Daniel Burrus'

Celebrating 30+ Years of Publication

TECHNOTRENDS®
NEWSLETTER

The biggest ideas that are changing everything

IN THIS ISSUE

www.DanielBurrus.com

12 Technology Trends Redefining Manufacturing

By Daniel Burrus, CEO of Burrus Research

The pandemic accelerated the application of digital technologies by as much as ten years in a short amount of time, driving the exponential rate of change far faster. This, in turn, has created beyond exponential opportunities to truly transform every industry and every business process.

In this article I'm going to focus on the technology-driven trends that are shaping the future of manufacturing. Each one represents a Hard Trend based on future facts that will continue to grow at beyond exponential rates. As you read through each one, look for opportunities to transform and grow.

" *Manufacturers should be looking for opportunities to add AI functionality to both current and future products.*

Trend #1. Artificial intelligence, including machine learning, deep learning and cognitive computing, will increasingly be integrated into all manufacturing processes.

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 manufacturer, regardless of size. In addition, AI hardware is rapidly shrinking in physical size, soon to the chip level, allowing

manufacturers to embed AI functionality into products, applications and processes. Manufacturers should be looking for opportunities to add AI functionality to both current and future products.

AI applications for manufacturers include three key areas: (1) *machine vision systems* for real-time quality control, pick-and-place robotics, networked co-bots and e-commerce search, to name a few; (2) *number crunching* for real-time business intelligence, IoT predictive maintenance, forecasting models and search recommendations; and (3) *language processing* for smart voice interface, AI-enabled help desk and text analysis.

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 internal data audits to the use of semiautonomous and fully autonomous factory vehicles, humans will increasingly rely on AI.

Trend #2. Rapid advances in AI will drive both augmented thinking and augmented movement using exoskeleton technologies to reach new levels of application.

TECHNOLOGY NEWS HIGHLIGHTS

Advancements in 3D Printing

3D printing has been transforming many areas of our lives, and it's not just for prototyping anymore. As 3D processes have become more robust, they are now being used to manufacture products that would otherwise not be feasible to make using traditional methods.

New 3D printing systems can make products stronger and more versatile than early models, which basically fused layers of powder or filament using heat.

For example, the Carbon DLS (Digital Light Synthesis) process uses an ultraviolet laser to cure liquid plastic resin into solid parts. The finished product is then heated in an oven to create a secondary chemical reaction that further strengthens the bonds.

The result is higher-resolution parts with superior mechanical properties and a smoother finish. These printers are already being used to accelerate product development from the design iteration stage to rapid prototyping to manufacturing.

They give designers more flexibility by removing constraints inherent with molding techniques and allow mechanical properties to be varied throughout the printed part. Surface design and texture can be applied as desired, and each part can even be customized, since there are no tooling costs.

The printers are currently available only through a subscription service, which includes hardware and software updates as they become available.

For information: Carbon Global HQ, 1089 Mills Way, Redwood City, CA 94063; phone: 650-285-6307; email: info@carbon3d.com; Web site: https://www.carbon3d.com/ or https://www.carbon3d.com/carbon-dls-technology/

Smart Farming

Recycling the Unrecyclable

A South Korean startup is aimed at helping farmers expand their business and improve sustainability through the use of digital technology. Known as Farm Morning, the smart farming platform integrates a variety of software and hardware modules, enabling growers to better manage production.

Using a single mobile app, they can monitor factors such as temperature and humidity in real time. The data is then used to automatically adjust heating, cooling and ventilation as changes occur. On the distribution side, a service called Sinsun Market connects farmers to fresh market buyers – including e-grocers – to boost sales. Farmers can also check market prices by type, region and grade to maximize their return on investment.

The company is dedicated to transforming the future of farming and resolving global food supply problems. Through construction of farm ecosystems that improve yield while employing sustainable farming practices, as well as data-based livestock management services, Farm Morning is using the power of digital technology and data analysis to optimize production and make farming sustainable.

For information: Green Labs, AJ Vision Tower 9, Eui-ro 8-gil, Songpa-gu, Seoul, Korea; Web site: https://www.farmmorning. com/

In the U.S. alone, about 42 million tons of plastic waste is generated every year, and less than 10 percent is recycled. But now, some of this waste is being put to use as building blocks for retaining walls, privacy fencing, sound barriers, landscaping and even furniture.

