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TECHNOTRENDS®
NEWSLETTER

The biggest ideas that are changing everything

IN THIS ISSUE

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Looking Back to Look Ahead

By Daniel Burrus, CEO of Burrus Research

Today, technology innovations are happening at beyond exponential levels, and I feel a monthly newsletter no longer provides you with the latest innovations at the speed of need. Given that, I have decided that this will be the final issue of the *Technotrends Newsletter*.

I started Burrus Research in 1983 after selling four companies and then conducting a year of deep research into global innovations in all areas of science and technology. As part of my research, I pioneered a new and powerful methodology (my Hard Trend Methodology) for accurately predicting the future of technological change, and I developed *The Taxonomy of High Technology* as a way of organizing technology innovations that would drive economic growth for decades to come.

> " *Hundreds of corporations, universities and research laboratories have adopted this list to guide strategic decisions*

At that time, I became the first and only forecaster/futurist to accurately identify the groundbreaking technology categories that have driven decades of economic growth, and continue to revolutionize how we live, work and play. Since then, hundreds of corporations, universities and research laboratories have adopted this list to guide strategic decisions in a variety of areas. To this day, it remains an accurate depiction of the driving forces behind the monumental changes that continue to drive economic value creation.

The Taxonomy of High Technology

In my original list published in 1983, there were 20 major technology categories:

1. Digital Electronics
2. Distributed Computing and the Internet
3. Optical Data Storage
4. Fiber-Optic Networking
5. Microwaves & Wireless Networking
6. Advanced Communication Satellites
7. Parallel Processing Computers
8. Artificial Intelligence and Neural Networks
9. Flat-Panel & Advanced Video Displays
10. Nanotechnology & Micromechanics MEMS
11. Lasers
12. Photovoltaic Cells
13. Genetic Engineering
14. Advanced Biochemistry
15. Molecular Designing
16. Advanced Polymers
17. High-Tech Ceramics
18. Fiber-Reinforced Composites
19. Thin-Film Deposition
20. Superconductors

If you look at the major drivers of exponential change over the decades, including today, you can see why so many organizations have used this list and their subcategories as their go-to list of major technology categories shaping the future.

Three Digital Accelerators

In that same year I came across Moore's Law,

TECHNOLOGY NEWS HIGHLIGHTS

Spinal Implant

A new device that directly stimulates spinal nerves has been shown to restore mobility in patients who have suffered "complete" spinal cord injury.

The soft implantable electrodes are placed underneath the vertebrae to control specific muscle groups, enabling subjects to stand, walk, swim and even ride a bike.

Known as targeted epidural spinal stimulation (TESS), the protocols are designed to mimic the signals that are normally generated by the brain. Using a tablet, users select the activity that they wish to perform, and the appropriate stimulations are sent to a pacemaker-type device implanted in the abdomen.

Control buttons on a wheeled walking frame send the signals wirelessly to the implant, allowing the patient to activate the electrodes on demand.

So far, the system has been successfully tested on three individuals, all of whom were able to operate the device in just one day after receiving the implants.

After several months of following a training regimen, they also showed an increase in muscle mass. The technology has application for the treatment of paraplegia and tetraplegia as well as Parkinson's, stroke and traumatic brain injury.

For information: NeuroRestore; website: https://www.neurorestore.swiss/ or ONWARD Medical N.V.; website: https://www.onwd.com/

Upcycling Lithium-Ion Batteries

Robot Dogs

Lithium-ion batteries have become a cornerstone of the shift to sustainable energy, powering everything from smartphones to electric vehicles, as well as providing storage for renewable power from sources like solar and wind. But producing the batteries themselves creates a wide range of environmental issues, and supplies of the raw materials needed to make them are dwindling, so recycling the components is key to maintaining supply.

It has generally been believed that recycled batteries would not perform as well as newly manufactured ones, but recent research has shown just the opposite. A new upcycling process that focuses on removing impurities from the cathode actually results in a battery that can charge faster and last longer than a new one.

Examination of the recycled cathode powder revealed a more porous structure. Larger voids within the cathode crystal allow it to expand slightly as it absorbs the lithium ions, preventing it from cracking and prolonging its life. The greater number of pores also increases the surface area available, allowing for faster charging. The process is so successful that it may be used to improve performance in new batteries as well.

