



Foresight 2020:

The Twelve Trends
Transforming the Wheat
Industry Today

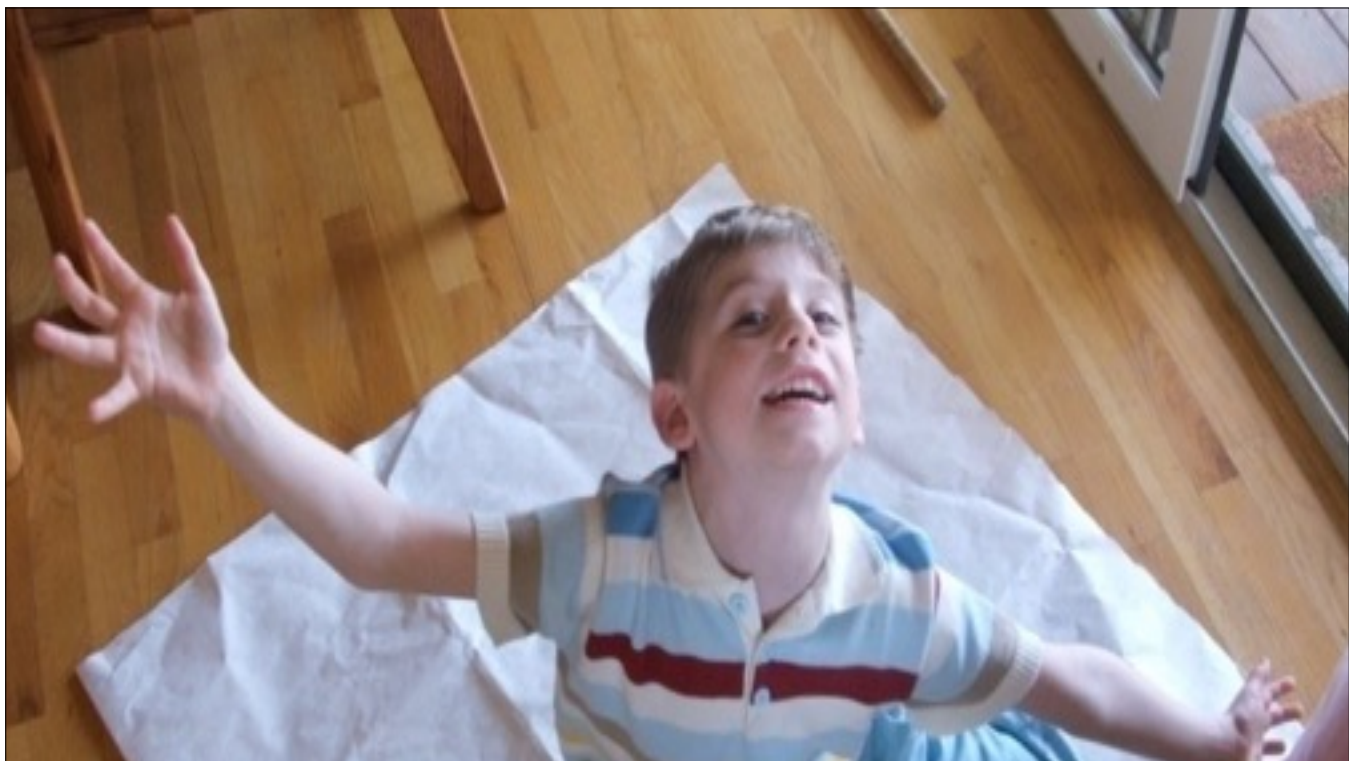
Colorado Wheat Association
Wiggins, CO
December 1, 2016

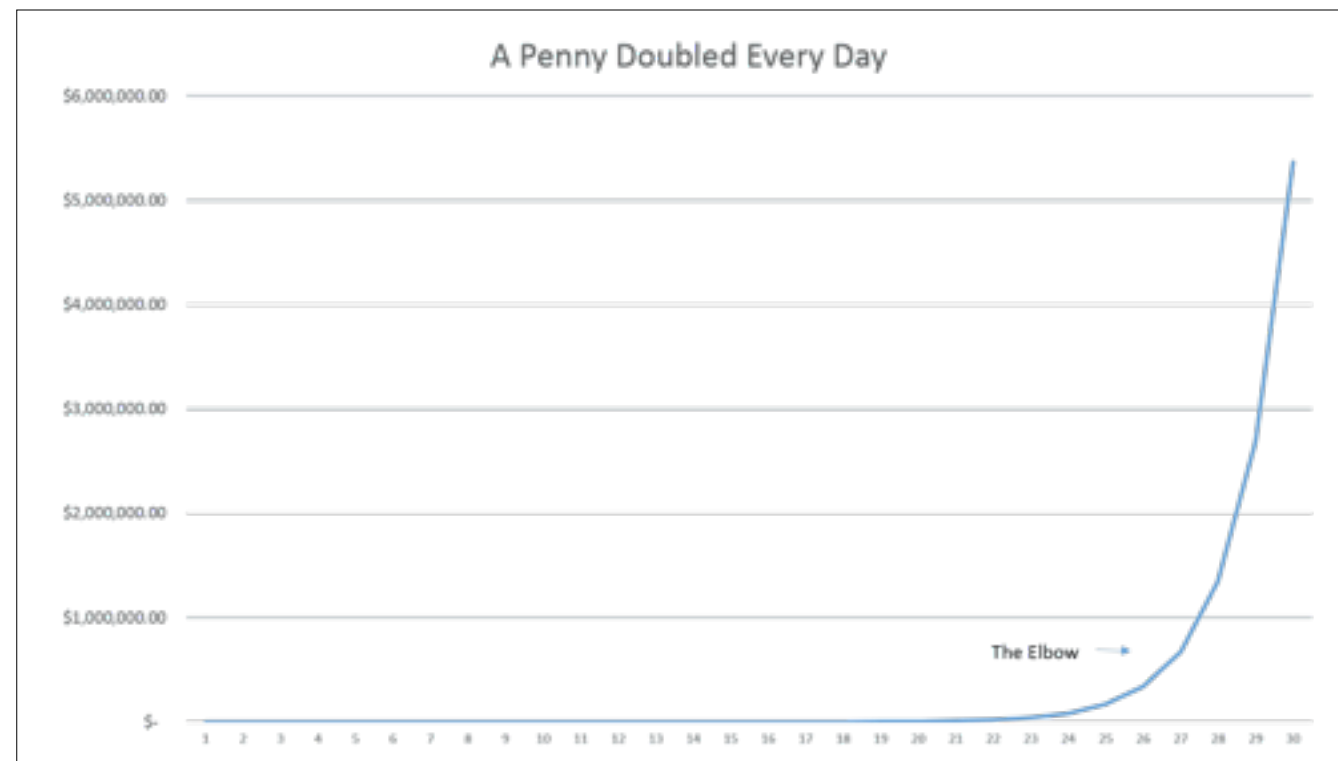
50 ESSENTIAL STRATEGIES TO
HELP YOUR COMPANY
STAY AHEAD OF
EMERGING
TECHNOLOGIES

JUMP^{THE} **CURVE**

JACK ULDRICH

author of *The Next Big Thing is Really Small* and *Thriving in Nanotechnology*





This is the “curve” that you and your clients must “jump”!



