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Smart Cities - Seeing the Invisible and Doing the Impossible

By Daniel Burrus, CEO of Burrus Research

By sheer definition, the word "impossible" connotes something that simply cannot be done. But we all know the impossible isn't completely out of our reach; for centuries, humans have been achieving the so-called "impossible" by developing conceptual understanding and making visible that which we've been previously unable to see and conceive of. When we develop this sort of understanding, previously unknown opportunities and solutions become clear — and then, doing the impossible becomes just a matter of commonsense problem solving.

An everyday iteration of this concept is being seen in cities across the globe as data analytics and technological innovations are providing new levels of clarity when it comes to issues like sustainability, pollution, energy conservation, and crime. As these tech developments give us greater insight into how the many different facets of our cities truly function, both local leaders and major companies are gaining the Foresight to come up with myriad solutions, thus creating "smart cities."

Statistically speaking, cities themselves present an array of challenges: according to a report by Verizon Wireless, fully 54% of the world's population now lives in cities, meaning these cities are responsible for 75% of the world's energy consumption. Further still, these numbers mean our urban resources — from water, to energy, to policemen and women — are under considerable, unsustainable strain.

However, high-speed data analytics, in allowing urbanites to more clearly see their resource consumption and utilization leading to clear, pragmatic solutions to the many crises our cities may face. Therefore,
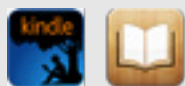
TECHNOLOGY NEWS HIGHLIGHTS

Dr. Watson, I Presume…

Back in April, IBM announced the launch of the Watson Health Cloud, a platform that is designed to improve collaboration and innovation in the medical community by aggregating the immense amounts of clinical, research, and social health data being generated every day. The initiative leverages Watson's cognitive and analytic capabilities to provide powerful new insights into health and healthcare. As a next step, IBM plans to acquire technology that will expand Watson's capabilities to include not only data, but medical images as well.

Imaging is the fastest-growing data source in the healthcare industry today – accounting for an estimated 90 percent of medical data. Some emergency rooms generate as many as 100,000 images every day, yet most of the analysis is still done manually. Machine learning and cognitive computing will enable Watson to filter this information, assist clinicians with identifying anomalies, and then recommend a course of action. In effect, the new acquisition is aimed at expanding Watson's capabilities beyond natural language recognition by giving it the ability to "see."

The added capabilities have tremendous benefits for clinicians and patients alike by reducing physician loads and increasing quality, efficiency and effectiveness. A patient's current images could quickly be compared to historical data as well as information from personal wearable devices to generate a personalized treatment and monitoring program. In addition, having a centralized storehouse of information will provide access to a broader array of information related to diagnostic criteria, therapeutic options, care guidelines and global trends.

*For information: IBM Corporation, 1 New Orchard Road, Armonk, NY 10504-1722; phone: 914-499-1900; Web site: **www.ibm.com/watsonhealth** or **www.ibm.com/watson***

Robots Transform 3D Printing

A new technology called MX3D will take 3D printing to a new level of sophistication and complexity by using multi-axis industrial robots to "draw" metal structures in mid-air. The new platform will allow virtually unlimited freedom of design for large-scale, functional structures.

The first project (which is set for completion in 2017) will be a pedestrian bridge to be printed in place by robotic arms at a location in Amsterdam that is, as yet, undisclosed. The robots will work their way from one side to the other, using the load-bearing structure to support their own weight as they progress.

Using a technique that can best be described as a combination of resin printing and welding, strands of molten metal are created in vertical, horizontal or spiraling lines as the robot arms rotate along six different planes of motion. Software controls the pulse-time, pause time, layer height and tool orientation for a variety of metals including steel, stainless steel, aluminum, copper and bronze. Compared to existing 3D printing methods, MX3D is more cost effective and scalable, and will offer a broader range of creativity for architecture, industrial design and art.

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Assistive Device Offers Better Mobility

Borrowing on technology originally developed for their ASIMO humanoid robot, Honda recently announced the introduction of the Walking Assist Device for use in hospitals and rehabilitation facilities throughout Japan. Designed to help the elderly, as well as individuals requiring physical therapy due to stroke, accident or other diseases, the device has been used experimentally in approximately 50 facilities since 2013.

The simple belt structure is worn around the waist and thighs, and is adjustable for a variety of body sizes and types. A computer controller activates a series of motors to improve symmetry and timing of leg movements, while providing support and lift at the knees to promote a normal stride length. Sensors monitor walking patterns and display the information on a tablet-style device enabling clinicians to optimize settings for flexion, extension and weight distribution. Tests indicate that, after a period of use, muscle strength often increases sufficiently to allow the user to walk unaided.