The U.S. Department of Homeland Security is reportedly considering the use of "robot dogs" as surveillance multipliers along the nation's southern border. The Quadrupedal Unmanned Ground Vehicles (Q-UGVs) would be used to patrol for criminal behavior, human trafficking, and smuggling of drugs or other contraband in areas that are inaccessible or inhospitable to humans.

Known as Vision 60®, the ground drone adapts to a broad range of unfamiliar urban and natural environments. It can walk, run, crawl and climb, and eventually will also be able to swim. Even if it slips and falls, it will get back up on its own. The robots can operate fully autonomously or be controlled remotely while sending live video to a central command center.

Vision 60 currently has a maximum runtime of three hours and can cover a distance of nearly eight miles (12.6 kilometers) at a top speed of more than six miles per hour (3 meters per second).

Analyzing Speech to Diagnose Disease

China and Japan, that are "trained" on native language data samples.

Charging on the Road

A new technology that uses digital voice biomarkers to assess neurological health could someday be used to identify a variety of conditions, including Alzheimer's, anxiety, fatigue, depression and PTSD. The patented system combines automatic speech recognition, natural language processing and deep learning to provide an analysis of voice samples in three to five minutes.

Recent research suggests that many neurological conditions can have subtle effects on speech and language that are not distinguishable by brain scans, cognitive tests and observation. However, they can be identified by machine learning. Deep learning algorithms may even provide a means for stratifying patients along a cognitive impairment continuum to determine which individuals are likely to progress to Alzheimer's disease.

The new approach would enable more patients to be screened and assessed by bringing diagnostic capability to a wearable device. Remote, real-time monitoring would also allow clinicians to track changes over time more easily than traditional laboratory tests.

Although the system analyzes elements of speech that are not language-dependent, versions of the technology have been developed for use in other countries, including

The first mile of public road that can wirelessly charge electric vehicles while they cruise along is planned to be installed near Detroit. The project is an important first step in developing an infrastructure that will accommodate the growing number electric vehicles in the future.

The induction charging system uses a series of magnetic coils embedded in the pavement that send power to a charging pad underneath the vehicle. It's a fairly efficient method of charging with about 87 percent of the energy making its way to the battery, even while the car is moving. However, it does require the vehicle to be equipped for wireless charging, which can cost thousands of dollars. The biggest benefit is that drivers could extend the range of their electric vehicles without needing to plug them in and wait.

With the nickname of Motor City and its history in the automotive sector, Detroit seems an obvious choice to test advancements such as this. But it's also an excellent option because

it will enable testing in varying climate and weather conditions – from hot and sunny to below zero temperatures, with snow, ice, sleet, rain and everything in between. The project is slated for completion sometime in 2023.

For information: Electreon, Hadassah Neurim Youth Village, Beit Yanai, 4029800 Israel; email: info@electreon.com; website: https://electreon.com/

Towing System for Airplanes

Runway taxiing burns up huge amounts of fuel each year. It's been estimated that up to five percent of the aircraft fuel consumed is used while the plane is still on the ground. Now a prototype system has been developed that uses electro-hydraulic powered pull cars and an underground channel system to tow airplanes back and forth between the gate and the runway.

Called the Aircraft Towing System (ATS), it consists of a series of trench-like channels about four feet in width and covered with a steel plate. Inside the trench, pull cars run along a monorail, while above ground, a towing dolly attaches to the plane's nosewheel and then to the pull car through a slit in the steel plate. Software integrated into the ground control system and managed by tower personnel automatically controls movements of the plane during taxiing and

gate operations; however, the pilot can always override ATS in the event of an emergency.

In addition to reducing fuel consumption and emissions, ATS can actually increase throughput by an estimated 30 percent while improving safety by optimizing traffic. Although the installation cost is substantial, the benefits are huge. As an example, it would likely cost about $150 million to install ATS at Chicago O'Hare Airport, but airlines could save up to $500 million in fuel costs in a single year. Other benefits include reduced manpower, shorter taxi times, lower noise levels and safer operation during adverse weather conditions such as rain, fog, ice and snow. A prototype system is currently being installed at Ardmore Industrial Airpark in Oklahoma and is expected to be completed in April.