Trend #1: Wearables

Using Google Glass for crop scouting/inspection.



Trend #1: Wearables



Information will not only be all around us ... it'll be on us, literally.

New methods of helping SunTrust's clients?



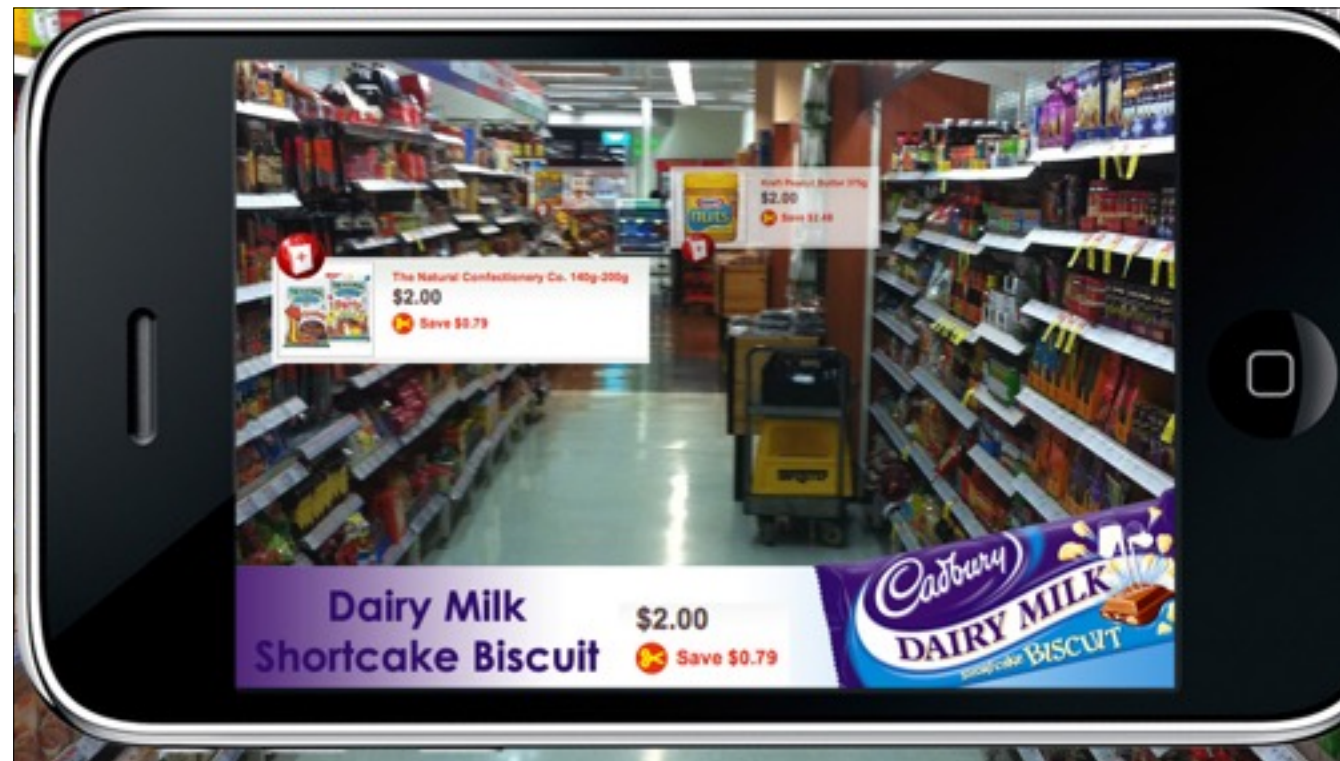
Trend #2

July 2016

Pokemon Go ... only 3 weeks old (faster than Twitter, Netflix)

Augmented Reality could be really big trend

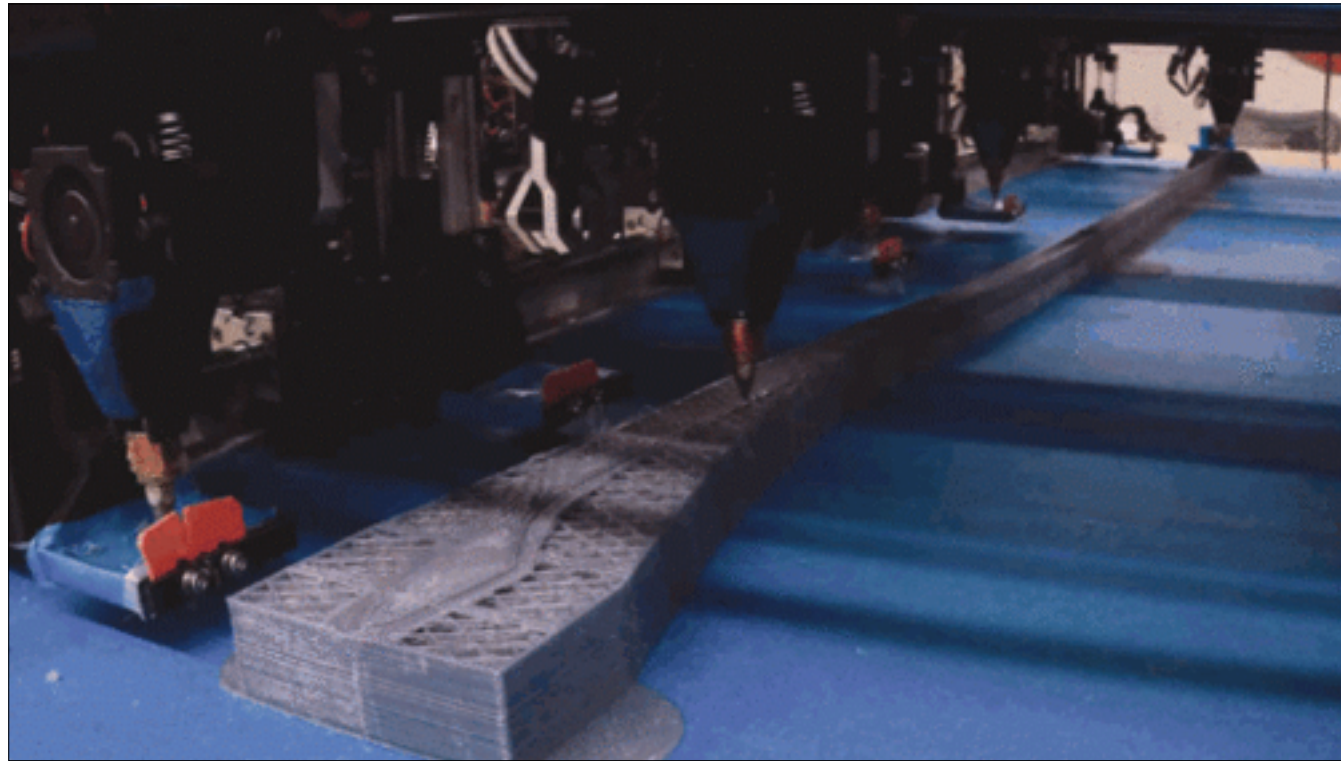
Retailers are experimenting with stores (maybe fewer people will go to stores)



General Mills “What’s in my food”?



