal AI \(Trends 2024\)](#) and [GLP-1s \(Trends 2024\)](#), in contrast, may be advancements that finally usher in a significant, sustained resurgence in productivity.

Artificial Intelligence (AI) and GLP-1s will have broad implications for businesses and the economy, but perhaps its most significant may be to accelerate labor productivity. According to data from the National Health and Nutrition Examination Survey (NHANES), over one third of Americans are obese and according to the Association of American Medical Colleges (AAMC), more than 21 million have a substance abuse disorder. While GLP-1s have grabbed headlines for effective weight loss, studies have also observed a reduction in addictive behaviors. The promise of a wonder drug such as GLP-1s could dramatically change the healthcare landscape and society, potentially making a greater portion of the U.S. population healthier and more productive. Additionally, AI will help to automate and scale many tasks humans currently perform. Companies such as Salesforce and Microsoft report seeing as much as a 50% productivity improvement using GenAI tools. As new GenAI tools roll-out to different industries and job functions it will be important to monitor how much of a productivity lift they see. According to J.P. Morgan Market Insights, most analyses posit 1.5-3.0% increase in labor productivity per year globally over the next decade. Importantly, this does not factor AI’s potential to accelerate innovation, which could provide further upside to estimates.



Immortality?

Benjamin Franklin once quipped, "...in this world, nothing is certain except death and taxes." While taxes may be unavoidable, recent breakthroughs in science and technology are working hard to extend human health spans, making people healthier and more productive well into their later years of life. Advancements and trends in computing, genetics, and medicine ([AlphaFold, Trends 2021](#); [SynBio, Trends 2022](#); [Connected Health, Trends 2022](#)) are converging and will help us live longer and healthier lives. Today, we are beginning to have a much more in-depth scientific understanding of how aging contributes to many fatal risk factors such as heart disease, diabetes, cancer, and neurological disease. Blue Zones, which are regions around the world where humans are healthy and active well into their 100s, have been extensively studied and have given us a potential blueprint of how humans can increase their health span. A wealthy entrepreneur, Bryan Johnson, is taking these advancements to an even more extreme level of experimentation on himself, spending \$2 million a year and with a team of 30 doctors tracking every metric possible in how his body functions. As a result of his strict regimen, he is aging at a rate substantially slower than a normal 45-year-old and his biological age based on some factors are equivalent to an individual half his age.

These efforts to slow down the aging process are not enough for some. Ray Kurzweil, a celebrated inventor and technologist, hypothesizes that by 2030 humans will have discovered how to achieve immortality, not just slowing down the aging process, but reversing it. Given the rapid advances we've recently seen in science and technology Kurzweil's prediction may not be as far-fetched as it once seemed. At the very least, the trend towards helping us all live longer, healthier, and more productive lives is something we all can look forward to, even if taxes are still a certainty.



Show Me the Money!

In previous trends we have highlighted how companies and markets adapt to the current interest rate and inflationary environment ([CRaP, Trends 2019](#); [Bond Vigilantes, Trends 2023](#)).

The past couple of years have seen a dramatic reset of interest rate and inflation expectations, given the fastest and largest increase in interest rates since the 1980's. At this stage, the million-dollar question regarding interest rates and inflation is: what does the new normal look like and how does that change corporate behavior, strategy, and investor expectations?

The post-Global Financial Crisis (post-GFC) period between 2009-2021 was one that resulted in deflation to low inflation, ultra-low to zero interest rates, multiple stages of central bank Quantitative Easing and negative bond yields in several parts of the world. The absence of a true market-based cost of capital combined with a low growth economy incentivized companies to pursue an aggressive growth strategy and, in many cases, chase that strategy with little to no regard for profitability. One example of this was Netflix's aggressive push into streaming and Subscription Video on Demand (SVOD), outspending the competition by billions of dollars and resulting in substantial losses in free cash flow ([Peak TV, Trends 2019](#)). In 2017, Netflix CEO, Reed Hastings commented, "In some senses the negative free cash flow will be an indicator of enormous success." Fast forward to today – Netflix spending has plateaued, the company is raising prices, and both operating margins and free cash flow are rising substantially. The trend recently is similar across many other companies and industries from small startups to Big Tech, but the message is the same: increase profits.

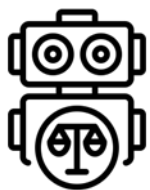
We believe it's unlikely we will return to near-zero interest rates into the next decade and are more likely to see a prolonged period of central bank quantitative tightening (QT) rather than quantitative easing (QE). We think this means investors will increasingly place more value on companies executing on operating margin performance and a balanced growth and profitability strategy. The environment for the foreseeable future may have investors demanding, just as Jerry McGuire shouted, "Show me the money!"



Munis in Motion

The municipal bond market is notoriously stubborn and slow to embrace change, especially relative to markets for other traditional asset class securities. While stocks, Treasuries, corporate bonds, and other security types offer highly-efficient, low-cost, technology-driven venues for transactions, municipal bonds still rely on systems that many investors consider clunky and outdated. For example, well-established personal relationships and timely phone calls still play a major role in finding good deals for investors today. However, algo-powered trading and digital execution have gained significant acceptance and market share in recent years, leading to cost reductions for both dealers and investors. New participants and platforms have helped to provide additional liquidity to markets, and ongoing pushes to embrace technologies like [Blockchain \(Trends 2016\)](#) promise to streamline the underwriting and trading process even further.

This embrace of technology hasn't come without some pain. Just recently, one of the largest Wall Street firms announced their exit from new issue and secondary market trading business- perhaps a sign of things to come as personnel, regulatory, and IT costs continue to rise for traditional trading desks. Will Wall Street's pain result in the muni investor's gain? As technology advances, expect liquidity of bonds to increase, costs for investors to decline, and settlement times for municipal securities to shorten. In a time where investors expect a prolonged period of higher interest rates and increasing individual tax rates, such advances may be received as a welcome development in an otherwise antiquated market for municipal bonds.



