DIGITAL'S NEXT STOP – FARMING

Digital technologies are beginning to transform farming, and hold the potential to resolve the growing food demand – by maximizing yield and minimizing resources and waste.

Just yesterday, within weeks of the start of the North American planting season, Indiana farmer Trent Boyd was installing field tiles. To those unfamiliar with farming, field tiles are a network of black pipes laid about 30 inches below the soil's surface, and, depending on the farmer's preference and the crop, about 40 feet apart. They run laterally until they meet a larger drainage pipe or ditch, similar to a household drain operating on a massive scale. Farmers like to joke that water never, ever runs uphill. The laying of field tiles is an example of the many important tasks a farmer must accomplish before the spring planting; from that point until harvest, the focus turns to coaxing maximum yield from the crops while optimizing the inputs.

Proper drainage and irrigation is one element of farming that can tip the scales between feast and famine. We humans should know – people have been farming for many thousands of years. And for the bulk of that period, calculating the right field grade and slope was an intricate and important part of the process. One of the proudest

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accomplishments for men of the 18th century enlightenment, like George Washington, was to become a land surveyor.

Until about a decade ago, it was not uncommon for farmers to prepare their fields like they did in Washington's day; spending hours per acre using surveying tools and making complex calculations in paper notebooks regarding the layout of the land. Yesterday, Mr. Boyd, a partner at Boyd Grain Farms in southwestern Indiana, hopped into his tractor, and using a digital GPS system that relayed information back to a base station, determined the grade and slope of every square inch of a 40-acre field and simultaneously, laid the field tile. What used to take weeks is now completed in a couple of hours.

Undoubtedly, the digitally powered human revolution sweeping the globe is on full display in the Silicon Valley. But there are other valleys – consisting of millions of acres of farmland – that have been quietly powering the human revolution just as profoundly as anything to come out of the Silicon version. Food is probably the most basic and essential necessity of life on this planet. Yet even today, a significant percentage of the world's population does not have enough food to eat. With the world's population projected to reach 9 billion by 2050, it's no wonder that the technological transformation currently affecting farming can have far more enduring effects than another social media app.

Farmers are using technology to grow more crops using less acreage, water, fertilizer, and fuel than at any time in history. They're empowered by advances in digital surveying systems like the one Mr. Boyd uses, and also by gigantic leaps in how seeds are developed to withstand unexpected changes in the climate. They're designing pest-resistant crops, which means farmers will no longer have to spray chemicals over large swathes of land and hope that the pesticide sticks to the plant and isn't part of the run-off into a local water supply instead.

Beyond Silicon Valley, other technology companies are also changing the world in ways that are just as powerful. Dozens of companies are developing products that improve crop and animal health, boost the nutritional value of farm products, and make farming more productive and efficient. These enterprises are dedicated to taking on global problems worth solving.

I come from a long line of farmers and still help my family manage land in southwest Indiana, some that we've harvested for generations. Although I've spent my career at technologically savvy digital corporations, I always look forward to each opportunity to return to my family's farm. In fact, the world of high-tech shares characteristics with today's farming: the basic mandates of a modern company include maximizing yield while minimizing waste and inefficiencies, reducing our carbon footprint, and designing and marketing products and services that help improve the human condition. In essence, accomplishing more with fewer resources for more consumers.

Along the way, the organizations I work with as clients of Infosys, want to leverage technology to give their customers or constituents more power and choice, as well as to give their employees more options when it comes to navigating the marketplace. Everything I've just described is equally true for the rapidly digitizing farm of today.

Seed research

My cousin, Mike Kavanaugh, is the Product and Agronomy Manager at a seed corn company called AgriGold Hybrids. With a Master's degree in soil and crop science from Purdue University, his specialty is to push the boundaries of agricultural science – and that means using technology to mitigate risk in the field. To a farmer, risk runs the gamut of things such as pests, disease, climate, crop characteristics, and probably the riskiest of all, time. These are elements of farming over which, until recently, a farmer had little control.

With the advent of biostatistical analysis, however, scientists can establish the characteristics of various strains of seeds in the laboratory long before they hit the soil. The result is that agricultural experts like my cousin can choose the finest seeds that eliminate guesswork and save precious time during the growing season. By the time those seeds are planted, farmers have a clear understanding about how they will perform

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under a wide array of conditions. Moreover, genetic improvements to seeds allow farmers to focus on high-yield crops that have the most nutritional benefits for the end consumer.

Maximizing crop yield

Seed research is only the beginning of how farmers are solving a worldwide problem. There is also a digitally enabled process known as 'variable rate seeding' that uses data such as soil analysis to know not only which types of crops will grow optimally in what part of a farm, but also how many seeds to plant per acre. In the recent past, farmers would have to wait until the harvest season to evaluate which crops grew better in certain sections of the field and institute their planting regimens for the next growing season. Now, time is on the farmer's side. They can use digital sensors and monitors to solve yield-limiting mysteries in the field while these are happening. Real-time analytics has saved millions of dollars' worth of crops.

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Near exactness with Global Positioning System (GPS) technology has improved accuracy of soil sampling. This in turn has enabled variable rate fertilizer applications to optimize the yield environment of specific fields, creating better fertilizer efficiency and timeliness. In 2015, AgriGold research in the US Corn Belt showed over 5 bushels per acre increase compared to field check strips, when digitally changing the population of seed on the go, within a field.

