Growing Smarter
Connecting Ag with Tech

June 2016
Orange Silicon Valley
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In Silicon Valley, we make products by building a minimal viable product (mvp): the smallest feature set that is your best educated guess at what your customer needs. You then take your mvp to customers, iterate quickly, and iterate often. This is a great method for building many products — especially consumer digital products where you can make quantifiable changes in days and weeks and test against a lot of users.

In agriculture, this methodology simply doesn’t work. You get one growing season per year, on average, and your product can’t fail in the middle of it, or you are out.

Thus, there is a gap between the very identifiable problems of agriculture and the solutions currently available. This is more than a data gap: frankly, it is a methodology gap.

With over $6B invested in the last two and half years, Ag understands that the geeks are coming. And we sensed real excitement among the farmers and botanists we spoke with about getting smart people to work on these problems. Are the expectations aligned? Right now, based on how few actual tech people have been in touch with this customer, there’s a disconnect.

There are a lot of smart people working on a lot of solutions to these problems, but, for the most part, these are absent the discipline of design thinking and the customer centricity it brings. We need a new methodology to solve the most important task facing us all, feeding the planet in a sustainable way. And Digital technology can get us there.

Here in California, we produce 50% of food for the US, and we also generate 50% of venture capital activity for the nation. Here at Orange Silicon Valley, we are the local presence for a global provider of communications for over 230 million people on multiple continents, including one out of every five Africans. This hybrid perspective of engaging locally and working globally is humbling and highly motivating.

It’s appropriate then that the topic of how Tech can help ensure Food — more specifically Agriculture — should be on our agenda for 2016. Based on the influx of venture funding into the “AgTech” sector, it is on a growing number of creative and entrepreneurial agendas as well. Being a major operator in frontier markets like Western Africa, we are looking for opportunities to bridging AgTech into these markets. In exploring how we could make a positive contribution to a topic that is literally of universal interest, we came to a very basic decision.

In French, there is a word that is undefinable, people use it in wine country as is: terroir. We decided that we would walk the terroir, and talk with growers about their challenges. This is nothing more or less than applying the product management disciplines of Silicon Valley, with the core principle of user-centric design and understanding the customer journey first.

This report is the first fruit of those conversations, held in the terroir of places such as the Salinas Valley, Napa, and up and down to the Central Valley, with growers covering over 50,000 acres of arable land.

Much of that acreage is not connected — and if the data-driven genius of Silicon Valley is going to help raise productivity, and close the gaps in labor and time-to-table that are there, connectivity needs to improve. That of course, is our métier.

We look at these conversations with Farmers, Founders, and Funders as an ongoing journey to a healthier tomorrow. We are honored to be in that conversation, and look forward to engaging with all interested stakeholders who share that vision.

Georges Nahon, San Francisco, California
June 2016
The opportunity... is within our reach

Handheld tools and horses gave us the rise from hunter gatherer to farmer. Mechanization in the 1800s and early 1900s increased the production efficiency of our farms. The Green Revolution of the 60s and 70s massively increased crop yields.

With the drop in the cost of technology, the rise of mobile, cloud computing, and recent advances in robotics and artificial intelligence, are data and digitization the next revolution in agriculture?
We are bridging the gap between farmers and investors, helping them to fund the right startups, and help shape the right expectations in term of outcomes.

As active participants in tech, we can help farmers talk to Silicon Valley about solving our food issues, which is the best outcome for all.

“The amount of movement of talent towards our industry is amazing...we’re grateful.”

Michael Christensen
Director,
Americas Forecasting Driscoll Strawberry Association

We have focused on our home state of California, because 50% of the US food supply comes from here, the largest Ag state.

Our Sustainable Food Systems team talks to Farmer, Founder, and Funder, as well as academics, agronomists, distributors and trade groups.
Agriculture is a domain ripe for optimization...but decentralized, slow, and highly variable. “Ag” doesn’t ‘scale’ the way Tech likes. (See 01: A Day in the Life of a Navel Orange)

For generations, farmers have used direct observation as data...in a very lossy way.