Ethical AI

The recent movie "Oppenheimer" chronicles the career of Robert Oppenheimer, the American theoretical physicist credited with being the "father of the atomic bomb" for his role in the Manhattan Project during World War II. It's a story of rapid scientific advancement that reminds us that pure and unencumbered progress can have unintended and far-reaching consequences. As technology rapidly advances into the Age of Artificial Intelligence (AI), the movie serves as a reminder to sometimes slow down and consider the broader implications. Coincidentally, around the same time as the movie "Oppenheimer" was released an open letter was posted, signed by hundreds of the world's leading AI scientists and experts, calling for a moratorium on AI development and warning that AI poses a "risk of extinction" comparable to that of nuclear war. Similar to "Oppenheimer", one of the letters most prominent signers was Geoffrey Hinton, a leading researcher in the field and considered one of the "Godfathers of AI". Hinton also at the time resigned from his prominent role at Google, so he could speak freely about the risks of AI and has spoken publicly about his regret for his role in the technology's development.

The rapid pace of technology and artificial intelligence (AI) more specifically are raising ethical if not existential questions among experts. Some fear the unintended risks of AI, including the rapid progress toward artificial general intelligence (AGI), which could bring change comparable in scale with the Industrial Revolution or electricity in a time frame much faster than society could adapt economically. Additionally, misuse of AI by malicious actors would be hard to prevent, with numerous potential issues that span from public disinformation to privacy concerns to military operations.

Other trends such as the recent spat between OpenAI CEO, Sam Altman, and OpenAI's Board of Directors suggest further stress between the for-profit motivations and arms race advancement of AI versus the public good and safety considerations. While details are still emerging about exactly why Sam Altman was temporarily fired as CEO, it does seem clear that some members of the board are concerned about the technology's rapid advancement toward AGI and the ethical lines the company should set.

Governments are attempting to get ahead of the potential risks from AI, with Europe being the first to set regulations around responsible development and use of AI technologies. While there are always risks associated with any new technology, the development does not appear likely to slow down any time soon. Perhaps Robert Oppenheimer summed it up correctly in his motivation for completing the atomic bomb: "I don't know if we can be trusted with this, but I know the Nazis can't."

Appendix



Bond Vigilantes (Trends 2023)

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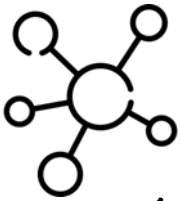
In the 1990's, President Bill Clinton's political adviser, James Carville, famously remarked, "I used to think that if there was reincarnation, I wanted to come back as the President or the pope or as a .400 baseball hitter. But now I would like to come back as the bond market. You can intimidate everybody." At that time (November 1994), US 10-year Treasury yields climbed from 5.2% to just over 8%, fueled by concerns about federal spending. This period, known as the Great Bond Massacre, was a clear example of bond vigilantes making their opinion known within financial markets.

The term "bond vigilante" was coined in the 1980's by economist Ed Yardeni, which refers to a bond investor who threatens to sell, actually sells or avoids buying a large amount of bonds to protest or signal disagreement with policies of the issuer. Generally, this behavior results in higher borrowing costs for the issuer, be it a government or corporation; however, if enough investors disagree with the policy, this can result in sharply higher borrowing costs, forcing the entity into distress, change of policy or a higher rate of return that compensates the investor for the additional risk.

Many thought bond vigilantes had gone extinct as over the last decade, as we've seen mostly a period of zero-to-low interest rates and increased central bank intervention. However, it now appears the vigilantes had only been in hibernation mode, and inflation and higher interest rates have awakened them. The latest episode of bond vigilantism recently occurred in the United Kingdom, as then Prime Minister Liz Truss announced her economic plan. Bond investors saw the plan and foresaw the trouble it would inflict on an already tenuous economy, resulting in the 30-year UK Bond yield surging from just under 3.5% to nearly 5% in just a few days. This caused the Bank of England to intervene in the bond market, backstopping support as several pension and insurance companies came under considerable distress. As a result, Liz Truss's reign as prime minister only lasted 45 days and forced the UK government to change its plan.

Are further bouts of bond vigilantism in our future? The originator of the term, Ed Yardeni, believes so, saying, "They're Baaack!" as huge amounts of monetary and fiscal stimulus released during the pandemic has awakened these market forces. During the COVID pandemic, we wrote about [Zombie Companies \(Trends 2021\)](#), which described the unprecedented actions by the Federal Reserve; while necessary, it had the unintended consequence of keeping many near-dead companies from failing.

Zombie Companies beware! The living dead may not walk forever.



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Chat GPT (Trends 2023)

A prototype artificial intelligence chatbot (ChatGPT) developed by OpenAI and released on November 30, 2022, has captured the imagination of the public and has provided a glimpse of what's to come. OpenAI (an artificial intelligence research lab also responsible for DALL-E2 which interprets natural language inputs to create images of realistic objects) counts among its founders tech luminaries Elon Musk and Sam Altman.

In [CAIS \(Trends 2020\)](#), we discussed advances in machine learning and introduced the concept of comprehensive AI services. It may have seemed like a distant scenario that would emerge over time, but ChatGPT appears to be a step change. Perhaps, we'll let ChatGPT speak for itself. Below is ChatGPT's response to the query, "Write two paragraphs in journalistic style to describe ChatGPT and its future impact":



E Write two paragraphs in journalistic style to describe ChatGPT and its future impact.

 ChatGPT is a new natural language processing tool developed by OpenAI. It uses cutting-edge machine learning algorithms to generate human-like responses to user input in real-time. This technology has the potential to revolutionize the way we interact with computer systems, making them more intuitive and easier to use.

One potential application of ChatGPT is in the customer service industry, where it could be used to provide instant and accurate responses to customer inquiries. This could greatly improve the efficiency and satisfaction of the customer experience, and could potentially even reduce the need for human customer service agents. In the future, ChatGPT and other similar technologies could play a key role in making artificial intelligence a more integral part of our daily lives.