Trend #3: 3D printing



Trend #2: Additive Manufacturing

New reality ... autodesk



Print combine parts?



What next?

What are the implications for construction, building, real estate

1 Thousand
1 Million
1 Billion
1 Trillion
1 Quadrillion



Do you really understand the power of exponential growth?

If so, what is the mathematical relationship between these numbers?

I'll explain.



Here is an example of 1000-fold growth that you have lived through.

Here are seven additional trends that are about to experience 1000-fold growth ...



Trend #4: Bandwidth

4G ... 1400-fold faster

5G ... 100X faster than 4G (Download movies in second vs minutes)



John Deere ... cloud farming





Sep. 20, 2016

Places cheap plastic antenna atop power-line poles

Speeds rivaling 4G LTE and someday 5G

If tests are successful, a cheap way to bring internet service to those who need it.AT&T AirGig

Use cheap plastic antenna to deliver high speed internet service to those who need it.

Use clip

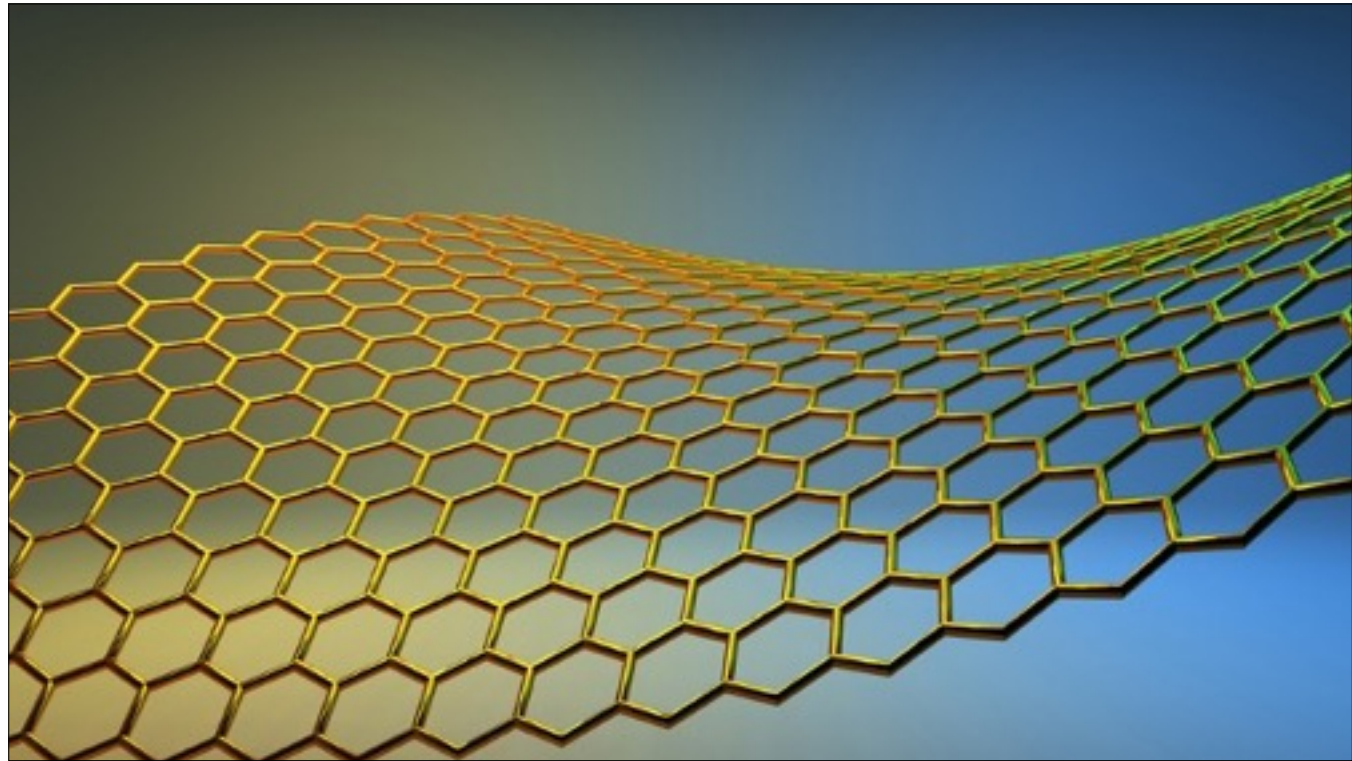


Trend #5: Nanotechnology

Nissan's self cleaning car











Desalination? Impact on drought areas?



What if vast new areas of land become suitable for growing wheat?



Trend #6: Robots

Rosphere

Robots like Rosphere would be able to move about crops without damaging them, making close-up examinations of local conditions and precisely applying pesticides and fertilizers.



Trend #4: Robotics

Precision Drone

Drones have certainly emerged as promising tools in agriculture, with several groups including MIT and DJI announcing crop-monitoring unmanned aircraft inside the last year. But what if you've already got a perfectly good drone capable of taking long, automated flights over your farmland? Parrot has just announced a sensor attachment that can be slapped on old drones to take infrared pictures and help farmers work out areas in need of attention.

Dubbed Sequoia, Parrot's new attachment is claimed to be compatible with all civil drones. Fitted with a 16-megapixel camera and multispectral sensor, the device records images of crops in four different spectral bands: green, red, red-edge and near infrared. The captures are stored on the 64 GB onboard memory and can then be converted into aerial maps through image processing software such as Pix4Dmapper Pro, Airinov or MicaSense.

The maps and data can then be translated by crop consultants or the software itself into practical recommendations. These might include identifying sections of a field that need special attention, picking up on nutrient deficiencies, observing where living organisms are causing damage and managing irrigation. Also onboard Sequoia is a GPS and IMU unit, along with a separate luminosity sensor that records lighting conditions and calibrates the four multispectral sensors. This sensor also features an SD card slot for additional storage.

Sequoia will be launched in March 2016 with a recommended retail price of US\$3,500.