ByBlock is a construction-grade material made entirely from plastic waste. Discarded plastic (including non-recyclables) are shredded, superheated and fused into 16x8x8-inch blocks. Each block weighs about 22 pounds, but the material can be customized depending on the desired density.

The whole process generates 41 percent fewer greenhouse emissions than producing an equivalent amount of concrete, and the resulting product will not crack or crumble like concrete can.

The blocks are produced using a patented, modular system known as Blocker, which can leased or purchased. The system can be installed in smaller recycling facilities or scaled up for larger operations. The goal is to recycle 100 million tons of plastic into ByBlocks by 2030 by making recycling operations more efficient and controlling costs.

For information: ByFusion Global Inc.; Web site: https://www. byfusion.com/byblock/
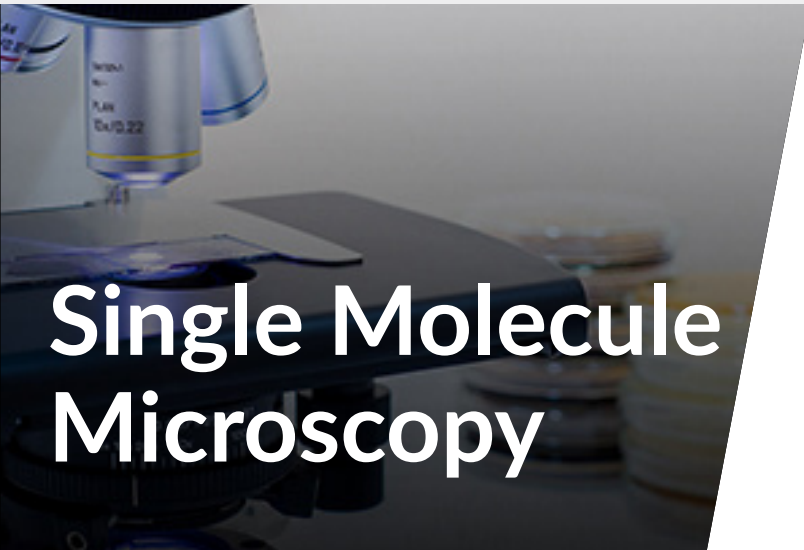
Single Molecule Microscopy

Personal Robot

A super-resolution desktop microscope has been developed that can visualize, track and image single molecules within a living cell. The technology will make it possible to develop new drugs and bring diagnostic capabilities to a wider audience than ever before.

Nanoimager combines imaging modalities with advanced software to observe particles at a resolution of 20 nanometers in two dimensions, and with a three-dimensional resolution of 50 nanometers.

Using high-powered lasers and imaging techniques, the device is not only capable of localizing individual molecules and their position within complex structures, but also follows their movements for a more accurate picture of particle behavior.

The technology will be helpful for investigating pathogens, their life cycles and how they cause disease. It will also enable a more thorough understanding of neural networks and the basis of neurodegenerative disorders such as Alzheimer's and Parkinson's disease. The ability to study a wide variety of biomolecules could lead to earlier diagnosis and treatment of many debilitating diseases in the future.

For information: ONI; Web site: https://oni.bio/nanoimager/

Amazon's recently introduced home robot is designed to help users with a variety of tasks, from safety and security to remote monitoring of family members.

Currently available by invitation only, early units are being used to identify and resolve technical issues as well as gauge consumer interest.

Known as Astro, the new robot features a 10-inch touchscreen "face" that displays circular blinking eyes and acts as an Echo-style interface for viewing movies, teleconferencing and controlling smart home devices, including Ring security systems. It also features facial recognition capabilities to enable more personalized interaction.

Astro navigates using an advanced simultaneous localization and mapping (SLAM) technology called Intelligent Motion, which enables it to operate autonomously even in a changing home environment.

The electric motor allows it to move quietly, while an array of on-board sensors enhance safety. Strong privacy controls protect personal information and permit users to easily turn off microphones and cameras. When it becomes available for general distribution, Astro is expected to sell for less than $1,500.

Fully Electric Travel Trailer

Flying Fruit Picker

From the makers of the iconic Airstream travel trailer, eStream is designed to take recreational vehicles to a new level.