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Unproductive People (Trends 2023)

The U.S. economy is currently at one of its lowest unemployment rates in history and has around ten million unfilled job positions according to the U.S. Bureau of Labor Statistics; however, labor force participation rates remain historically low, and is at the lowest level ever recorded for prime-age males. Though perhaps exacerbated by the COVID pandemic, the trend was well-established prior to 2019 and may be associated with other trends such as [Great Resignation \(Trends 2022\)](#) and [Playing with FIRE \(Trends 2019\)](#). What gives? Perhaps Tyler Childers got it right in his song Whitehouse Road, "Get me higher than my grocery bill." Whether it be loneliness, lack of job skills, substance abuse or a combination of all three, there is a significant portion of the U.S. population that has gone from forgotten, to unproductive, to becoming a serious drain on public resources. According to the Association of American Medical Colleges, 21.2 million Americans have a substance abuse disorder. The U.S. Department of Health and Human Services estimates that 760,000 Americans have died of drug overdoses since 1999 and 10.1 million Americans over the age of 12 misused opioids in 2019. Relatedly, the homeless issue in many large U.S. cities is only getting worse despite the billions of dollars being spent. According to the Hoover Institute, San Francisco alone is spending \$852 million in its current budget year on homeless and supportive housing for its estimated 8,000 homeless people. That equates to \$106,500 per homeless individual- this in a city that spends roughly \$19,500 annually per student in its public schools. It simply is not sustainable.

The U.S. is facing a structural labor deficit despite a growing population, and those remaining in the workforce are not becoming more productive despite widespread use of technology. This lack of productivity appears more severe in the U.S., but it is a global issue. Whether it be work-from-anywhere ([WFA Trends 2021](#)), lying flat in China, or quiet quitting, the world needs to address this issue if it hopes for satisfactory economic growth going forward.



XR (Trends 2023)

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eXtended Reality (XR) is a catch-all term for technologies that enhance or replace our view of the world. This is often through overlaying or immersing computer text and graphics into real-world and virtual environments, or even a combination of both. XR encompasses augmented reality (AR), virtual reality (VR), and mixed reality (MR) - technologies we first introduced in [Alternate Realities \(Trends 2017\)](#). A central feature of all XR wearable devices is the ability to use visual input methods such as object, gesture, and gaze tracking to navigate the world and display context-sensitive information. However, XR devices vary based on the type of AR, VR, and MR experience and the complexity of use case that they are designed to enable.

Apple Inc.'s focus on AR/VR has ramped up over the past few years and will likely make the technology mainstream. As XR technology continues to advance, we expect it to play a crucial role in the development of the [Metaverse \(Trends 2022\)](#). This technology has the potential to revolutionize the way we interact with the digital world, blurring the lines between the physical and the virtual.



Connected Health (Trends 2022)

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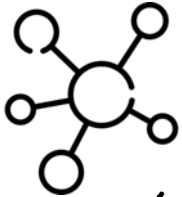
With the wide-spread adoption of fitness trackers, smart-watches, and other wearable devices ([see Wearables, Trends 2015](#)) we've never had more information at our fingertips about our daily health. We can track our steps, heart rate, blood sugar, blood pressure, and many more vitals in nearly real time throughout the day. This unprecedented level of understanding about our daily activity levels and general health is leading to a boom in the connected health industry ([see Telehealth, Trends 2021](#)). This is making our fitness smarter and more accessible as companies such as Peloton have popularized high-quality workouts into our homes. It's making our healthcare system smarter by providing medical and insurance providers more detailed information about patients. Apple and Fitbit, for example, have entered partnerships with health insurance companies to share data and explore offering incentives to members. Connected Health is also ushering in a new era of personalized medicine as companies such as 23andMe can genetically test an individual's DNA, providing new insight into how to treat patients based on their individual genetic predisposition. Healthcare is one of the last sectors to have been digitally transformed; as connected health devices and applications proliferate further, that transformation appears closer than ever.



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Great Resignation (Trends 2022)

In 2021, whether they were fed up with a daily commute to the office, or tired of working hard jobs for little pay, or simply using the labor shortage to find a job that better suits their preferences, Americans quit their jobs at record rates. This phenomenon is not a uniquely American one. In China, young workers and professionals are opting into the “lying flat” movement, rejecting the promise of consumer fulfillment and the accompanying struggle for workplace success. In a trend synonymous with the Financially Independent Retire Early movement ([see Playing with FIRE, Trends 2019](#)), workers around the world are showing a desire for an improved work-life balance, more time for themselves and their families, and more autonomy in their daily life, not to mention the savings produced by a lack of a commute. In addition to the desire for greater autonomy in their daily routines, workers are also struggling with childcare dilemmas and taking the opportunity to retire early. According to economist Miguel Faria-e-Castro at the Federal Reserve Bank of St. Louis, more than 3 million people have retired early due to the COVID-19 crisis. All these factors have led to a shortage of labor, often referred to by economists as full employment. The current shortage may have placed workers in a relatively strong bargaining position for the time-being, but it’s noticeable that wage growth still trails inflation and over time, companies grow more likely to respond to higher wages with labor-saving investments.



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Metaverse (Trends 2022)

Over the last year, the Metaverse ([see Metaverse, Trends 2021](#)) has gained significant notoriety as Facebook (now Meta) has made it a key strategic priority. Meta is investing \$10 billion into its Metaverse vision to build out the critical hardware and software infrastructure, as Mark Zuckerberg believes it to be the next major technology platform. Key debates remain about what the future Metaverse will look like. While the amount of time we are all spending in digital worlds is increasing (from Zoom calls to Roblox games), many of these use cases are what we would consider a Metaverse 1.0 user-interface. The next iteration, Metaverse 2.0, we believe will require more lifelike experiences and interaction. Video game developers and companies such as NVIDIA, Unity Software, and Epic Games continue to push the boundaries of making the digital almost indistinguishable from the physical. Real-time 3D capabilities is one of the biggest trends in the media industry and increasingly media consumption is moving from a static, passive 2-dimensional experience to a 3-dimensional experience where the viewer can interact, change and customize the content. Already many television and movie studios are aggressively integrating these real-time 3D capabilities into their content. More ways of engaging in the Metaverse continue to grow from Augmented Reality glasses to Virtual Reality headsets, allowing the user the ability to choose how they will engage in the Metaverse. Humans are social creatures by nature and the last two years of relative isolation during COVID has taught us that virtual environments remain a highly relevant and necessary platform for social interaction.