Spot irrigation problems

soil variation

multi-spectral images -- healthy vs distressed

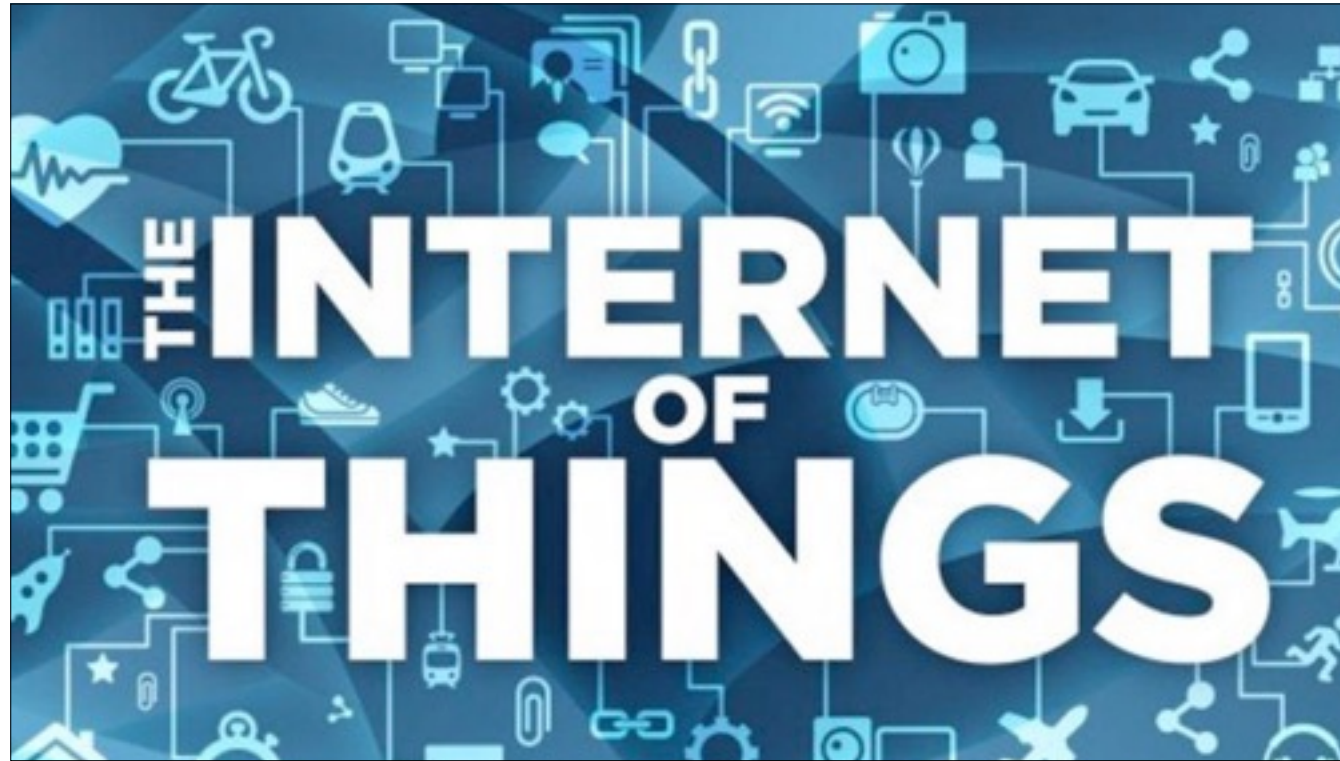
Fly often, at lower cost, and under clouds

Real estate appraisals





Gothenberg ... 100 self driving cars on the road by 2017



Trend #7: The Internet of Things

The extension of the Internet to the physical world.







Cattle rumens — digestive problems
when ready for insemination



Savings:

Deloitte's HQ in Amsterdam. World's smartest building—houses 2,500 people but only 1,000 offices.

The greenest building in the world

All told, the Edge is packed with some 28,000 sensors.

App knows individuals preference for lighting and heating

Makes best of humans!

“Hot design” ... 2500 workers but only 1000 desks

“We think we can be the Uber of buildings,” says Coen van Oostrom, chief executive officer of OVG Real Estate, the building's developer. “We connect them, we make them more efficient, and in the end we will actually need fewer buildings in the world.”



Trend #8 The Genomics Revolution

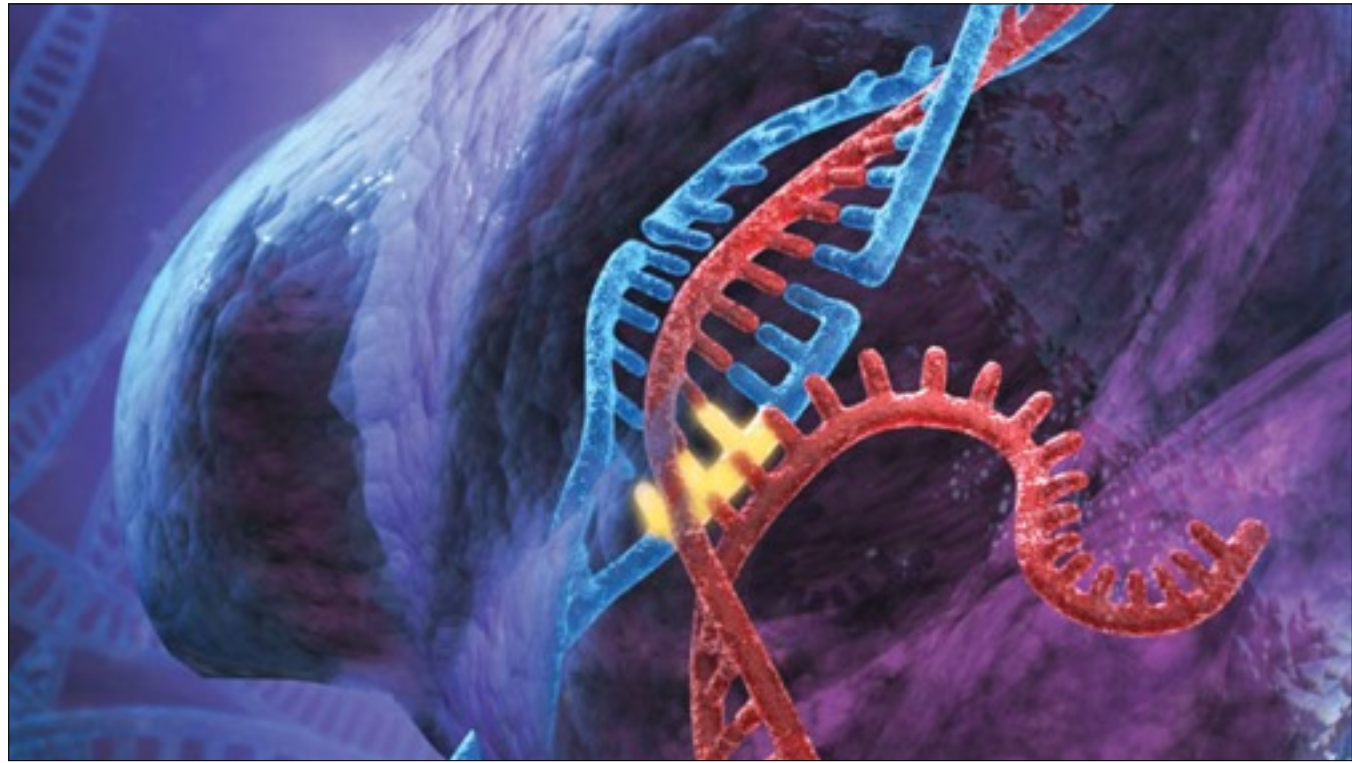


Wheat genome ... 5.6x more complex than the human genome



Fiber, salt tolerant, heat/drought resistant, etc.

Better milling/baking charters tics ...



Chinese Researchers Stop Wheat Disease with Gene Editing

Researchers have created wheat that is resistant to a common disease, using advanced gene editing methods.

By David Talbot on July 21, 2014

Less water, less nitrogen, less soil erosion

Other issues ... Cargill is suing Syngenta over GMO corn ... after China refused to accept Corn grown with Syngenta's seed. (Sueing because Syngenta didn't get approval from Chinese government)



DuPont, Gene editing ... **powerdy mildrew**

Stop wheat from self pollenating in order to make the development of hybrid easier

AquaMax is making **corn drought-resistant**

At DuPont, researchers are working on CRISPR/Cas9-edited versions of commodity crops such as **corn, soybeans, canola, rice, and wheat**, which they expect to have on the market in 5 to 10 years. The plants have new traits like drought resistance and **higher yields**—both critical features for farmers trying to deal with a changing climate and the fact that the world population is growing faster than our food supply.

