DANIEL BURRUS' TOP 25

TECHNOLOGY HARD TRENDS SHAPING 2021

Burrus Research®

1 AI as a Service

Artificial intelligence (AI) is a broad category of machine intelligence that includes powerful subcategories, such as **machine learning** (ML), **deep learning** (DL) and **cognitive computing** applications, and they are increasingly being offered as a service, dramatically lowering the cost and increasing the application to every industry. In addition, AI hardware is rapidly shrinking in physical size, soon to the chip level, allowing AI functionality to become increasingly embedded in products, applications and processes. Thanks to the as-a-service model, coupled with better sensors, increased machine intelligence and Alexa-like voice communications, advanced automation and **intelligent networked robotics** will increasingly work with humans in new and productive ways. From **demand forecasting** to **real-time audits** to the use of **semiautonomous and fully autonomous vehicles**, humans will increasingly rely on AI.

2 Big Data and the Use of AI-Enabled High-Speed Data Analytics

"Big data" is a term that describes the technologies and techniques used to capture and utilize exponentially increasing streams of data. The goal is to bring enterprise-wide visibility and insights to users that enable making rapid, critical decisions. Using **advanced cloud services**, AI-enabled high-speed data analytics will increasingly be employed as a must-have complement to existing information management systems and programs to identify actionable insights from a mass of big data. **Real-time data audit services** that separate good data from bad data and irrelevant data will also become a rapidly growing service.

3 Advanced Distributed Cloud Computing Services

Businesses of all sizes will increasingly embrace new variations in public, private, hybrid and personal mobile clouds. In addition, distributing cloud services to different locations with centralized cloud governance provides many new applications. The 2020 pandemic rapidly accelerated the shift in how organizations obtain and maintain software, hardware and computing capacity to cut costs in IT, human resources and sales management. Beyond cost cutting, new cloud computing services will increasingly be used to create new products, services and markets. Not all clouds are created equal. Some are optimized for IoT applications, while others are designed for different levels of security and speed.

4 Social Business Applications, Behavior Analytics and Personality Profiles

Social software for business will reach a new level of adoption, with applications to enhance relationships, collaboration, networking, social validation and more. AI, AR and VR will increasingly play a role to grow engagement. Marketers and researchers will employ social search and social analytics to measure real-time sentiment of large groups of targeted people. Social media platforms such as Facebook and others are increasingly using AI and **user engagement data** to create **behavior analytics** and **personality profiles** for each user. By identifying an individual user's emotional hot buttons, marketers will increasingly know which buttons to push to get the desired behavior. This has created an unexpected consequence, shifting us from the Information Age to the Disinformation Age. Note that this shift represents a Soft Trend than can be changed.

5 Visual Communication for Virtual Conferences and Remote Working

The 2020 pandemic has driven visual communications and **virtual meeting software and services** to a transformational level, with an ever-increasing number of both free and paid programs, such as Zoom, Skype, FaceTime, Microsoft Teams and others, enabling video communication on laptops, tablets, phones and home televisions. Businesses of all sizes, as well as schools and doctor offices, were forced to embrace this as a primary meetings, relationship-building and communications tool. Corporate meetings, large multiday events and virtual trade shows were forced to run remotely, creating a host of new hardware, software and service options for meeting planners, speakers and attendees.

7 Augmented Reality (AR) and Virtual Reality (VR) Apps and Devices

Augmented reality allows users to point a digital camera at something and overlay just-in-time information about the subject they are focusing on. For example, you might aim your smartphone camera at a crowded street to see the stores that have the exact products you're looking for. Soon, Apple and others will be selling conventional-looking AR glasses that allow wearers to overlay data on their fields of vision, providing useful information about what they're looking at. Business applications for AR glasses will grow rapidly. By contrast, VR uses oversized headsets to shut out the real world and provide an immersive, computer-generated 3D environment with which the wearer can interact. Thanks to new relatively low-cost hardware, new commercial applications for specific industries are rapidly growing. For example, architects and designers use VR to show potential clients specific features of buildings prior to actual construction. AR and VR have already shifted from a single-user to a multiuser social experience, and that will drive accelerated growth for both business and gamers in the near future.

6 Virtualization of Storage, Desktops, Applications and Networking

The virtualization of software and hardware has been increasingly used by both large and small businesses as virtualization security improved. **Hardware as a Service (HaaS)** has increasingly joining **Software as a Service (SaaS)**, creating what some have called "**IT as a Service**." In addition to the rapid growth of virtual storage, virtualization of processing power will continue to grow rapidly, allowing mobile devices to access supercomputer capabilities and apply them to processes such as purchasing and logistics. These services will help companies cut costs and accelerate innovation, as they provide access to powerful software programs and the latest technology without the expense of a large IT staff and time-consuming, expensive upgrades.