SynBio (Trends 2022)

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Synthetic biology (SynBio) is a multidisciplinary area of research that seeks to create new biological parts, devices, and materials, or to redesign systems that are already found in nature. SynBio builds upon many of the trends we have identified in the past such as gene editing ([see CRISPR, Trends 2017](#)), advanced computing ([see AlphaFold, Trends 2021](#); and [Quantum Computing, Trends 2017](#)), and organic material grown in a lab ([see Where's the Beef?, Trends 2018](#)). As critical investments in infrastructure bear fruit, we believe SynBio could be a disruptive technology. In principle, scientists could engineer a patient's own cells to multiply, differentiate into different cells types and even self-assemble into new tissues (even organs!) to repair those damaged through disease or injury. SynBio also offers the opportunity to integrate biochemical components from living systems with inorganic components to create new materials that are able to sense the environment (or internal signals) and dynamically change their properties. Imagine the possibilities for new and improved protective clothing or building materials. SynBio has far-reaching potential for new solutions impacting global healthcare, agriculture, manufacturing, and environmental challenges.



AlphaFold (Trends 2021)

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For decades, scientists have been working to uncover ways to predict the shape and structure of proteins, the building blocks of life. Most of what happens inside a cell is determined by the proteins within it. Thus, if you want to understand how a cell will react or be influenced, understanding the shape and structure of the underlying proteins is essential. This problem has been worked on for decades and was increasingly thought to be unsolvable. That is, until now. In one of the largest breakthroughs ever in molecular biology, a team from Google's DeepMind artificial intelligence (AI) group appears to have solved this problem with remarkable accuracy in what they are calling AlphaFold.

The DeepMind team developed a consensus model of what the protein should look like by using deep learning to predict the distance between pairs of amino acids, then using an AI network, incorporated information about the physical and geometric constraints that determine how a protein folds. Combining these two methods, the team was able to accurately predict the final structure of the target protein sequence. According to Janet Thornton, a structural biologist at the European Molecular Biology Laboratory-European Bioinformatics Institute in the UK, "It's a breakthrough of the first order, certainly one of the most significant scientific results of my lifetime".

The implications are immense. The technology can provide key insight into how diseases progress and could dramatically change how we discover new drugs. AlphaFold could help uncover the function of thousands of proteins in the human genome and make sense of disease-causing gene variations that differ between people. AlphaFold may also represent an inflection point in the field of Artificial Intelligence, as this is one of the most significant real-world impacts seen from the advancement of this technology.



Metaverse (Trends 2021)

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The term Metaverse originates from Neal Stephenson's science fiction novel, Snow Crash. In the novel, human beings interact as avatars in a three-dimensional space based on the real physical world. For most people today, the film adaptation of the Ernest Cline novel Ready Player One demonstrated a vision of what the Metaverse might look like. Coinciding with our previous years' gaming trends ([see eSports, Trends 2018](#) and [Cloud Gaming, Trends 2019](#)), the idea of a Metaverse is now an evolving trend to watch over the next several years. Advancements in 3D graphics, computing power, artificial intelligence, virtual reality, and social gaming are colliding creating early, small Metaverses. Gaming and digital worlds, such as Fortnite, are the forum for many young people today to experience a significant part of their social connections. Other companies such as Roblox even have thriving economies built inside of them, where players build virtual goods and games, generating income in the form of the platform's digital currency, the Robux. The COVID-19 pandemic is pushing the idea of a Metaverse even further as we are all forced to interact more in a digital world than a physical world. Concerts, meetings, birthday parties, weddings among many other events have all moved into the Metaverse during the pandemic. Time will tell if the Metaverse becomes a normal part of our daily lives, that is, if we are not living in a simulation already.



Solid-State Batteries (Trends 2021)

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A solid-state battery differs from today's lithium-ion or lithium polymer batteries in that it uses solid electrodes and a solid electrolyte, instead of liquid or polymer gel electrolytes. As both the electrodes and the electrolyte are solid state, the solid electrolyte also behaves as the separator, allowing volume and weight reduction due to the elimination of certain components. In addition, the removal of flammable liquid electrolytes can be an avenue for safer, longer-lasting batteries as they are more resistant to changes in temperature and physical damages which occur during usage. While the concept has been known for decades, implementation has been challenged in the past by short lifetimes and slow charging rates. However, in 2020 Volkswagen-backed QuantumScape announced a breakthrough of its single-layer solid-state battery cells with much higher energy density, significantly increasing the drivable range per charge of electric vehicles, as well as the ability to fast charge to 80% in 15 minutes. According to Kent Helfrich, Executive Director, Global Electrification and Battery Systems at General Motors and other known experts in the industry, there is potential for at least a 50% reduction in battery pack cost over the next several years, putting the cost of an electric vehicle at or below parity compared to the internal combustion engine. This could be a game changer for electric vehicles.



Telehealth (Trends 2021)

Return to Trend ↶

The concept of telehealth has been around for years, but the industry had just been dabbling. Then - as with so many other industries - the COVID-19 pandemic accelerated the trend toward remote healthcare. The long-term implications of delivering healthcare services remotely are immense. Time savings and efficiency gains for both patients and doctors; access to doctors for those who have mobility issues or live in remote areas; robotic surgery or physical therapy being performed using remote instruments; and volumes of patient data being sent to medical facilities in near real-time ([see "Internet of Things/Wearables" trend from 2015](#)). This trend will be with us and maturing for years, but there's little doubt it's coming. And in a surprise to no one, large tech companies are looking to capitalize on healthcare trends. Apple is building a healthcare business centered on the consumer (wearables, etc.). Google will almost certainly play in the consumer market as well, while also trying to capitalize on healthcare-related analytics (population genomics, devices & sensor monitoring, etc.). Consumer and regulatory reaction to these trends will be worth watching in the years to come. Eventually, technology touches everything, and the future of healthcare will bring technology to the forefront of patient care.