"When you think about the fact that your average biotech crop takes 10 to 17 years, that's a really remarkable speed compared to where the market is today," says Rachel Haurwitz, cofounder of Berkeley-based Caribou Biosciences, which partnered with DuPont to provide **Caribou's version of CRISPR**. "I find that really, really exciting."

“The plants have new traits like drought resistance and higher yields—both critical features for farmers trying to deal with a changing climate.
”



UG-99 (fungal disease)

The enemy is Ug99, a fungus that causes stem rust, a calamitous disease of wheat

As they queue to fill water jugs from a rusty communal tap, the women of Njoro can't help but gawk at the odd scene across the road. In a wheat field ringed by barbed wire, a dozen men wearing white polyethylene jumpsuits stand in a tight huddle, eyes fixed on the green-and-amber stalks that graze their knees. They chat in foreign tongues — Urdu, Farsi, Chinese — that are rarely heard here amid the acacia trees and donkey carts of Kenya's Rift Valley. The men's hazmat-style safety gear suggests they might be hunting down one of the infamous viruses that flourish in this part of the world — Ebola, perhaps, or Marburg.

Then the leader of the huddle, Harbans Bariana, a rotund Australian in an undersize safari hat, begins reading aloud from his clipboard: "Wylah?" he asks.

His colleagues bend down to examine some flaccid plants flecked with red splotches. A lanky Pakistani with a salt-and-pepper beard rakes a finger along one of the mottled stalks; an iodine-like residue rubs off on his skin. "40 S," he calls out.

The men move three steps right to a slightly more robust clump of wheat. The Australian asks: "Yandanooka?"

"25 MR?" comes the tentative reply from a mustachioed Nepali in a green baseball cap. They slide over to inspect another stalk, and then another.

To the women at the tap, faces scrunched in puzzlement, the call-and-response sounds like gibberish — and to most of the world, it is. But to the jumpsuited strangers in East Africa — a group of elite plant pathologists — these codenames and numbers are a lingua franca, describing just how badly a crop has been ravaged by disease. These specialists have come to Njoro on this autumn afternoon to study a scourge that is destroying acres of Kenyan fields. **The enemy is Ug99, a fungus that causes stem rust, a calamitous disease of wheat.** Its spores alight on a wheat leaf, then work their way into the flesh of the plant and hijack its metabolism, siphoning off nutrients that would otherwise fatten the grains. The pathogen makes its presence known to humans through crimson pustules on the plant's stems and leaves. When those pustules burst, millions of spores flare out in search of fresh hosts. The ravaged plant then withers and dies, its grains shriveled into useless pebbles.



Trend #9: Artificial Intelligence/computer processing power

IBM Watson ... 80 trillion calculations per second

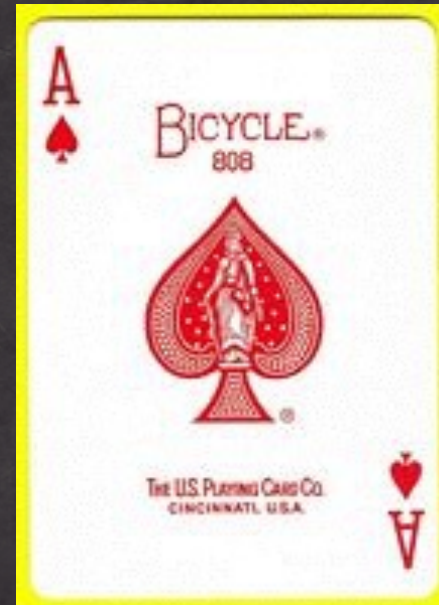


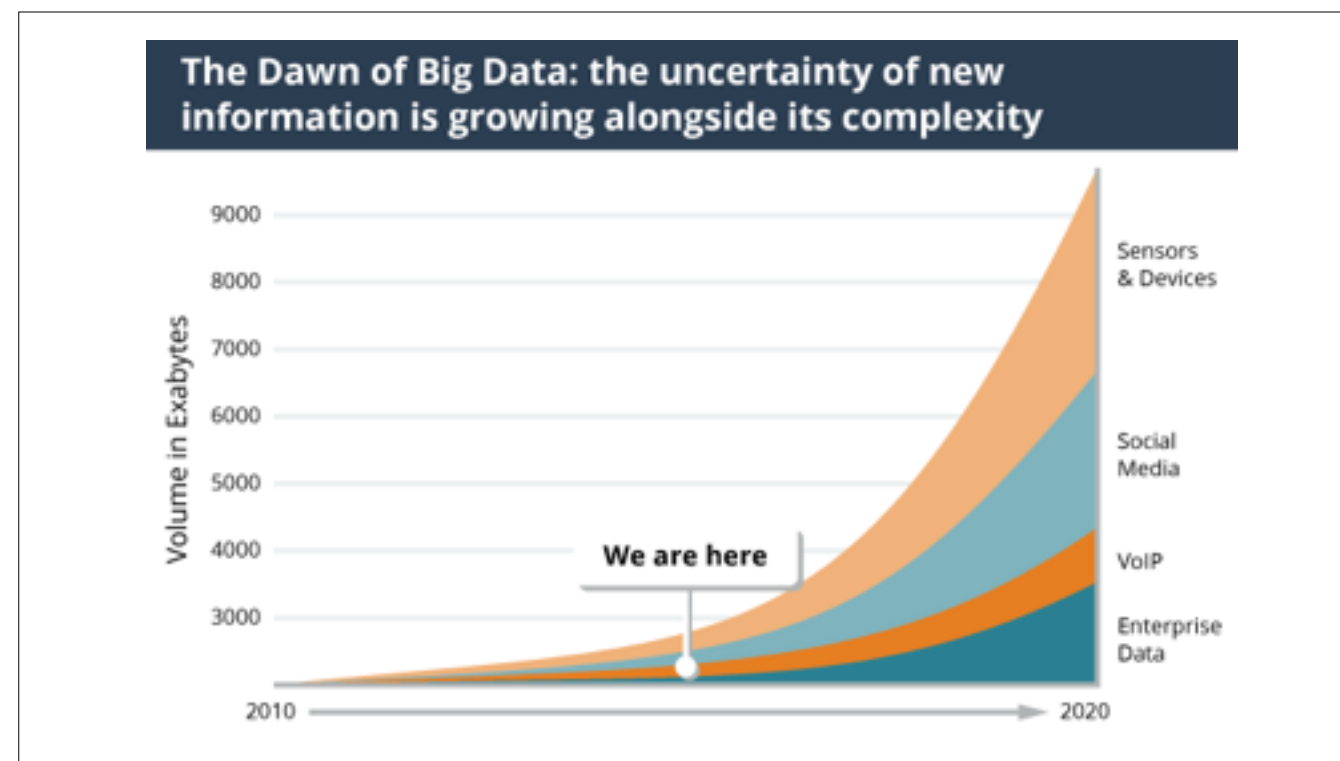
Farming implications





What's next?