...but this is changing as sensing in the ground—and from above—evolves thanks to new tech. (See 02: The Data Doesn’t Come Easy)

Smartphones & Tablets.

Inexpensive yet sophisticated sensors.

Cloud-computing & and big data science.

UAVs, satellite imaging, & GPS/GNSS guidance systems.

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While many sectors worry about tech unemployment, Ag is one area where automation of labor would be welcomed with open arms.

A tradition of tacit knowledge and a reliance on direct experience means skepticism in the field. (See 02: One Million Flowers).

1% of US acreage is organic, but it’s 5% of food sales, growing at 11% YoY. (USDA)

90% of world soy production is used to feed animals. (UN IPCC)

1,450 lb grass-fed cow takes 20 - 22 months. (TomKat)

38% of arable land is degraded by poor resource management. (Arabella)

30-40% of calories grown are wasted. (Refed)

7 years for new fruit varietal to make it to the supermarket. (SunWorld)

75% of the $140B spent on fertilizer does not reach target crops. (Agrilarity)

60% of cost for many types of food crops is labor. (Food Origins)

27% of foreign-born agricultural workforce is aged 45+. (PNAE)

The changing terrain for Ag... is opening new opportunities for tech.

“...I don’t like to deal with tech. I don’t know what questions to ask...”

Christine Gemperle
Gemperle Orchards

At TomKat Farm, the rotation of livestock across different grazing lots is charted on a whiteboard.
For Tech, bandwidth is abundant and assumed to be available; dashboards make sense in an always-connected world, but that’s not the farm.

For Ag, connectivity in the field is a daily challenge, making data collection and monitoring a daily challenge.

...The few technology companies that have approached him, in large part, don’t understand how things really work on the ground, in the field. None of them has spent time on farms.”

Aaron Lange, LangeTwins Winery

“The transformation of a trillion-dollar industry that feeds the world is not going to happen at the same pace that people learned to upload cat videos.”

Sumer Johal
Founder & CEO, Agralogics

Unexpected requirements: talk with (not at) the growers.

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(See 04: The $30K tower).
A day in the life... of a navel orange.

10 million cartons of Navel & Valencia oranges are produced by one company.

That’s how many oranges Sun Pacific ships annually. We followed thousands of them in just one day from grove to pallet at its 50,000 sq ft facility in the Central Valley of California.

In tracking the fruit from grove to pallet, we saw virtually no screens: no laptops, no iPads, no smartphones really. We saw one 90’s-looking industrial process controller console, for the control of the label-printer.
In the grove, each tree gives up a bounty of 1,000+ oranges, which are put in bins, measured, and loaded onto trucks with a paper manifest. Any fruit that hits the ground stays there.

A sampling of the fruit in each bin is taken by hand to estimate size, for grading purposes.

The truck is accompanied by a (paper) ticket showing location of grove, # of bins, and sizes of the fruit.
To increase consumer appeal, oranges are "degreened" by adding gas in temp-controlled chambers.

Fruit is put on conveyers and washed.

A process of sorting and grading, both mechanical and human, begins.

Roger, our guide from Sun Pacific explains they have tried automation in grading, but it isn't as accurate as humans.

Food safety means labeling every piece of fruit, for tracking purposes. This is done with high-speed printers and specialized machines that use codes developed by the Produce Marketing Association (PMA) in the US.

Special care is given to premium grade product, which is selected for overseas based on its appearance. On the day we were there, all of the “Premium” — the most perfect in appearance — was going to China, leaving only “Choice” for the US.

Pallets used to ship overseas return, but domestic ones are one-way, and untracked.
At Sun World’s Variety Development office we see just one computer, and a process that starts with a million hand-pollinated flowers, and takes 7 years to produce a new fruit varietal for your table.
Demand
Changes in consumer behavior means farmers are racing to meet new demands from the retail channel — but in Ag, change is measured in seasons and years, not financial quarters.

“Labor here is one of the biggest line item costs in the year. It’s getting harder to get it, and it’s getting more expensive.”
Christine Gemperle, Gemperle Orchards

Supply
Ag is not software. Scaling is still based on human labor and water, both of which are getting scarcer and more expensive.