For information: ATS World Wide LLC, 620 General Drive, Suite 3, Ardmore Airpark, OK 73034; phone: 405-694-9861; website: https://aircrafttowingsystems.com/

Rethinking Package Delivery

A new electric vertical takeoff and landing (eVTOL) aircraft has the potential to transform package delivery and alleviate some of the bottlenecks that plague today's shipping industry. With 36 million packages being shipped daily, streamlining at least

a portion of these shipments could help customer and retailers alike.

Alia can take off and land like a helicopter, so it doesn't require runways to operate. But when traveling point-to-point, it glides like a plane at speeds of 150 to 170 miles per hour. With a cargo volume of 200 cubic feet and a range of 250 miles, it's well suited for delivering small packages between warehouse facilities or distribution centers more efficiently than trucks or larger cargo planes.

Eventually, the developers may move on to transporting passengers as well, but for the moment they plan to concentrate on securing approvals for cargo shipments only. They are also reportedly working with biotech companies that have an interest in transporting organs for transplant and expect that other applications will emerge between now and the time the first fleet of aircraft is ready for takeoff.

For information: Beta Technologies, 1150 Airport Drive, South Burlington, VT 05403; email: info@beta.team; website: https://www.beta.team/

along an 80-mile freight-hauling route between Phoenix and Tucson without a driver behind the wheel, and plans to begin hauling freight for Union Pacific sometime this spring.

The 53-foot rig operates at Level 4 autonomy, which means that no human is required to be in the vehicle, but the route must be predefined and mapped out in advance. In the seven trips that have taken place, a survey vehicle was deployed about six miles ahead to scout out potential problems and a trailing car monitored the truck's movements. The test runs have taken place in early evening traffic, but additional runs are planned during daytime hours and along different routes.

The company hopes to begin commercial operations on a larger scale by the end of 2023 and has identified the Texas triangle – Houston to Dallas to San Antonio – as a potential target market.

For information: TuSimple, Inc., 9191 Towne Centre Drive, Suite 600, San Diego, CA 92122; website: https://www.tusimple.com/

Self-Driving Semis

In a real-world demonstration of autonomous trucking, one company has run seven trips

Looking Back to Look Ahead

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which most of you know today, but way back in 1983, few knew about it. Because it basically stated that processing power would double every 18 months as the price dropped in half, it gave me a way to know how fast a computer would be in the future and how much it would cost. Knowing those two things allowed me to make many accurate predictions going decades out into the future.

At that time, I found that I needed more than Moore's Law, so I added the exponential growth of digital storage and bandwidth and I called them the *Three Digital Accelerators* driving exponential growth. Thanks to the exponential curve of all three, I could create accurate timeframes for many innovations.

Around 2010, I changed processing power to computing power because exponential growth is now taking place in the cloud ecosystem, and there is a lot of exponential growth to go from here! So here are the three, computing power, digital storage, and bandwidth. Major innovations are launched when all three are at a point of enabling a great end-user experience.

Pathways to Innovation
Two years later, in 1985, I published and shared in hundreds of speeches another powerful list I called the *Eight Hard Trend Pathways to Innovation*. They included:

1. Dematerialization (Reducing Size to Elevate Value)
2. Virtualization (Hardware, Software and Services, as-a-Service)
3. Mobility (Hardware and Software)
4. Intelligence (Think IoT)
5. Networking (Fiber Optics, Wireless and Virtual)
6. Interactivity (Interactive Media)
7. Globalization (Technology Enabled Globalization)
8. Convergence (Converging Features, Functions and Industries)

Take a few minutes now and look over this list to see if you can identify a pathway you should be innovating in now. And remember what I have said about technology-driven innovation if it's based on a Hard Trend: *If you don't do it, someone else will!*

The First Technotrends Newsletter
In 1985, I started this newsletter, and at that time it was called *The Technology Futures Newsletter*, I know many of my long-time subscribers will remember that name. Because the word "Futures" could be confused with stock market futures, I changed the name to *The Technotrends Newsletter*, and as many of you know, that became the name of my fifth international bestselling book, *Technotrends: How to Use Technology to Go Beyond Your Competition*, published by Harper Business in 1993.