8 Virtualization of Processes and Services: Everything as a Service (XaaS)

The virtualization of processes and services will increasingly be accessed by companies needing to update and streamline existing services and to rapidly deploy new services. Anything can become a virtual service offering. For example, the rapid growth of **Videoconferencing as a Service, AI as a Service, Collaboration as a Service, Security as a Service, Networking as a Service** and **HR as a Service** are a few quick examples.

9 Voice Commerce, Smart Virtual Assistants and Voice-Enabled Devices

The use of smart e-assistants and chatbots is accelerating, offering what is rapidly becoming a **mobile electronic concierge** available on any smart device, including phones, tablets, televisions and cars. Stand-alone audio assistants, from Amazon, Google, Apple and others, will continue to expand rapidly into business and governmental applications. Retailers will increasingly have a Siri-like sales assistant, and we will be increasingly using an e-personal health assistant that taps into the real-time health data from a smart watch to predict potential problems and offer suggestions. From the help desk, to sales and marketing, to adding voice instructions and advice to any product, creative applications are unlimited.

10 IoT combined with Edge Computing form the Internet of Everything (IoE)

Machine-to-Machine (M2M) Communications using chips, microsensors, and both wired and wireless networks will join networked sensors to create a rapidly growing IoT, sharing real-time data, performing diagnostics and making virtual repairs, all without human intervention. There are well over 50 billion "things" talking to each other, performing tasks and making decisions based on predefined guidelines using AI. With our homes, businesses, parking meters, bridges and even our bodies, through wearables, all getting connected, the rapid growth of IoT brings us to the IoE. Not all generated data needs to come back to the mother ship to create high value. **Edge computing** will increasingly be used to tame the massive amounts of data IoT and IoE will create by bringing instant insights and actions at the point of use and at the speed of need.

11 Adaptive and Predictive Cybersecurity Systems

Business, government and education have recently moved cybersecurity from an underfunded back-office activity to a major initiative going forward. With the rapid growth of connected technologies, such as **edge computing**, the **Internet of Things** (IoT), and **semiautonomous and fully autonomous vehicles**, security systems will move beyond reacting faster to include adaptive security systems using AI and other advanced tools, such as **behavioral analytics**. This will add a level of Predict and Prevent, allowing us to stop many, but sadly not all, attacks before they start.

12 Multiple Biometrics, Tokenization and Quantum as a Service

Next-gen biometrics and advanced tokenization will increasingly be integrated into computers, smartphones, tablets, wearables and other devices for identity management and security. First-gen biometrics used finger, facial and voice recognition for identification, and it is now expanding into heartbeat patterns, blood vessel patterns under the skin and much more. Different levels of security will require different combinations of biometrics and tokenization. Quantum computing represents a major threat and opportunity when it comes to encryption. Quantum computing is already being offered as a service by Amazon and a few others, creating yet another platform for advanced innovation.

13 Enterprise Blockchains and Cryptocurrency

Introduced as a means of transferring bitcoins, blockchains and related **distributed ledger technologies** are gaining traction fast in any number of areas. A system that enables secure, digital direct transfers, blockchains decentralize transactions by eliminating the middleman, thereby allowing for direct connection among all involved parties. Blockchain technology goes far beyond cryptocurrency applications to processes such as the transfer of contracts, insurance policies, real estate titles, bonds, votes and other items of value. Blockchains provide increased transparency and, as a result, distributed trust. They can be applied to low-transparency high-cost industries, such as the U.S. healthcare market, to bring increased transparency and trust, greater competition and thus lower prices, and a new level of security. The average person discovered bitcoin thanks to its meteoric rise in value in 2017, as well as other coins such as Ethereum and Litecoin. Cryptocurrency is still relatively new and therefore highly volatile, as many investors have found out, yet the crypto genie is out of the bottle, and we will see cryptocurrency increasingly become part of our lives.

14 Satellite Mega-Constellations and 5G Wireless

Satellite mega constellations, such as OneWeb and Starlink, consist of thousands of mass-produced small satellites operating in low Earth orbit combined with a network of ground receivers designed to provide internet service to anywhere on the planet. By providing global gigabit access, businesses large and small will have access to a vastly expanded global workforce and customer base expanded by billions of people. 5G advantages including greater speed, lower latency and the ability to connect large numbers of sensors and smart devices will enable the creation of new multibillion-dollar businesses. There are several variations of 5G each with different advantages, and it can be deployed as a public and/or private network. Large enterprise applications of 5G are already finding new applications to accelerate innovation and growth.