The lithium-ion battery-powered device weighs about 6 pounds (2.7 kilograms) and will operate for more than 60 minutes on a full charge. The first units are scheduled to become available for lease in November of this year at a cost of 45,000 Yen (less than $400) per month.

Airless Tires

Imagine a tire that never goes flat! That's the idea behind the non-pneumatic tire (NPT) being developed by a Korean manufacturer. And after several iterations, it looks like they finally have a winner.

Known as iFlex, the new tire is made from eco-friendly recycled, material. On the outside, it looks much like a traditional tire with a similar sidewall height, but inside it consists of a compressible web that delivers the same shock absorption and handling characteristics as air-filled counterparts. Unlike earlier NPT designs, which integrated the tire with the wheel (commonly referred to as a "tweel"), iFlex is designed to be mounted to a standard wheel, which also reduces cost.

Ride and handling tests – including durability, stability, hardness and slalom (zig-zag-ability) – at speeds of up to 80 miles per hour (130 kilometers per hour) indicate that iFlex prototypes match the performance characteristics of pressurized tires. The company has not yet disclosed when the puncture-proof tires will be available for purchase.

Inkjet-Printable Silk

Numerous researchers have looked at inkjet printing technology as an economical means of depositing biomolecules (such as enzymes, antibodies and growth factors) on surfaces for a variety of applications – from sensing microorganisms to promoting tissue regeneration. Inkjet printing technologies are economical, affordable, readily available and adaptable to a wide variety of substrates. However, the biomolecular compounds used are notoriously unstable, particularly when exposed to heat, which means that the printed biomaterials can quickly lose functionality.

Recently it was discovered that silk protein – also called fibroin – acts as a "cocoon" to stabilize biomolecules so that they remain active for longer periods of time. The intrinsic strength of silk also makes the inks more mechanically robust. Using a single silk-based ink, doped with a variety of compounds, researchers have now been able to create a library of printable materials for specific applications. Future applications of this technology include surgical gloves that turn from blue to red when exposed to bacteria and smart bandages that incorporate antibiotics to promote faster healing. Multi-cartridge printers could even combine functions to address more complex applications.

Smart Paint

A new family of paint pigments has been developed that change color when exposed to variations in temperature, light or pressure. A combination of organic and inorganic compounds, the pigments can be calibrated to respond to specific levels of change, and the color change may be permanent or reversible.

For example, photochromic (light sensitive) pigments are available which change color when light intensity reaches a defined level, and then return to the original color when the intensity is decreased. Another type of photochromic pigment changes color when light intensity increases, and retains that color even after it drops back to original levels. Yet another version is designed to measure the cumulative effect of multiple exposures.

Piezochromic (pressure sensitive) and thermochromic (temperature sensitive) pigments are also available to produce reversible or irreversible color changes over a range of defined pressures and temperatures. All products are available in a broad range of colors and particle diameters (from nanometer to micrometer).

The new paints have diverse applications in the aeronautical, construction and automobile industries, such as identifying potential structural damage that may otherwise not be visible.

Intelligent Oven

Even the most "kitchen-challenged" folks can produce delicious meals with an oven like this! The June Intelligent Oven has more computing power than many laptops, plus a variety of sensors and controls, to recognize common foods and automatically cook them to perfection.

A little larger than a microwave, June has a built-in scale, high definition camera and multiple temperature probes to identify the food you want to prepare. A 5-inch touch screen allows you to select, for example, how you'd like your steak – rare, medium, well, or somewhere in between? As your food is cooking, the camera can stream live video to your smartphone, from which you can also control the oven remotely. Finally, automatic alerts (selectable by you, of course) will let you know when dinner is ready so that you can entertain your guests while June does the cooking.

You can also customize your smart oven with recipes, link your shopping list with your calendar and save favorite cooking modes for one-button operation. June will be available for purchase next year at a price of $3,000, however, a limited number of units can be pre-ordered now at a discounted price of $1,500.

*For information: June Life, Inc., 1805 Broadway Street, San Francisco, CA 94109; Web site: **http://juneoven.com/***

Plastic Roads

Engineers in Germany and the Netherlands are researching the feasibility of constructing roadways out of plastic – a move that could greatly reduce the cost of not only building, but also maintaining streets and highways.

Sections of road are pre-fabricated using recycled materials that would otherwise pollute waterways and landfills or be incinerated. The modular parts can be installed in one piece on top of a layer of sand, reducing construction time to weeks rather than months. Underneath the surface is a series of hollow structures that can be used to run electrical connections, house sensors and measuring equipment, or even store water – paving the way for other innovations such as building heated roads or harvesting power from traffic.