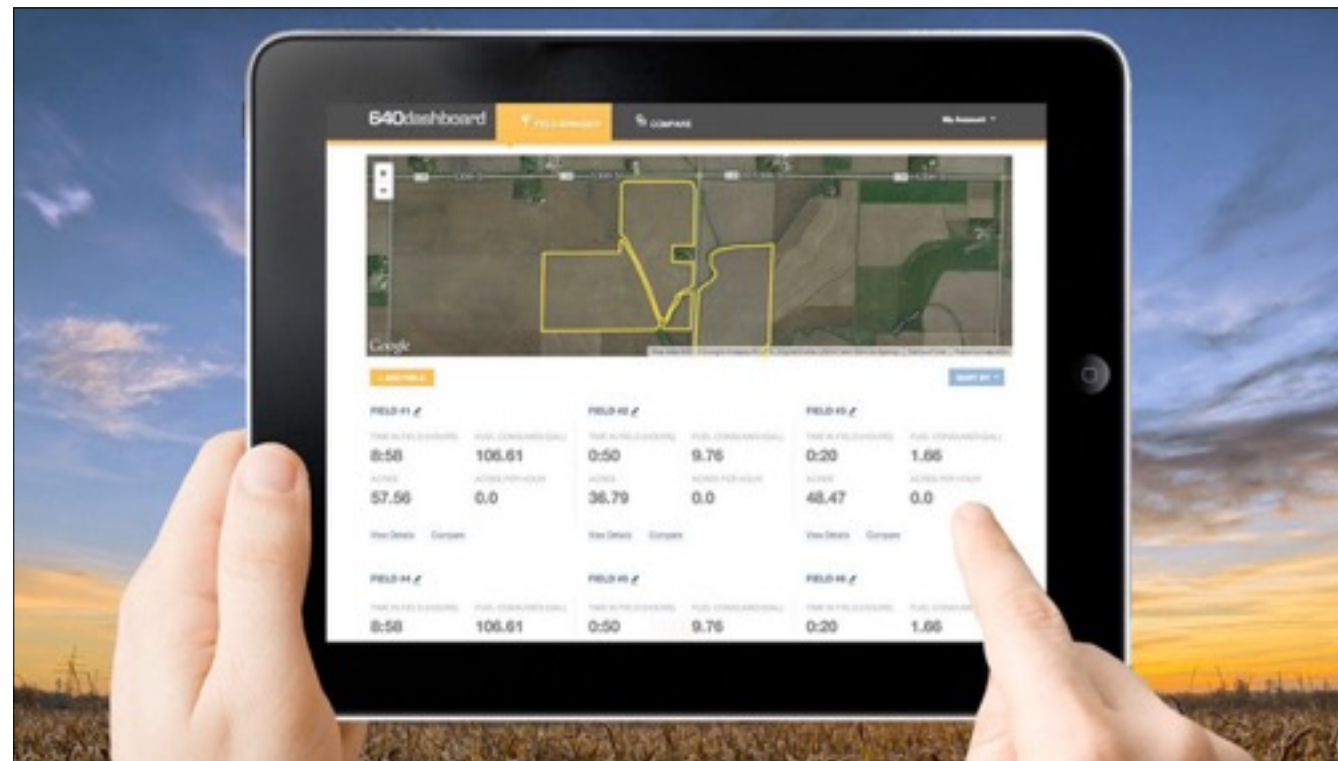




Trend #10: Big Data



Monsanto ... \$1 billion ... Climate Corps
Land O'Lakes ... Geosys
Dupont ... DTN/The Progressive Farmer



Acquired 640 labs in Dec 2014 ... transmit data wirelessly to cloud-based analytics system



What two colors are the yield sign?







Just as yield signs are yellow and black anymore ... either are taxis



Trend #11: Sharing Economy/Collaborative Economy

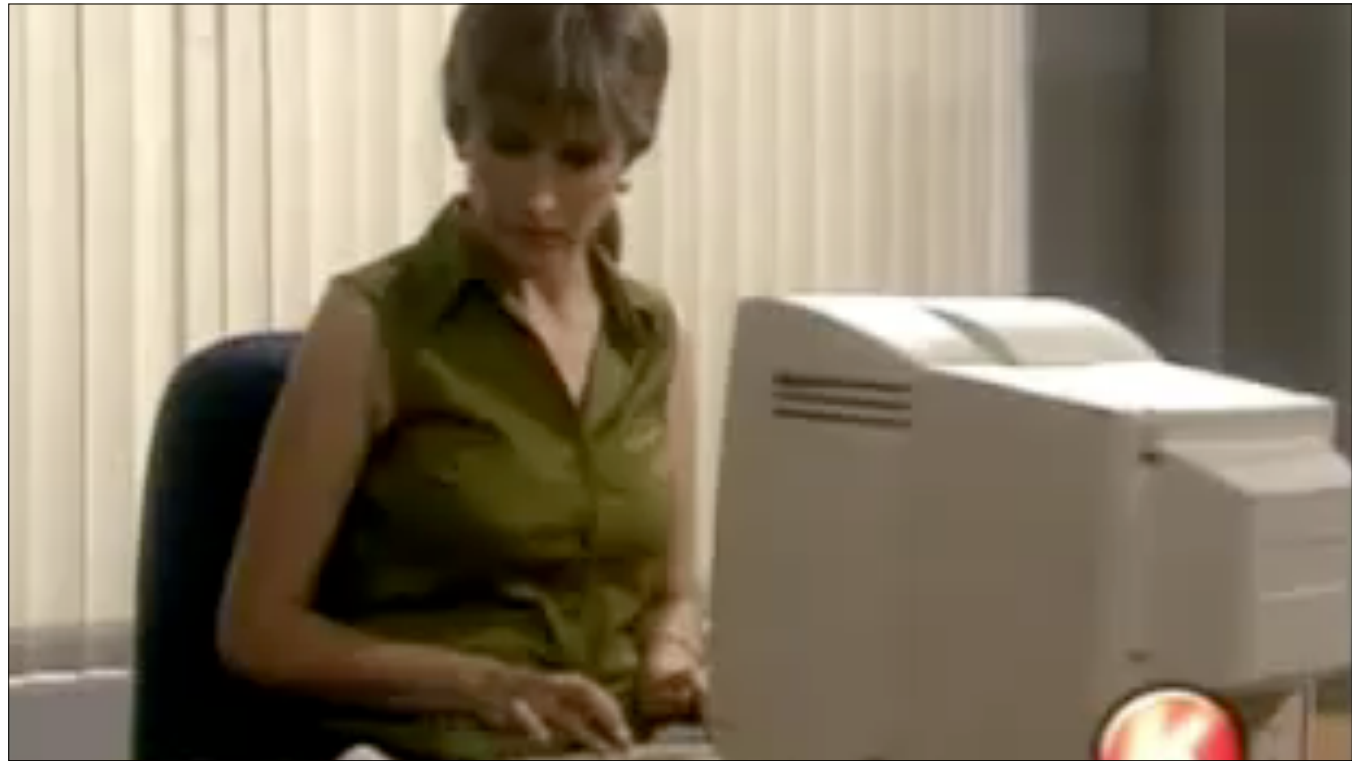


MarvX ... the “Uber” of drones

Drone-assisted scouting



We must have humility when considering new technologies





Trend #12: Virtual Reality

Grandma watching Jurassic Park



Farmers in Nebraska



Have you been paying attention?