15 Smarter Smartphones and Tablets Drive Mobile Process Innovation

The vast majority of mobile phones sold globally have browsers, as well as having access to **on-demand virtual services**, making a smartphone our primary multimedia computer. This has created a profound shift in global computing, allowing businesses of all sizes to transform the ways in which they market, sell, communicate, collaborate, educate, train and innovate using mobility. An enterprise mobility strategy that integrates **XaaS**, and other technologies in this report, will find unlimited ways to accelerate innovation and growth.

16 Mobile Apps Using 5G Capabilities for Business Process Innovation

As we increasingly transform business processes using mobility, the use of mobile applications for purchasing, supply chain, logistics, distribution, service, sales and maintenance will continue to grow rapidly. There will be an increasing focus on multimedia, AR and VR business applications giving companies a competitive advantage and giving users access to the personalized information they need on their mobile devices anytime and anywhere. The low latency and higher speed capabilities of 5G will bring a host of new business applications.

17 Wearables with Advanced Sensors and Communications

Wearables will increasingly be used for both personal and business applications as 5G capabilities become increasingly added. Apple, with its smartwatch fitted with an increasing number of health sensors and software, joins Google, Samsung, Microsoft and others in a battle for market share. More complex software and applications will drive further innovation and sales in other wearable technology. One example is a patch that can be attached to the skin for remote disease management, diagnostics and general health via wireless transfer.

18 Mobile Banking and Contactless Payments

Mobile banking, using smartphones and watches as e-wallets, and contactless point-of-sale payment systems, coupled with the use of telebanking accelerated by the 2020 pandemic, has opened the door to new virtual banking and payment services. The global use of smartphones and wearables with secure mobile banking apps, near-field communications (NFC) chips, biometric identification, and the use of tokens for which no credit card or personal information is exchanged is accelerating beyond exponential levels, creating new opportunities.

19 Online Learning and the Gamification of Training and Education

Taking classes online has been dramatically accelerated on a global basis thanks to the 2020 pandemic. Blended learning using a combination of online and in-classroom instruction, together with **instructional chatbots** and **AR and VR** tools, will increasingly be used to give the user an immersive experience as the need for retraining and reskilling continues to grow. Education and training will increasingly focus on accelerating learning by using **advanced simulations** and **skill-based learning systems** that are self-diagnostic, interactive, game-like and competitive. By making the experience fun, engaging and personalized, learning will improve, and the use of **gamification** will spread. **Massive open online courses (MOOC)** have already been embraced by highly recognized and traditional educational institutions, putting them in a position to make location and tuition far less of a barrier to receiving the information, training and knowledge people need in order to succeed in a rapidly changing world.

20 Autonomous and Semiautonomous Technologies

Autonomous technologies use AI and a host of networked motors, actuators and sensors to automate functions like driving a car, piloting a ship, flying an aircraft, driving a harvester or operating a forklift, to name only a few. Semiautonomous technologies blend human input with selected autonomous functionality that has predetermined parameters that allow autonomous functions to take control when needed. For example, a human driving a semiautonomous vehicle can control the vehicle, but autonomous functionality will take over to avoid potential accidents as needed.

21 Augmented Cognitive and Physical Technologies

Augmented technologies are designed to increase humans' physical and cognitive capabilities. **Cognitive augmented technologies** will increasingly provide real-time actionable insights and knowledge drawn from AI-enabled data analytics of large data sets to enhance human thinking and problem-solving. Humans and AI will increasingly have a symbiotic relationship in which one needs the other to peak perform. **Physical augmented technologies** enhance physical human functionality. A hearing aid is an example of sensory augmentation, an artificial leg is an appendage augmentation, and a 95-pound nurse in Japan wearing a powered exoskeleton so that she can lift a 200-pound patient into a bed is a functional augmentation. GM workers wear powered exoskeletons to lesson arm, hand and joint problems while assembling cars. All of our physical parts and systems, including our genes, can be augmented.

22 3D Printing (Additive Manufacturing) of Finished Goods and Much More

Personalized manufacturing of finished goods using 3D printing has been growing exponentially and, thanks to 2020 pandemic supply chain problems, has been accelerated to a new level. 3D printers build things by depositing material, typically plastic or metal, layer by layer, until the product is finished. Originally designed to print prototypes, 3D printers are increasingly being used to print final products, such as jewelry, iPhone cases, shoes, car dashboards, parts for jet engines, prosthetic limbs, human jaw bones, blood vessels, organs and much more. This allows companies to manufacture one-of-a-kind or small runs of items quickly, locally and with far fewer costs. **3D printing as a Service** will be offered by companies such as Amazon and FedEx, who will print (manufacture) and ship any CAD design from anywhere to anywhere. And if they don't do it, others will.