WFA (Trends 2021)

Return to Trend ↻

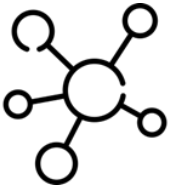
As COVID-related office closures extend beyond their initial expected lives, both employers and employees have learned to embrace the concept of Work from Anywhere (WFA), a new reality where if an employee has internet and cell service, work can be done. This newfound freedom relaxes the need for employees to make time-consuming and expensive commutes to the office and reduces the need for employers to provide designated office space for each employee as the availability of low-cost, easy-to-use video conferencing services provides a viable alternative to in-person meetings.



Zombie Companies (Trends 2021)

Return to Trend ↻

As the COVID-19 pandemic took hold and governments were forced to lock down, the speed at which the Federal Reserve and U.S. Government moved to initially provide support was incredible. Trillions of dollars of support to individuals, businesses, and the capital markets helped ensure a public health crisis did not turn into a financial one. Looking back, it's hard not to say that support was a resounding success in helping bridge the economy and capital markets beyond the sudden shock of the pandemic. However, while the Federal Reserve may have staved off an economic depression, there are likely to be unintended consequences of these actions for years to come. One of those unintended consequences is the expansion of "Zombie Companies". Very much as the name suggests, Zombie Companies are near-dead companies that continue to exist. These companies, which would have gone out of business, but for the Federal Reserve's intervention, have been allowed to take on an even larger amount of debt. One distinction of a Zombie Company is an inability to earn enough to cover its interest expense. According to a Bloomberg analysis of 3,000 publicly traded companies, total debt obligations of these Zombie Companies have swelled to nearly \$2 trillion dollars, which is substantially higher than companies of a similar profile during the 2008 financial crisis. The Federal Reserve's actions may have given hundreds of unproductive and near-dead firms unlimited access to the capital markets. This creates a long-term moral hazard problem for capitalism. One needs to look no further than Japan in the 1990's and the European Union more recently as to how Zombie Companies negatively impact longer-term growth in an economy. For capitalism to thrive, companies must be allowed to fail.



CAIS (Trends 2020)

Return to Trend 

Recent advances in machine learning and deep learning have captured the public's imagination. Computer algorithms are mastering capabilities and applications once believed limited to humans, such as image classification, and vision, speech, and language translation.

New barriers are being broken where forms of artificial intelligence (AI) can beat world champions at strategic games like chess and GO and detect cancers better than human doctors. Even creative barriers are being breached using generative adversarial networks (GANs) where two neural networks compete with each other - the contest between one network learning to generate new data and the other learning to discriminate true, "real" data from those fabricated by machine. GANs can be used to create photorealistic images for design, computer landscapes, and even human faces and figures in place of models or actors.

This progress is generating both excitement and fear, fueling a debate on the development of artificial general intelligence. In his New York Times bestseller, *Superintelligence: Paths, Dangers, Strategies*, Nick Bostrom warns of superintelligence as potentially highly dangerous to humans. Whereas Eric Drexler's concept of comprehensive AI services (CAIS) assumes that specialized, narrow AI will continue to improve (as it has) for specific tasks and that the range of tasks that algorithms will be able to perform will become wider and so comprehensive that it will begin to resemble a general intelligence. Rather than an artificial "superintelligence being," general AI would be more like a search engine, looking among the tasks it can perform for a match to the request. Indeed, engineers at Google know a thing or two about search and have indicated ambitions to build AI systems that can generalize to a new task, using much less data and with much less computation.



Cloud Gaming (Trends 2019)

Return to Trend 

As we saw with the eSports trend we cited last year, video gaming is going more and more mainstream. According to industry tracker Newzoo BV, the global games industry is on track to reach \$134 billion in annual revenues this year while growing faster than the broader entertainment sector. The cloud is the future for video gaming and promises to expand the addressable market for an already enormous business. Pricey hardware may no longer be necessary for top-tier games when streaming via the Internet (i.e., the cloud) allows users to access vast computing power online using smartphones and smart TVs. According to Barron's, the number of households that own either a dedicated console or high-end gaming PC is estimated at 300-400 million worldwide, whereas the universe of all gamers (including the casual ones who play on their phones) numbers in the billions.

Cloud Gaming can also mean "Gaming-as-a-Service" (GaaS) and could potentially lead to steady and more-predictable recurring subscription revenues like the monthly fees that Netflix and Spotify collect for video and music services. However, there are unique challenges to streaming games. Unlike movies and music, games are interactive and can involve sophisticated real-time rendering of images and latency issues. If successful, cloud gaming could lead to more engagement and competition for consumers' time, diverting more hours away from movies, music and other media. With a convergence of technologies and new business models ahead, Ken Moss, Electronic Art's Chief Technology Officer predicts, "There's going to be more change in video games in the next five years than there has been in the past generation."



CRaP (Trends 2019)

Return to Trend ↻

In the tech world, disruption has been more valuable than profits - a land-grab for eyeballs and share-of-wallets financed by valuation-indifferent investors. Now, e-commerce retailers are changing the dynamic and focusing on profitability, casting off categories and cheap items that Can't Realize a Profit.

Recognizing the land-grab may be nearing an end, many companies have begun locking in consumers using subscription business models. Most people are familiar with subscribing to media like cable or Netflix, or to services like internet or cell phones; companies are hoping you will also consider subscribing to cosmetics, toilet paper, razors, and clothing. Retailers such as Walmart with their recurring "Beauty Box", Nordstrom with their "Trunk Club", or Amazon with "Subscribe & Save" hope to consolidate your monthly purchases, while brands hope to tap into demand directly with things like Procter & Gamble's "Gillette on Demand", Sephora's "Play!", or Blue Apron's meal delivery service.