“Irrigation systems are still shockingly sub-optimal and labor-intensive on large farms. Just having the switches at the end of the rows is a huge improvement.”
Danny Royer, VP of Technology, Bowles Farming

At LangeTwins Winery and other progressive wineries up and down the California terroir, the economics of viticulture encourage tech adoption. Long-term contracts may provide revenue visibility, but as minimum wage increases kick in, margins are squeezed and the search for automation becomes pressing.

“The youth is not following the family’s footsteps, the trainwreck is not right around the corner but it is coming...”
Tyler Scheid, Tech Coordinator, Scheid Vineyards
The data doesn’t come easy, the computation story

Six feet under the ground is a very long way if you’re trying to get data about your soil... hardware on the Farm is nothing new, and often disappointing. Before it can get Ag to the Cloud, Tech needs to get grounded.

The Dolcini’s are 5th generation farmers in Marin and Sonoma counties. The family acquired their 600 acre ranch back in 1852 as one of the original ranching families in the new state of California, where their great-grand parents emigrated from Switzerland. This is deep tacit knowledge, not uncommon among the farmers we have met.
The amount of work in the field should be recorded and digitized, but farmers don’t need algorithms to tell them how to farm.

“Farmers are operating everything through their iPads.”

Robert Tse  
CSO, USDA CA

Dave and Nate (at Silver Oak Vineyards) are getting maps of vigor from the sap flow sensor, and new shoot growth on the vines via another sensor. The ability to use a laser to measure shoot growth (in millimeters), produces maps of the field with a different view. It also replaces capturing these measurements by hand.

Data ownership is already a common issue in Ag, but as the level of data grows from more sensors and connected machinery, the business model of sharing evolves to more inclusion.

“We can say that the farmer owns the data, but the market is going to ask the farmer for that data to help it get more revenue, the farm workers will hopefully get it, and the consumers will demand it.”

Nathan Dorn  
CEO, Food Origins

Robots represent more than automation of work; they automate the collection, recording, and reporting of data about work.

In the dairy industry, automation of the milking function allows for highly accurate data to be recorded and matched with genetic information about each cow. This tracks historical data milk production for each individual cow and forecasts future production based on the cow’s genetic lineage.

“The Cloud and the Dashboard are useless without hard-working hardware.”

We can also think of TomKat’s Data Scientist as a systems modeler, with the plots being stocks, and the cattle feeding off them flows of energy.

“farmers were the first systems engineers.”

Sue Raftery,  
CEO, Agrown

Ag has been sold technology for a long time now. Farmers have been burned and let down in the past decade...there are a lot of bad hardware and data products out there.

“The joules required to move data from the ground to the cloud is atrocious.”

Manu Pillai, Waterbit
From their 246 acres, the Lange family grows over a dozen varieties of wine grapes, but they can't get signal. When we visited they had a quote on their desk to erect a cell tower on the property, at a cost of $30,000.

Communications is about connecting Workers to Management, and Soil to Cloud.
Demand
Big Data, Sensors, Handsets, thrive on signal. Network needed to complete the cycle.

Voice of the customer: Talking with Farmers

“The problem we have in produce is not knowing what we want.”
Robert Verloop, VP Marketing, Naturipe Farms

“If you talk to a farmer about AI they probably think you’re talking about artificial insemination.”
Overheard at a conference

“We always get two questions right away: where do I put this sensor in the field, and how do I connect the sensor to the network?”
Adam Wolf, Founder of Arable, the Nest of Farming

“We have cellphones and walkie talkies, but no coverage, and the walkie talkies in the past were better than they are today.”
Diane Wagner, Owner, DW & Associates

Supply
As the scope and variety of radio tech evolves, new models for connectivity welcome.

It seems clear that the Internet of Things is a connected model, but the things on the Farm don’t have much connectivity.

In five conferences convened in California on the topic of Agtech in Q1 2016 we heard from 215 speakers.
Only 1 of them came from a telecom company, and that was us, Orange Silicon Valley.