23 Drones Reach a New Height Adding AI

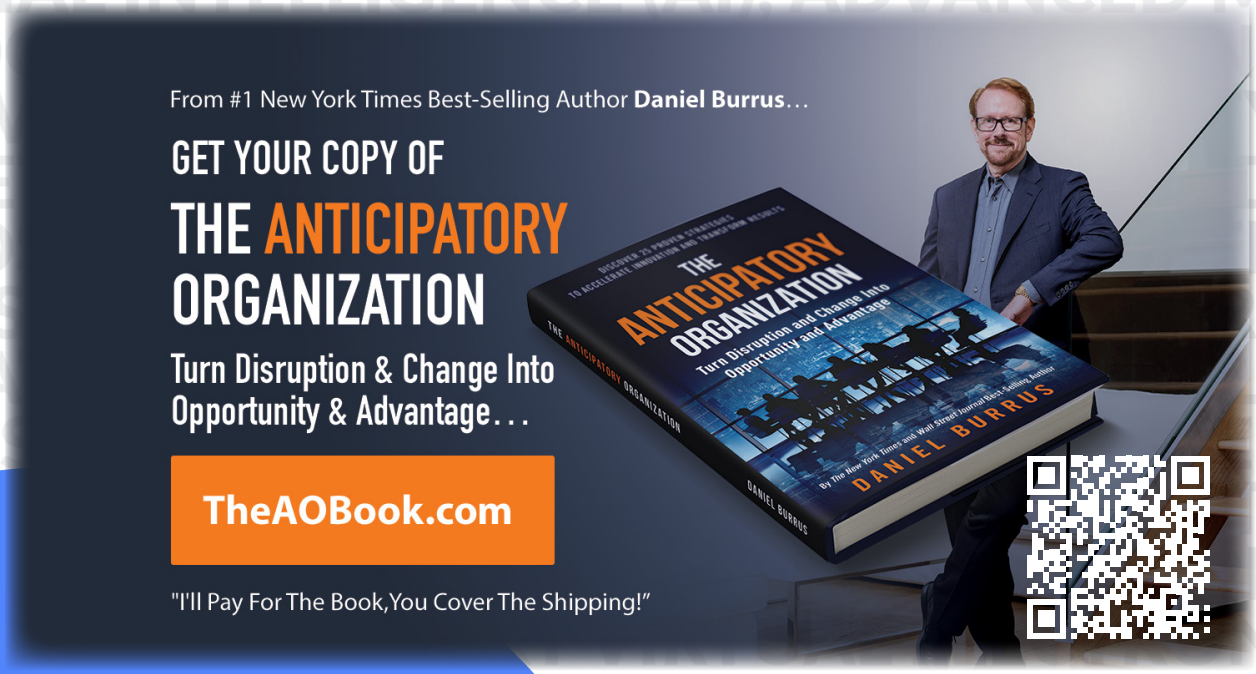
The number of applications for drones will continue to expand rapidly. Drones have already proven to be of high value for search and rescue and are rapidly being applied to many industries. For example, agriculture uses drones to check crops, fences and cattle; utility companies use them to look for downed power lines; and real estate agents use them for aerial photography. The explosion of hobby drones will continue to drive innovation for both personal and industrial applications. AI will be increasingly integrated, expanding capabilities far beyond today's applications.

24 Energy Storage and Microgrids

Energy storage will increasingly play a key role in driving the widespread use of green energy, such as wind and solar. Companies such as Tesla are selling their smart battery systems (SBS) to businesses and homes that generate some of their own power using solar, wind or other systems. The rapid growth of energy storage systems will enable national networks of smaller and more secure smart microgrids. In addition, as first-generation hybrid and electric vehicles get too old for the marketplace, there will be millions of batteries that will still hold enough of a charge to be repurposed into inexpensive energy storage systems.

25 Genomics, Gene Editing with CRISPR and Synthetic Biology

Synthetic Biology is a rapidly growing field that combines biotechnology, genetic engineering, molecular engineering and computer science, to name a few, that can be used for designing and building engineered biological systems. Applications include processing information, fabricating materials, and structures, producing energy, manipulating chemicals, and even producing food. CRISPR is a revolutionary gene editing technology that can be used to create human cellular models of disease, genetically modified organisms to mimic disease, and correct genetic mutations to name a few. Advances in AI and other technologies on this list, have accelerated gene editing, whole genome printing and synthetic biology creating a new biology-driven revolution with amazing growth potential.



Daniel Burrus is considered one of the World's Leading Futurists on Global Trends and Disruptive Innovation. *The New York Times* has referred to him as one of the top three business gurus in the highest demand as a speaker.

He is a strategic advisor to executives from Fortune 500 companies helping them to develop game-changing strategies based on his proven methodologies for capitalizing on technology innovations and their future impact. He is the author of seven books, including *The New York Times* and The *Wall Street Journal* best seller *Flash Foresight*, and his latest book, *The Anticipatory Organization*, is an Amazon No. 1 besteller.