Because I was giving over 100 keynote speeches a year, with an average audience size of 1,000, the newsletter grew rapidly, quickly reaching 10,000 subscribers in the first year, then over 20,000 subscribers in the second year, and it has continued to have a very large international executive readership from the largest technology companies, government agencies (including the Department of Defense), major news agencies, and many of the big consulting firms.

As I was writing this article, I decided to review my first newsletter from 1985. The format of the newsletter then was different than the *Technotrends Newsletter* format today in that there was no opening article; instead, it focused solely on providing a larger number of technology innovations that would shape the future.

Here are a few subjects I covered in the first newsletter:

•Email, or as it was called by the very few at universities who were using it back then, electronic mail, and how that would grow starting in the '90s and beyond.
•The ability to get a college degree by attending classes virtually.
•Using voice recognition to interface with our computers.
•Smart tractors with sensors that allow them to save fuel and self-drive.
•Electronic shopping (think e-commerce), and I mentioned how it would bring profound changes to retail in the mid '90s and beyond.
•Smart cards that had both information and chips for near-field communication.
•Fiber-optic communication networks. (As a side note, I hosted the first all fiber-optic teleconference in the world.)
•Office automation systems.
•Satellite broadcast television systems for home users.
•Cars with sensors that, for example, can stop the car for the driver when an object is in the way.
•New robotic systems using multiple sensors, including robot lawn mowers.
•Computerized homes with home security and automation systems.
•Supercomputers using parallel processing to drive artificial intelligence applications.
•Electronic news as a new way to get up-to-the-minute news as it happens.
•Using ultrasound to treat kidney stones and more.
•Computers that can read handwriting.
•Battery-operated portable multimedia computers.
•Laser surgery applications.
•Listening to music on personal digital devices.
•Genetically altered crops.
•Smart tires with sensors for inflation and temperature.
•Machine vision to read and recognize the color of paint and more.

•CAT scans showing real-time moving pictures of the inner body, PET scans to see how the brain works, and MEG to help brain surgeons operate.

And there was much more in the first issue way back in 1985.

I must admit, after looking at my first newsletter, even I was impressed, since I had not looked at it in decades.

Since I was already looking way back, I thought I would provide a small sample of few of the article subjects and titles I wrote about in over 430 newsletters we've published over the decades.

•In 1984, an article on sequencing of the human gene code by 2000
•In 1986, an article on interactive television (streaming video) by the mid-1990s
•In 1988, an article on GPS for navigation and agriculture by the mid-1990s
•In 1996, an article on interactive television (streaming video) big by the early 2010s

Each year I covered a wide variety of key innovations and subjects. For example, here are a few of the article headings published over 20 years ago in the year 2000:

•In 2000, an article on smartphones becoming our main personal computers by 2010
•In 2000, an article on social media and social-media marketing going mobile and standard on smartphones by 2010
•In 2000, an article on genetics and digital transformation that will enable healthcare predict and prevent strategies by 2010
•In 2000, an article on the wireless web that would dominate how we surf the web by 2010
•In 2000, an article on ultra-intelligent agents (nots) by 2010

If you have been a subscriber over the decades,

you've had a clear advantage. Many subscribers have used the newsletter as an investment letter, although that was not my intent, and I have had communications from many that their investments worked out very well for them.

Looking Ahead
I urge you to stay on the anticipatory journey with me!

There has never been more opportunity to elevate your relevancy, accelerate your growth and transform your business than there is today! Therefore, it's now more important than ever to be anticipatory and to stay ahead of, as well as take advantage of, change and transformational innovations.

Before I share the best way to stay connected with my articles and technology innovation news, I want to thank all of you for subscribing and staying with me on this journey into the future. I especially want to thank the large number of you who have been a subscriber for almost four decades!

I regularly post important innovations as they happen on both **LinkedIn** and **Twitter**. In addition, many of you already subscribe to my free Strategic Insights Newsletter, where I post key blogs and articles on a weekly basis. To continue to receive my weekly Strategic Insights Newsletter, please click below to stay connected:

https://www.burrus.com/resources/strategic-insights-enewsletter/

In addition, the main article I write every month is published both on **my website** and on LinkedIn. I encourage you follow me to stay connected.

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