What farmers want automated*:

- Spatial analysis of farm for workforce management purposes.
- Precision irrigation for reporting pesticide applications.
- Remote sensing of yields.
- Automated harvesting
- Better on-farm radio communications
- Laser and RGB sorting
- Electric pruners
- Soil moisture sensors
- Remote frost thermometers
- Automated transplanters
- Water monitors
- Better and more abundant radio communications
- HR knowledge management software
- Continuous yield measurement

*Compiled from “Farmer’s Fireside Chat” panel at AgTech 2016, answering “what automation would you like to see?”

How NOT to talk to a Farmer:

“The idea is, if you’re the farmer, it shows exactly what you should do.”
Marketing exec selling IoT solutions

“Don’t tell me you know how to farm better than me...don’t tell me what you have, ask me what I have.”
Kristy Lyn Levings, Program Director, AgStart

“Farmers are a tough sell, we let our neighbor figure things out and if it works for him, we’ll try it...also, we’re cheap.”
Jonathan Hoff, CEO, Monte Vista Farming

“If you can make it simple, like pushing a button on a phone to take a picture, that will work for us.”
Diane Wagner, Owner, DW Associates

“Silicon Valley people forget that they’re dealing with biology. It’s like the butterfly effect: small changes can have drastic effects. Things change and it’s very unpredictable.”
Christine Gemperale, Gemperale Orchards

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Iron Ox: Meet Brandon Alexander and Jon Binney. After building robots at Google and Willow Garage, they wanted to build robots for agriculture, so they spent six months visiting California farms, getting ideas, iterating them, and refining. As Brandon explains it: “Getting a robot to work outdoors reliably is hard. We invalidated many of our original product ideas.” In the end, they honed in on building automation for indoor, controlled ag.

AgriData: Prasad Nair has designed robots and solar panels, his co-founder Cyrille Habis, is a certified pilot and Amazon software engineer. With these backgrounds, it seemed natural to start a company to do drones for agriculture. But after spending time talking to growers, they identified the problem of automating yield forecasting. They are now building a computer visioning system that can do more precise yield forecasts, and are working closely with a couple of key growers to refine their technology as the growing season progresses.

PastureMap: Before building a product, founder Christine Su spent months talking to cattle ranchers, going to their conferences, finding the ranchers that were key influencers and early adopters, and getting them on her advisory board. Once she knew them and their problems, she built a tool that enabled them to take photos and tag their blocks with notes. It has evolved into PastureMap: a tool for managing cattle grasslands.

Acknowledgements

This report is based on in the field research with farmers around California who are working hard to grow our food. It has been an absolute pleasure to be allowed on to their farms, to hear their stories, to see first hand how they care for their land and grow our food. We are tremendously thankful to the following people who shared their work with us:

Jim Ahlem, Hilmar Cheese Company, Ahlem Dairy
Terry Bacon, Sun World
Kitty Dolcini, Kitty’s Chicken City, Dolcini Red Hill Ranch
Joe Felipe, Entre Nous Wines
Roger Hill, Sun Pacific
Aaron Lange, LangeTwins Family Winery and Vineyards
Erin Miller, Winemaker, Twomey Cellars
Christine Gemperle, Gemperle Orchards
David Marguleas, Sun World
David Schien, Silver Oak Vineyards
Kevin Watts, Livestock Manager, TomKat Cattle Ranch
Aaron Wickstrom, Valsigna Farms and Dairy

A special thanks to the following people who helped make these visits possible, and spent countless hours sharing their first hand knowledge and reviewing our work along the way:

Seana Day Hull
Nathan Dorn
Brian Frank
Peter Herz
Stephen Hohenrieder
Henry Johnson
Renske Lynde
Rob Trice
Olivia Wenger
Sarah Williams
The Team at Comet Labs
The Team at Dairy Management, Inc.

The Team at Orange Silicon Valley:

Micki Seibel, Lead Researcher
Mark Plakias, VP Knowledge Transfer
Carolyn Ma, Designer
Dellaena Maliszewski, Marketing
David Martin, Senior Technology Analyst
Hugo Wagner, Senior Technology Analyst

*All photos by Micki Seibel and Mark Plakias.
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