The plastic road is virtually maintenance free and

expected to last up to fifty years. It can resist temperatures from -40 to 80 degrees Celsius (-40 to 175 degrees Fahrenheit) and is highly resistant to chemical corrosion. One remaining hurdle is to ensure adequate skid-resistance by incorporating sand or crushed stone into the surface. The plan is to test the new design on a bicycle path before exposing it to automobile and truck traffic.

*For information: VolkerWessels, Podium 9, 3826 PA Amersfoort, Netherlands; phone: +31-88-186-6186; fax: +31-88-186-6187; Web site: **http://en.volkerwessels. com/** or h**ttp://en.volkerwessels.com/en/projects/detail/ plasticroad***

Smart Cities

these crises can be considered part of a Soft Trend — a pattern that isn't necessarily set in stone, one we can change through Anticipatory thinking and technological prowess. Essentially, by using high-speed data analytics and placing sensors all around cities — making these cities a part of the Internet of Things (IoT) — we can transform our cities into smart cities.

An example: according to the same Verizon report, a full 40% of municipal energy costs comes from street lighting — not many people would've realized that before data analytics made it abundantly clear. The company did a recent experiment in Lansing, Michigan, building a "smart street lighting" system by installing things like LEDs and motion sensors, and by monitoring energy consumption by the city's lighting and power infrastructures. As a result, the city of Lansing saw a 70% cost reduction in energy consumption from street lighting, complemented by a 30% reduction in outages and a 65% reduction in outage duration.

Another fantastic example of this idea relates to parking. Now, if you've ever driven through a city, especially a major one like Chicago, New York, or Los Angeles, you know finding a parking spot can be a

purgatorial experience — driving in circles, praying desperately for someone to pull out of a spot, seething with breathless rage when the driver in front of you goes for the very spot you'd had in mind. It turns out that 30% of traffic congestion in cities is actually caused by people looking for parking spaces — and this congestion, overall, represents a loss over more than $121 billion in the US. Verizon decided to run an experiment in Ellicott City, Maryland, in which they used IoT to develop smart parking apps, which let drivers know when parking spots became available nearby. Using this app reduced the time drivers spent looking for spots by 43%, and overall congestion by 10%.
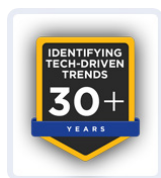
In a similar endeavor, Verizon has been developing smart traffic grids in some cities, using IoT to create intelligent stoplights that monitor traffic flow. In these cities, travel time and congestion have been reduced by 20%, thanks to these "smart lights." Of course, reductions in travel time and congestion equate to a drop in the emission of greenhouse gases, as well as improved air quality.

These developments can also be utilized in resource conservation, which is paramount to cities the world over. Even something as simple as a "smart meter" for energy or water usage can drastically reduce costs and conserve resources by 20 to 25%. Back in Lansing, Verizon Wireless used this smart tech in confluence with IoT to connect water, light, security, and legacy systems into a Smart Grid, diminishing overall energy costs by 15% and emissions by 20%. The company even created solar-powered benches, which allow citizens to charge their devices outdoors. And because these benches are off the grid, there was a 100% reduction in energy costs. While getting citizens to truly care about conservation and sustainability in their cities might be somewhat of a

sisyphean task, it's a safe bet to say pretty much everyone cares about local crime. We look at a country like England — which, with roughly one CCTV camera for every 11 citizens, has become known as the "most watched country in the world" — and conjure up Orwellian images and rhetoric of Big Brother tracking our every move. But the stats speak for themselves: when Verizon installed CCTV video monitoring in several U.S. cities, using edge storage, compression, and analytics to create real-time situational awareness, crime was reduced across the board by 5 to 20%, and these cities saved an average of $1.50 for every dollar spent. But this notion of saving money in the long run by spending a little bit of money now seems largely lost on many cities. In suburbia, we're starting to see the advent of houses with smart tech built in, houses that rely on IoT and mobile technology to be safer and more energy-efficient. But these houses are usually reserved for the affluent, who don't mind spending a little bit of money now to save a much greater amount in the future.

By refusing to make these simple financial concessions, city leaders are essentially using yesterday's thinking to solve tomorrow's problems today. Saying "no" to developmental expenses used to gain politicians popularity but now, it's turning them into financial and environmental liabilities; it's much more expensive, these days, to say "no" to the kind of technology that stands to provide huge quality-of-life increases for your city. Part of changing this system of governmental city management relies on education, around making the invisible visible to create flashes of Foresight for people from mayors to city planners. The local heroes of tomorrow, the ones who get re-elected and really push their cities forward, will have adopted these methods and this new technology to the benefit of their cities and the people they serve.

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