According to a McKinsey & Company report, subscription e-commerce has grown greater than 100% per year for five years through 2016, accounting for more than \$2.6 billion in sales, up from just \$57 million in 2011. As e-commerce wrestles with the balance between market share and profitability, a steady predictable revenue stream from subscriptions may offer the best of both.



Peak TV (Trends 2019)

Return to Trend ↻

While speaking at an industry conference several years ago, John Landgraf, CEO of FX Networks, made a controversial presentation coining the term “Peak TV” while referencing the significant increase in video content production. According to Landgraf, “This is simply too much television. My sense is that 2015 or 2016 will represent peak TV in America.” He has since tempered his view and now believes that television is in a gilded age. According to the FX Networks study, the number of scripted original series has grown from a total of 216 in 2010 to a forecast of over 500 in 2018. Virtually all of this growth has been driven by online streaming companies, such as Netflix. This number of original scripted series appears poised to increase even further: AT&T is integrating TimeWarner (HBO), Disney and Fox are combining, Netflix and Amazon are committing to even larger content budgets, and new entrants Facebook and Apple have announced billion dollars plus commitments for content development. Even Wal-Mart has been rumored to be throwing its hat into the TV video production game.

All this is progressing towards a content arms race to gain global scale, disrupt, differentiate and access direct-to-consumer relationships. Netflix has been the most aggressive and successful so far, burning through billions of dollars of cash per year. As Reed Hasting said during a company conference call in the summer of 2017, “In some senses negative free cash flow will be an indicator of enormous success.” While Landgraf’s original prediction of “Peak TV” may have been too early, serious questions remain as to whether increased content can be adequately monetized over the long-term. TV’s gilded age may be great for starving actors, but for investors it could be a house of cards.



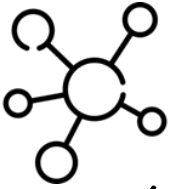
Playing with FIRE (Trends 2019)

Return to Trend ↻

The new wave of spending less and saving more prioritizes time and experiences over income and things. Financial frugality is gaining traction among a small but growing cohort of primarily millennial households' intent on "hacking retirement" by substantially increasing their savings rate in an effort to be Financially Independent and Retire Early (FIRE). In some cases, adopters of the FIRE movement look to save over 50% of their annual income, invest aggressively and find new ways to minimize expenses.

While the desire for financial independence isn't new, the motivation for living a life of experiences and having control of your own time - rather than consumerism and things - is more unique to the current wave. Often, this means downsizing houses/cars/etc., moving to cheaper neighborhoods/cities, and generally cutting back on expenses to maximize savings rates in a battle against lifestyle creep and the stresses that can come with it.

Many who pursue this path are tired of high-stress jobs, or places where they feel unfulfilled - and they're not willing to "grind it out" for a good paycheck. They choose to live well below their means in a life rich on time, but short on other luxuries.



eSports (Trends 2018)

Return to Trend 

E-Sports have arrived. This year, about 191 million people worldwide are expected to watch an e-Sports competition at least once a month, more than double the number in 2012, according to Newzoo BV, a global market research and predictive analytics firm with a primary focus on games. By 2020, the research firm expects that viewership to climb to 286 million. The International Dota 2 Championship, the richest e-Sports tournament in the world, had a total purse for the event of over \$20 million, nearly double the total payout of The Masters.

The global games industry, according to several forecasts, is on course to exceed \$100 billion in annual revenues this year and continues to grow faster than the broader entertainment sector. Some are even pushing to have e-Sports as an Olympic event by 2024. Alex Lim, secretary-general of the International e-Sports Federation, explains, "One generation grew up kicking a ball in the back yard, the next grew up with choices that included video games. We live in a digital culture that most people accept is redefining a whole range of things: sport is one of them."

Most of the e-Sports trend is evolving out of Asia, as 57% of e-Sports viewers come from China. Advertisers are constantly looking to get in front of younger demographics, especially as the media industry continues to move away from traditional forms of entertainment. Companies are taking note; according to Jefferies & Co., media rights for e-Sports are expected to increase from \$95 million in 2017 to \$340 million in 2020 and 600 sponsorship deals have been struck since the beginning of 2016, including major advertisers such as Red Bull and Coca-Cola.

With traditional sports leagues such as the NFL encountering ratings declines for the first time in their history, expect more companies to capitalize on the rapidly growing e-Sports trend.



Return to Trend ↶

Passenger Economy (Trends 2018)

The auto industry and passenger economy are experiencing paradigm-shifting changes not seen since the birth of the automobile. Today the industry looks like this: the current auto industry produces approximately 80 million cars per year at an average price of approximately \$19,000 for a total addressable market of \$1.5 trillion dollars. Toyota has the largest market share globally at 13% , sells approximately 10 million cars and generates about \$250 billion in annual revenue (a milestone that took the company over 70 years to achieve).

As autonomous driving and electric vehicles are gaining relevance, the business model for the auto industry is transforming and technology companies are taking a fresh approach with the idea of shared mobility. The future auto market, from their perspective, looks like this: approximately 10 trillion miles globally are driven annually at a cost of approximately \$1 per mile for a total addressable market of \$10 trillion dollars. A ride sharing model company with a nominal 1.7% market share globally would be traveling 170 billion miles a year at a price of \$1.50 per mile, generating approximately \$255 billion in revenue (some companies view this milestone as achievable in less than 7 years).

The average car is only used 4% of the day, massively under-utilized. The theory goes that by increasing the utilization rate of the car through shared mobility, the cost per mile goes down significantly. With the addition of autonomous driving the cost per mile goes down even further. As the cost per mile goes down many believe that miles driven will increase exponentially.

A study, prepared by Strategy Analytics, predicts autonomous vehicles will create a massive economic opportunity that will scale from \$800 billion in 2035 (the base year of the study) to \$7 trillion by 2050. An estimated 585,000 lives could be saved due to autonomous vehicles between 2035 and 2045, the study predicts.