Minimizing resources and waste

The assets and inputs needed to make a farm as efficient as possible are expensive parts of the equation. Whether it's a tractor, bailing turbine, or other mechanized equipment that run on fossil fuels, or varieties of fertilizer that help crops get the most from a growing season, digital farmers are leveraging tools that help them use less and yet reap more. For instance, digital tools have created programs of multi-hybrid seeding where a farmer can plant one or more hybrids or varieties in one geographical area.

The point is that hybrids can thrive in more than one environment; so the farmer can use overly wet areas of the field and, on the other end of the scale, drought-prone areas of the same field to plant a combination of hybrids or varieties of the same crop. The hybrid that can thrive in a water-logged environment would shut down when its seeds got to the drought-prone area. But within feet, if not inches, the other hybrid would pick up and thrive in that area. Not to waste even an acre, the `in-between' areas are where both crops would conceivably thrive. Digital monitors relay data back to the farmer, who then knows when and where to plant seeds more likely to thrive in that soil. In 2015 AgriGold research in western Iowa showed a 7.8 bushel per acre advantage when changing hybrids on the go, while using a 24-rope hybrid planter.

The digital journey that has transformed the farming industry has many benefits. Farmers now have the capability to understand the climate before they even plant a crop. That's the future. My cousin likes to say that the world of digital farming is just now dipping its toe into the water. Of the many benefits and changes that digitization has brought to the practice of farming, arguably, the most significant one is that farming has become a forward-looking industry. Everything about farming used to depend on evaluating last year's crop, weather, and soil to make decisions as to how to prepare for the next growing season. That means that for tens of thousands of years, farmers relied upon past data with little visibility into the future. Now farmers can analyze a weather trend in real time or study the characteristics of a seed and its potential performance long before it is planted.

A verdant, bright future ahead

The possibilities for Planet Earth are tremendous. It starts with grassroots innovation in some of the remotest farms on earth – places that don't yet have access to a computer. But what they do have is ingenuity and innovative thinking. Take the story of Pandharinath More, a resident of Maharasthra, India, who demonstrates that grassroots innovation remains alive and well. Pandharinath is a 66-year-old farmer who anticipates the arrival of the Internet of Things. Every year, he makes the bulk of his income during the precious couple of months between November and January when he cultivates onions. It's the only time of the year this cash crop will grow; so a farmer like him wants to achieve the longest season possible

The problem Pandharinath faced was how best to plant seedlings at the beginning of each growing season. It's the most labor-intensive part of the two-month process. So he got to work creating an onion transplanter. It took him 43 days to invent and build a piece of farm machinery at a whopping total cost of US$725. This tractor-drawn implement can simultaneously perform three functions – transplanting onions, applying fertilizer, and making equally spaced irrigation channels. Pandharinath's invention has made being an onion farmer in India a far more lucrative pursuit than it was even a year earlier.

Another inspirational story of agricultural innovation comes from the Hussain brothers in the Darrang district of Assam, India. Mohammed and Mushtaq Hussain are rice farmers who became fed up with frequent power outages that interrupted their water pumps. Rice paddies fail pretty quickly without lots of irrigated water. Sure, you can turn to diesel pumps if the electricity is spotty in your area. But diesel fuel is expensive and a drain on resources. After watching a kite fly high into the sky from a gust of wind, the Hussains got the idea to assemble a windmill that could power their irrigation pump.

They searched for building materials that were abundant, cheap, and strong. Their prototype was a combination of bamboo, polypropylene, iron rods, and rubber from old

tires. The rotation of the windmill cranks the handle up and down, creating a continuous flow of water for their farm. They built their prototype in only four days, and the final product cost less than US$70 – 90 percent less than commercially available models! Better still is that they can dismantle the entire structure in under an hour and carry it to another field or even another farm if needed. This innovative story is well-known in the farming community because of the low-cost, high-value application of technology to improve the human condition.

The investment community has taken notice; venture capitalists are taking a strong interest in the ancient industry of farming. Monsanto made news when it bought weather big data company Climate Corporation in 2013 for US$1 billion, creating a large payout for its investors. Last year, a group known as the Farmers Business Network, received a US$15 million investment round led by Google Ventures. Their goal is for their team of rural data scientists from around the American Midwest to make agricultural data more accessible. The more farmers know about what crops are doing well and under what conditions, the more chances they have to improve yields.

Another venture capitalist firm, Kleiner, Perkins, Caufield and Byers, has funded a group that claims to have aggregated data on the performance of seven million acres of farmland across 17 American states. The database also includes information on more than 500 seed varieties and crops such as alfalfa, corn, wheat, and soybeans. None of this widespread sharing of highly detailed knowledge would be possible without big data and its underlying technologies.

Using real-time and predictive analytics, as well as big data pertaining to crops, seeds, weather, and soil, humans have the opportunity to improve productivity for land all over the world. From Indiana to India, think how much more productive these farmers will become as they become fully connected to the Internet of Things. The endgame is that as the population of the planet continues to increase, agriculture will keep pace, and no one will go hungry. That's a problem not only worth solving, but it's one that's being solved today by farmers around the world who are embracing new technologies that are revolutionizing their industry.

About the Author

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Jeff has more than 20 years of consulting experience and is currently focused on the high-tech and manufacturing sectors. His areas of specialization include consulting, engineering, technology, and intellectual property, and he has led several transformations in product innovation and life cycle management. In addition, he has anchored strategy and supply chain programs in high-technology, software, discrete manufacturing, and consumer goods. He is a Lean Six Sigma Master Black Belt and a Professional Engineer.

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