The 22-foot, single-axle camper features the same distinctive polished aluminum exterior that characterizes earlier models. But advanced batteries, motors and systems offer new features not found before.

By integrating electric drive-assist motors into the powertrain platform, eStream extends towing range by working with the tow vehicle. It can also be controlled via a remote at slow speeds without a tow vehicle to maneuver around a campsite or in the driveway.

Solar panels on the roof provide fully electric living for the occupants, including a Wi-Fi hotspot and modern electric appliances, without the need for noisy generators.

The interior features a fully equipped kitchen, a bathroom with shower, and sleeping space for four people. The eStream concept trailer recently deputed at the 2022 Florida RV Super Show.

A new drone that autonomously targets, picks and collects fruit right off the tree could revolutionize the orchard farming industry. Although it's still in the development stage, pilot programs will soon be underway in Europe and the U.S.

Dubbed FAR™ (flying autonomous robots) the drones are equipped with sensors and cameras that enable them to determine whether a piece of fruit is ready to be picked.

QR codes are then used to instruct them where the fruit is to be collected. Several drones are tethered to a central machine that travels slowly through the orchard, providing power and enabling them to operate for longer periods. Individual drones can be monitored through use of GPS and a mobile app while they operate 24 hours a day.

The company is planning to rent out the service to farmers during harvest time Although the cost has not been disclosed, the goal is to make the system more efficient and

cheaper than hiring temporary labor.

For information: Tevel Aerobotics Technologies; Web site: https://www.tevel-tech.com/

Reusable Cold Storage

The market for shipping temperature-sensitive products – from food to pharmaceuticals – is expected to exceed $580 billion by 2030. Much of those products are currently being transported in single-use cardboard, Styrofoam and cold pack containers that end up in landfills – to the tune of an estimated 7 million pounds each year.

Now, the same company that has become known for making mugs to keep beverages hot has engineered a system to do the reverse. Called Cube, the box (which looks like a safe) uses many of the same sensors and algorithms to keep things cool. However, the vacuum-insulated container is surrounded by a phase change gel that starts out frozen and turns to liquid as it absorbs heat.

Before use, Cube is plugged into a system that freezes the gel with water and ethanol. When it's ready to be shipped, it will maintain a temperature of 41 degrees Fahrenheit for up to 72 hours.

Sensors and a built-in GPS enable each box to

be monitored so that if a shipment is delayed or the contents start to warm up, it can be pulled from a plane or truck and plugged back in to extend the shipping time.

And it's durable enough to provide up to ten years of use.

For information: Ember Technologies, Inc.; Web site: https://ember.com/pages/cold-chain *or* https://emberhealth.com/

12 Technology Trends Redefining Manufacturing

continued from page 1

Augmented technologies are designed to increase humans' physical and cognitive capabilities. *Augmented thinking 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 for peak performance.

Augmented movement technologies enhance physical human functionality. A hearing aid is a simple 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. Manufacturers will increasingly use functional augmentation to reduce injury and lower insurance costs. For example, GM workers wear powered **exoskeletons** to lessen arm, hand and joint problems while assembling cars. Manufacturers should start looking

12 Technology Trends Redefining Manufacturing

for opportunities to apply functional augmentation to not only reduce injury and cost, but to help attract and retain talent.

Trend #3. Rapid growth in the application of both semiautonomous technology and fully autonomous technology will both disrupt and transform manufacturing.

Autonomous technologies use AI and a host of networked motors, actuators and sensors to automate functions like driving vehicles within the manufacturing facility or operating a forklift, for example. 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. The use of both semiautonomous and fully autonomous technologies goes way beyond vehicles, but that is where most of the investment will continue to flow in the next several years.

Trend #4. Advances in AI and wireless broadband are accelerating the application of voice commerce, business bots and voice-enabled products.

The use of smart e-assistants and chatbots is rapidly becoming a mobile electronic concierge available on any smart device, including phones, wearables, tablets, televisions and cars, to name a few. Stand-alone audio assistants, including Amazon,

Google, Apple and others, will continue to evolve rapidly into industrial business bots for manufacturing applications.