Even as reclaimed parking spaces may fuel a downtown building boom, autonomous vehicles will encourage builders to push deeper into the suburban fringe, confident that homebuyers will tolerate longer commutes now that they don't have to drive, according to the report, sponsored by a unit of Capital One Financial Corp. The potential impacts are profound for the auto, insurance, technology, media, airline , retail, real estate and energy industries.



Picogrids (Trends 2018)

Return to Trend ↻

What started as a trend in the Military decades ago (needing to ensure power reliability in a decentralized system) has spread to remote communities such as Alaska, that are far off from the traditional grid. New technologies, such as fuel cells and battery storage systems (to store extra power produced by renewables), along with more sophisticated software, have led to “nanogrids,” which Walmart and other megastores have begun to adopt. Now, “picogrids” are becoming increasingly common in places such as university campuses and hospitals. The falling cost of renewable energy in some areas is helping fuel this trend and transforming the electricity markets. Wind and Solar account for almost 30% of the power in Germany; in Hawaii, its 25%. Utility companies in particular may face challenges in evolving their businesses. In Texas, among many other places, prices occasionally turn negative when the wind is blowing hard, meaning companies are paying customers to use the electricity they generate.

As more and more people rely less on the traditional grid for power (while still interconnecting with it to help ensure reliability), policymakers and companies will need to create new regulatory systems and business models. Some states, such as New York, have embraced these changes, aggressively promoting decentralization by rewarding companies that invest in decentralized systems. But no one has yet worked out a detailed plan for how to integrate new grids with traditional power systems.

The long-term implications of nanogrids and picogrids could be significant from a global political, economic, and environmental standpoint.



Where's the Beef (Trends 2018)

Return to Trend ↶

Meat that's not made from animals could be the next big thing in the protein industry. Everything from high-end items like foie gras to regular ground chuck could be up for grabs as consumers are increasingly drawn to "painless proteins," or meats grown in a laboratory with cultured self-producing animal cells, according to analysts at Jefferies & Co. Besides squeamishness among some consumers about the way the sausage is literally made, Jefferies cites pathogen outbreaks, fish fraud, distaste for insect proteins and high levels of food waste as factors that could boost acceptance for substitute meats. While the industry is still nascent, lab meats have already attracted high-profile investors including billionaire Bill Gates and Cargill Inc., one of the largest global agricultural companies.

Some investors are betting governments around the world will find a way to start taxing meat production as they aim to improve public health and hit emissions targets set in the Paris Climate Agreement. Socially focused investors are starting to push companies to diversify into plant protein, or even suggest livestock producers use a "shadow price" of meat – similar to an internal carbon price – to estimate future costs.

Meat could encounter the same fate as tobacco, carbon and sugar, according to a report from investor group the FAIRR (Farm Animal Investment Risk & Return) Initiative. Lawmakers in Denmark, Germany, China and Sweden have discussed creating livestock-related taxes in the past two years, though the idea has encountered strong resistance.

Greenhouse gas emissions from livestock are about 14.5 percent of the world's total, according to the Food & Agriculture Organization, which projects global meat consumption to increase 73 percent by mid-century, amid growing demand from economies like India and China. That could result in as much as \$1.6 trillion in health and environmental costs for the global economy by 2050, according to FAIRR.

Plant protein, however, is already capturing a sizable amount of demand for protein, pushed partially by millennials and a trend toward incorporating more vegetarian food into Western diets. About 4 in 10 Americans and Canadians are actively trying to incorporate more plant-based food into their diets, according to a Nielsen Co. global survey.



Alternate Realities (Trends 2017)

Return to Trend 

Virtual reality (VR), a completely fabricated reality, entered the mainstream during 2016 with the launch of the Oculus Rift, HTC Vive, PlayStation VR, Gear VR, and Google Cardboard.

Augmented reality (AR), or the overlay of data on top of your current world view, has been in existence for many years through heads-up displays and Google Glass ([see GUI to NUI, Trends 2016](#)). Mixed Reality (MR) is still in its infancy, and lies somewhere between AR and VR, projecting fabricated elements on to existing real world structures and spaces. The most advanced MR technologies are Microsoft's HoloLens and a company called Magic Leap, backed by Google, Qualcomm, and Alibaba. The magic of VR is "presence", or the ability to trick your brain into believing it's somewhere it's not. VR has so far been relegated to entertainment. AR has been more focused on utility, overlaying information on to the real world, allowing the perception of both synthetic light and natural light bouncing off objects. Mixed Reality is the best of both worlds and could potentially have the most obvious path to mainstream consumer adoption. MR overlays completely synthetic visuals and anchors them in the real world, allowing a shark to swim through your kitchen for example, or displaying a three-dimensional castle on your desktop that you could walk around to explore. MR clearly has applications in entertainment but can also be used to create virtual computer desktops on any surface, allows for three-dimensional design work, or even aiding surgeons while working in patients. There are also implications for electronics, real estate, employment, industry, and media.



CRISPR (Trends 2017)

Return to Trend 

CRISPR (clustered regularly interspaced short palindromic repeats) is a DNA editing tool originally used by bacteria to identify and destroy virus DNA. Scientists have recently made two important discoveries around harnessing this tool of nature. First, they discovered how to cut DNA quite precisely using the bacteria's own Cas9 enzyme. Second, they discovered how to harness the guide RNA which targets the section of DNA they would like to alter, thereby giving them unprecedented ability to edit genes in organisms. Most importantly, CRISPR technology is relatively cheap and easy to use, lowering the hurdles for the proliferation of uses.

The potential, just a few years into being studied, is staggering. Cancer treatments that harness your own immune system to target cancer cells more effectively ([as mentioned in our 2016 trend "Precision medicine"](#)). The elimination of genetic diseases in utero before they can cause lasting damage. The ability to edit genes that cause predisposition toward addiction, high cholesterol, depression, and a host of other conditions.