Another little test ...



To future-proof yourself and SunTrust's clients you must ... think!!!!



Advances in renewable energy



Google Ventures is investing \$15 million in FBN

For \$500 farmers can benchmark against 7 million acres across 17 states ... which seeds, fertilizer, land quality, crop spacing, etc.

Risk mitigation



Ancient wheats: einkorn, spelt, emmer, sonora



That work yielded the company's first product, which the company is launching today. Indigo Cotton is a **seed coating that grows with the plant**. Perry wouldn't go into detail about how the microbe helps a plant to improve water efficiency. But more generally, he says a microbe could encourage root growth so a plant is **better able to extract water from the soil**, or it could channel more energy toward a plant, or it could do both.

Indigo might not yet know exactly how its microbe works, says Gwyn Beattie, a professor of bacteriology at Iowa State University who is not involved with the company. Microbes that have the biggest impact work by multiple mechanisms and it can take a long time to determine what those mechanisms are and under which conditions they're most potent, she explains. Indigo has advanced quickly from inception to commercial launch. Beattie says it's possible that the company was screening for efficacy and will work on optimizing the microbe later.

Indigo will offer two commercial products this year, said Perry, who came aboard as chief executive last year. The company's laboratory and field tests of a **microbe-based seed coating** showed a 10% increase in yield for several crops, including corn, soy, wheat, cotton, sorghum, canola, chickpeas, tomatoes and strawberries, Perry said.

Microbes can also protect wheat from take-all root rot



Microbes can also protect wheat from take-all root rot



Reduce nitrogen usage by 50%, save \$, reduce run-off, lower nitrate-oxide emissions



Think Twice ... you might be on “thin ice”



Light conditions for growing carbohydrate-rich crops like wheat and potatoes indoors are also being studied

Philips has opened a new facility for developing tailored LED "light recipes" for indoor farming. The GrowWise City Farming research center in Eindhoven, the Netherlands, will be used to study how light can maximize the quality and yield of different crops. The aim is to help producers grow tasty and healthy food indoors all year round.

"Our aim is to develop the technology that makes it possible to grow tasty, healthy and sustainable food virtually anywhere," explains global director of city farming at Philips Gus van der Feltz. "The research we are undertaking will enable local food production on a global scale, reducing waste, limiting food miles and using practically no land or water."

Inner city indoor farms, such as London's Growing Underground, are exactly the sort of places that could benefit from the research. The conditions at Growing Underground, for example, are closely matched by those at the new research center.

The 234 sq m (2,519 sq ft) facility, which is said to be one of the world's biggest, is a clean and sterile environment and is totally closed to natural light and air. This means that the growing conditions are fully controllable.

Philips GreenPower LED lighting is used, which the firm says is highly energy efficient and produces less heat than other LED lighting, meaning it can be placed closer to plants for optimal positioning and uniform illumination. Crops are planted in four-layered mechanized racks and there are eight rooms with set climactic conditions.

Research is focused in particular on leafy vegetables, strawberries and herbs. **Light conditions for growing carbohydrate-rich crops like wheat and potatoes indoors are also being studied.**

**think
different.**



Superwheat: Kernza!

Less water, more carbon, less erosion (no tilling), 50% less nitrogen.

It didn't look like much: Just a little bag of brown grains. I whizzed them in the blender to make flour, then cooked up a batch of pancakes. They looked like pancakes. And tasted like them, too — though did I perhaps detect a hint of malt? I looked over at my 4-year-old, a precision instrument when it comes to observing (and rejecting) new flavors. But there she was, wolfing them down without complaint. Now my question was: Could this little seed help save the planet?

The grain was Kernza, a new breed of wheat. Unlike the usual varieties, it is perennial, which means it grows back in subsequent years rather than being sown each spring. That matters because over time, the plant develops a **deep, dense root system** that helps to build healthy soil and to keep carbon in the soil, a counter to climate change. No wonder perennial grains have long been the holy grail for a certain set of agroecologists (visionaries or eco-weenies, depending on your perspective). Now here was Kernza in my kitchen. And, it turns out, in other places, too.

Patagonia Provisions, a new division of the outdoor gear company, this week releases **the first commercial product made with Kernza, Long Root Ale**. The Perennial, a new restaurant in San Francisco, is serving it, along with its house-made Kernza bread and crackers and a deliciously toasty Kernza ice cream. In Minneapolis, close to a large Kernza test plot, chefs and food artisans are using Kernza in tortillas, muffins, pasta and more. **Minnesota-based General Mills is also evaluating the grain.**

One drawback to Kernza is the small size of its seeds, which are one-quarter the size of a conventional wheat berry. The Land Institute has been working to create Kernza plants that grow larger seeds. (Scott Seirer/The Land Institute)

The commercial availability of Kernza is something of a dream come true for the academics who have long evangelized perennial grains. Here in the United



Think different



Blockchain Could Transform The Agriculture Economy



“Souped up audit trail”, a “trust machine” ... be able to verify food from farm to fork.