Manufacturers will increasingly have a Siri-like virtual sales assistant, and we will be increasingly using an e-personal job assistant that taps into connected, intelligent sensors to provide real-time data that can predict potential problems and offer suggestions. From the virtual help desk to sales, marketing and accounting, to services such as finding the correct replacement part, adding AI enables voice instructions and advice to any product or service will exponentially accelerate.

Trend #5. The increasing datafication of everything, creating even bigger big data, will increasingly drive 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. Edge computing, IoT adding networked intelligence to an increasing number of "things" will exponentially increase the amount of data created. The goal is to bring enterprise-wide visibility and insights that enable users to make rapid, critical decisions at the speed of need. 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.

Trend #6. Rapid adoption of advanced distributed cloud computing platforms and services will provide the backbone for digital

transformations.

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 will provide many new applications. The shift in how manufacturers obtain and maintain software, hardware and computing capacity to cut costs in IT has been dramatically accelerated and will continue to transform all processes, from human resources to sales management. Beyond cost cutting, new cloud computing platforms and services will increasingly be used to create new products, services and markets. Not all clouds are created equal. Some are optimized for IoT and edge applications, while others are designed for different levels of security and speed.

Trend #7. Increasing use of virtualization of hardware and software, including storage, applications and networking.

The virtualization of software and hardware has been increasingly used by both large and small businesses as virtualization security has improved. Hardware as a Service (HaaS) has increasingly joined 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 manufacturers 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.

Trend #8. Increasing use of virtualization for processes and services enabling Everything as a Service (XaaS).

Advances in cloud platforms, AI and 5G, to name a few, will dramatically accelerate the virtualization of processes and services by organizations of all sizes needing to update and streamline existing services and to rapidly deploy new and often disruptive services. This will lead to a distributed enterprise model that accelerates innovation and digital transformation and drives growth far beyond national borders. Anything can become a virtual service offering, and this trend is just now starting to explode. For example, the rapid growth of Videoconferencing as a Service, AI as a Service, Blockchain as a Service, Quantum 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. Many of the products manufacturers traditionally sell, such as cars, trucks, RVs, boats and motorcycles, will increasingly be sold using a subscription service model.

Trend #9. Virtual reality (VR), augmented reality (AR) applications and digital twins will shift from a rapid evolution to a revolutionary level of applications.

Augmented reality allows users to point a digital camera at something, using a smartphone or AR glasses, and overlay just-in-time information about the subject they are focusing on. 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.

This will spark business applications, especially for manufacturers, who will increasingly have their workers wear AR

glasses so they can get the information they need when they need it, without having to use their hands to hold a mobile device like a phone or tablet.

By contrast, virtual reality 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 industrial applications will be rapidly growing.

Manufacturers will increasingly use digital twin technology to virtually test new systems and applications.

Trend #10. 3D and 4D printing (additive manufacturing) are moving from rapid evolution to revolution and are rapidly being applied to an ever-expanding number of industries.

Both customized and personalized manufacturing of finished goods using additive manufacturing have been growing exponentially and, thanks to global supply chain disruptions, have 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, buildings, bridges, 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 increasingly be offered by companies such as Amazon and FedEx, which will print (manufacture) and ship any CAD design from anywhere to anywhere. And if they don't do it, others will.

Trend #11. Rapid convergence of the Internet of Things (IoT) combined with edge computing, AI and 5G, will accelerate, forming 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 Internet of Everything (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 to the point of use and at the speed of need. As AI increasingly becomes embedded at the chip level, the power and speed of edge computing will dramatically increase.

Trend #12. Increasing speed and availability of wireless broadband enabled by 5G wireless and satellite mega-constellations will dramatically expand business networking

on a global level as well as connecting more things.

There are currently several variations of 5G, including high speed and low latency, as global 5G implementations rapidly expand. In addition, 5G can be deployed as a public or a private network. In other words, manufacturers can set up a private, highly secure, blazingly fast private 5G network that covers their entire operation. Enterprise applications of 5G are already finding new applications to accelerate innovation and growth.

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 anywhere on the planet. By providing global broadband access, manufacturers large and small will have access to a vastly expanded global workforce and a dramatically larger customer base.

After reading through each Hard Trend, I suggest you select one to act on now – because if you don't, someone else will!

Burrus
Research ®