This amazing technology comes with potentially dire consequences as well. Theoretically, a single scientist could create the world's most horrific super virus. A society could elect to alter every baby born to have blue eyes and blonde hair. Armies can create super soldiers. The UN has hosted a number of summits on gene editing technologies and the responsibilities of nations to abide by clear ethical standards. CRISPR holds huge potential and unprecedented moral hazard.



Quantum Computing (Trends 2017)

Return to Trend ↶

In traditional silicon computers, data is represented in binary bits that are always in one of two states: either a 1 or a 0. However, in a quantum computer each quantum bit, or “qubit,” can represent both a 1 and a 0 at the same time through a principle called superposition.

What this means is that a quantum computer can perform multitudes of calculations simultaneously; harnessing millions of qubits could, in a matter of minutes, process data and solve problems that would tie up today’s fastest supercomputers for a century.

Since 2016, when we first began tracking successful experiments of quantum computational operations executed on a very small number of quantum bits, more companies (such as Alphabet, IBM, Microsoft, and Nokia Bell Labs) have been moving from the lab to engineering development and even commercial experiments. The implications of large-scale quantum computers will be staggering. With such orders of magnitude improvement in computing power expect to see leaps forward in machine learning, artificial intelligence, and simulation modelling. At the same time, quantum computing could pose a threat to traditional encryption security measures that operate on the fundamental assumption that the encryption is too complex to break in a reasonable amount of time given prevailing computing speeds.

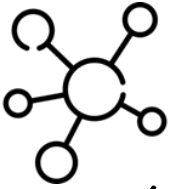
While it’s still early days and many challenges exist in the development of Quantum Computing, we cannot help but imagine the possibilities which could have a fundamental disruptive impact on the current technology market as we know it.



Blockchain (Trends 2016)

Return to Trend 

The blockchain is an immutable, distributed ledger system and the underlying technology behind the Bitcoin cryptocurrency created in 2009. Essentially, blockchain is a network of computers, all of which must validate a transaction before it is recorded in a “chain” of computer code. The details are recorded on a public ledger that anyone on the network can see but cannot change. The legacy approach is to have a central ledger system act as the custodian of information; whereas with the blockchain, information is transparently shared and distributed across the network without a single agent acting as middleman. Concerns about lack of control and security have many feeling that blockchain hype may be outpacing the reality, but as with the internet, the longer-term promise may be transformational. Blockchain and distributed ledger technology could alter and disrupt the way value and risks are shared between counterparties. This has implications for payments, trading, clearing, settlement, and property title transfers. Furthermore, a tamper-proof distributed ledger could be used to validate identity, store medical records, or facilitate transparent electoral voting systems. The potential cost, time and risk efficiencies could be significant.



GUI to NUI (Trends 2016)

Return to Trend 

When the personal computer was made readily available in the 1980's the Graphical User Interface (GUI) was a major contributor to its success. GUI allowed people to interact with the computer in a more intuitive manner through a keyboard and mouse with point and click rather than only through programming code. The computing industry is in the midst of its next major transformation as Graphical User Interface (GUI) increasingly shifts toward Natural User Interface (NUI). NUI allows people to interact with computers in not only a more intuitive manner, but also more naturally like they would with another person or object. Speech recognition, facial recognition, natural gestures, among many other forms are increasingly being built into our PC's, smartphones, tablets and wearable devices. This transformation from GUI to NUI is increasingly more evident in many of the recently launched personal digital assistants, virtual reality products, and augmented reality products from the tech industry and is likely to shift even further toward a more natural interface between man and machine.



Return to Trend ↻

Precision Medicine (Trends 2016)

Precision Medicine refers to the tailoring of medical treatment to the individual characteristics of each patient. It does not necessarily mean the development of drugs or devices that are unique to a patient, but rather the approach to classify individuals into subgroups that differ in their susceptibility to a particular disease or response to a specific treatment. Preventive or therapeutic interventions can then be concentrated on those who will benefit, sparing expense and side effects for those who will not. Diagnostic testing is often employed for selecting appropriate and optimal therapies on the content of a patient's genetic makeup. For example, recent advancements in cancer treatments have been based on knowing the precise mutations a patient's tumor has acquired, as opposed to treatments based on the tissue in which the cancer originated. Immunotherapies are also based on tuning our body's immune system to recognize and respond to cells carrying mutations. Cancer is so difficult to cure because it is not one disease, but many. For this reason, precision medicine may be promising.



Internet of Things/Wearables (Trends 2015)

Return to Trend 

The number of connected devices continues to exponentially grow, and with it the amount of data that is collected, organized, and analyzed. The Internet of Things is constantly making the world around us smarter and more efficient. One of the next key battlegrounds in the Internet of Things looks to be Wearables, which are directly integrating technology and consumer fashion. Several companies continue to push the threshold of capabilities for “Smart Watches” and other like devices. Many companies competing in the Wearables category hope to eventually make the Smartphone a secondary device, which makes Wearables a ripe area for further innovation. While it is still in its early stages, we believe one area that could be revolutionized by this trend is healthcare. Constant and real-time capturing of an individual’s data (heart rate, activity level, calories, etc. provides an immense amount of information for doctors to monitor and improve healthcare outcomes for patients. Unlike some of the technology trends we have highlighted in the past, “Internet of Things” appears to be more complementary than disruptive. Initially, we foresee certain semiconductor chip companies as potential beneficiaries.



Return to Trend ↶

Rise of the Machines (Trends 2014)

A new age of autonomous machines is upon us. From Google's self-driving car to Amazon's delivery drones, to iRobot's "smart" vacuum cleaner, we see many companies investing heavily in robotics technology. We expect major advancements in software that integrates sensors and robotics into our daily lives. A prime example: self-driving cars. Autonomous cars hold the promise of traffic-free commutes, life-saving technology, ecological benefits, and productivity-enhancing economic gains. The evolution from science fiction concept to potential reality demonstrates that the future is closer than one might think, with many analysts now believing that fully autonomous vehicles will be available by the end of the decade.