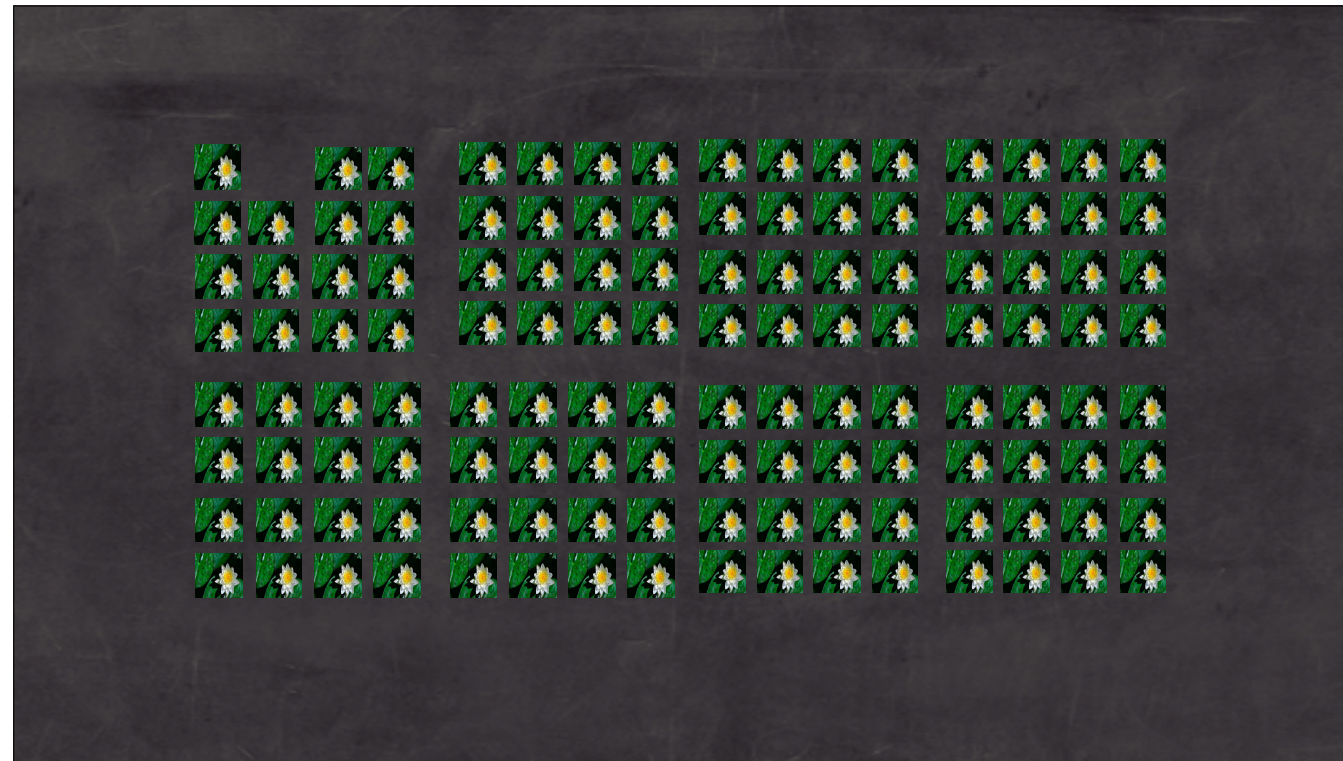


Question:



Why the future will arrive sooner than you expect.

Here is a simple analogy that explains why.



If a lilly pad doubled every day for a month, on Day 20 how much of the lake would be covered?



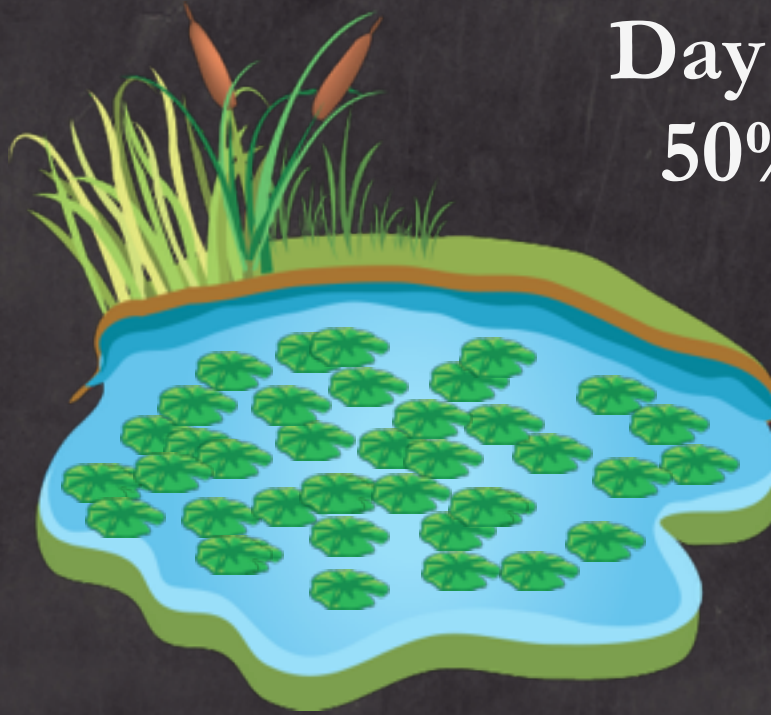
20 doublings only cover .1% ... but what happens over the next ten days is amazing:

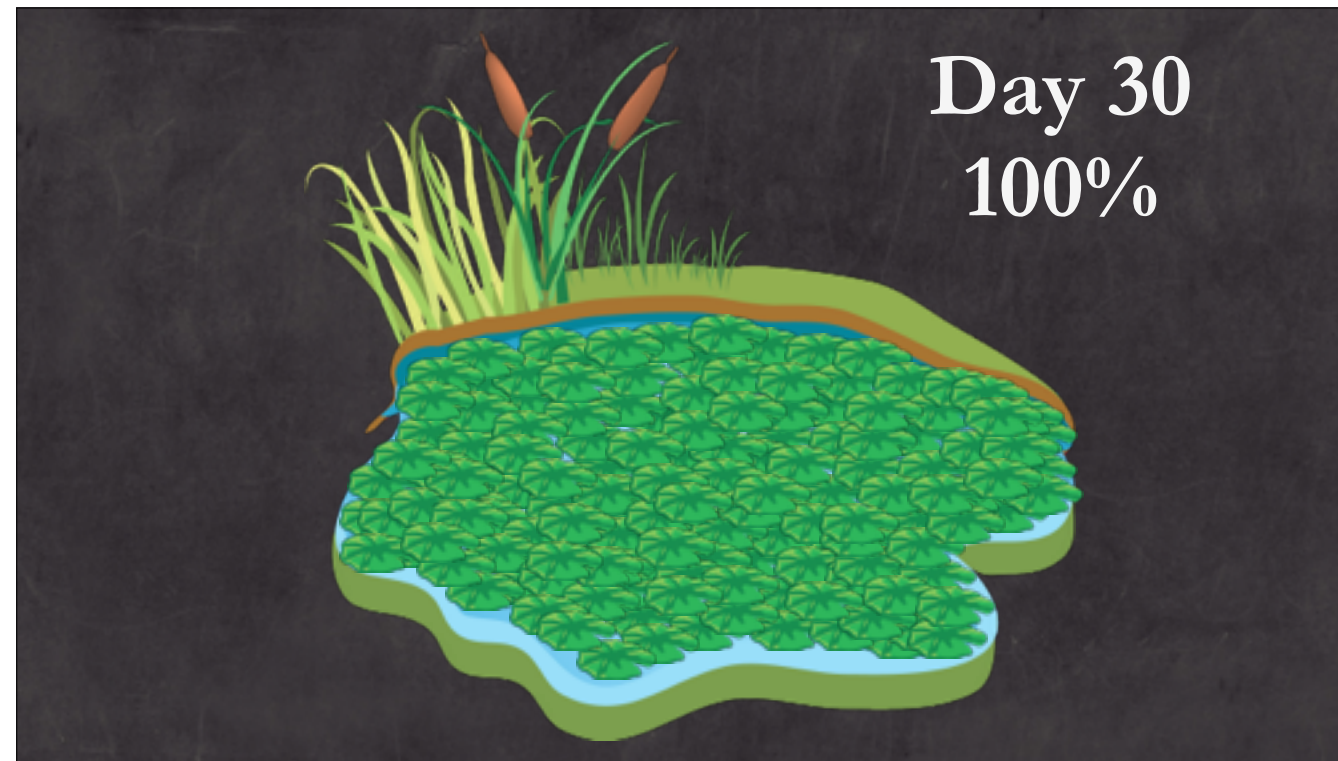
Day 20: 0.1
Day 21: 0.2
Day 22: 0.4
Day 23: 0.8
Day 24: 1.6%
Day 25: 3.2%
Day 26: 6.4%
Day 27: 12.8%
Day 28: 25%
Day 29: 50%
Day 30: 100%

Day 25
3.2%



Day 29
50%





The lesson is this: We are only at Day 20 ... the really big change is just ahead of us!



But SunTrust will future-proof itself. Here's the proof ...



But, remember, the future will be stranger than we can imagine ... so keep an open-mind and an active imagination.







... summer wheat field, feed all 10 billion people on planet.