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Entrepreneurs and Start-ups in the Agricultural Industry

Marta Grant

Iowa State University, mmgrant@iastate.edu

Wendong Zhang

Iowa State University, wdzhang@iastate.edu

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Disciplines

Agricultural and Resource Economics | Agriculture | Entrepreneurial and Small Business Operations | Technology and Innovation

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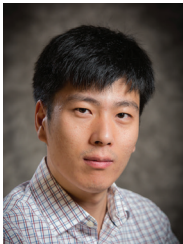
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Entrepreneurs and Start-ups in the Agricultural Industry



By Marta Grant and Wendong Zhang

Marta Grant is an Undergraduate Research Assistant in the Department of Economics at Iowa State University. Wendong Zhang is an Assistant Professor in the Department of Economics at Iowa State University.



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Abstract

Analyzing 24 recent agricultural start-up companies and 23 agricultural applications, this article provides an overview of entrepreneurs and start-ups in the agricultural industry, with a focus on crop production and farm management. Agricultural entrepreneurship is gaining traction and getting more support from universities and industries. While most recent agricultural start-ups focus on producers, opportunities exist to better serve investors and agricultural professionals. Better data management to assist agricultural production and management decisions would be a potential source of new ideas. Despite the challenges, the rural property professionals should be more aware of newer data, tools, and technologies brought by these innovative firms. Additionally, automation, artificial intelligence, and sensors will present significant opportunities for new start-ups.

INTRODUCTION AND METHODOLOGY

Since the late 2000s, there has been a boom in the number of agricultural start-ups and entrepreneurship careers. Hundreds of new services are available for producers and agricultural professionals to take advantage of, but learning about all of these new companies can be confusing. The goal of this article is to identify some of the newer agricultural technologies and services available by focusing on new start-ups relevant to crop farmers, landowners, investors, and agricultural professionals. Big data, drones, sensors, and satellite imagery have changed how crop farmers produce and market their grain and it is important to analyze the various types of services and customers that these technologies affect.

Several articles about new agricultural technologies within the agricultural media exist; however, few analyze the entrepreneurship side of the technologies. For example, Successful Farming wrote several articles about new agricultural companies and compiled a “top 10” list of apps for agriculture (Walter, 2016). CropLife and The Verge note that new technologies are available to agriculturalists and that ag start-ups can be found anywhere in the United States, from California’s Silicon Valley to small Midwest towns (Hopkins, 2017; Potter, 2016). Kevin Kimle of Iowa State University has written articles about agricultural technologies and entrepreneurship and provided congressional testimony on the subject (Kimle, 2018). Recently, researchers and professionals are increasingly cognizant of the implications of big data and artificial intelligence for rural property professionals (Linne, 2017, 2018; Griffin et al., 2016).

The purpose of our article is to analyze agricultural start-ups and entrepreneurship and offer a summary of new technologies and services available for farmers, landowners, and agricultural professionals. In this article, we identify start-ups as businesses less than 10 years old that develop their own technologies/apps. In particular, we analyze types of targeted customers, services offered, prices, years founded, and types of mobile apps being created. We include three interviews with separate entrepreneurs about their lifestyle, accomplishments, companies, and perspectives on agricultural entrepreneurship. We analyze 24 companies and 23 mobile apps from “top 10” lists from leading agricultural media previously mentioned. This is not an all-inclusive list of agricultural start-ups, and we omit start-up companies designed for livestock producers and investors and those that focus on the food industry as opposed to agricultural production and farm management.

Agricultural start-ups focus on several types of customers, but most recent start-ups focus on helping producers improve efficiency and management. Of the apps we analyzed, the majority analyze soil, crop, and nutrient data. Many of these apps and companies don’t create new information. Instead, they rely on public information from United States Department of Agriculture (USDA) or National Oceanic and Atmospheric Administration (NOAA), as well as private data submitted by users, to provide new platforms to better visualize, understand, and incorporate data into production and business decisions.

There are four main takeaways from our article. First, entrepreneurship is a career that is gaining interest, especially with Kickstarter campaigns and grants available. Second, most current start-ups focus on producers, thus there are not many services available for brokers, investors, businesses, or retailers. Third, better data management is an easy way to improve any operation. Businesses can become more efficient through better management of inputs, fertilizer applications, equipment, marketing, and analysis of data from nutrient samples, equipment logs, and land sales. Fourth, the experts and entrepreneurs interviewed in this article agree that automation, artificial intelligence, and sensors will present significant opportunities for new start-ups.

Results: Trends in and Determinants of Ag Start-ups and Entrepreneurs

This section provides a general overview, trend statistics, and determinants of agricultural start-ups and entrepreneurs.

WHO ARE THE ENTREPRENEURS?

Occupation: Entrepreneurs work at their business all of the time. Hard work and long hours are a consistent theme among all entrepreneurs, as they are responsible for all aspects of their company. However, all entrepreneurs have passion for what they do.

Funding Source: Most new businesses, (within the last 10 years) were funded through a Kickstarter campaign and still receive funding from investors. Kickstarter campaigns offer financial support to fund new businesses or projects, and many universities have Kickstarter campaigns to help students start their own businesses. There are several privately funded Kickstarter campaigns, such as Ag Start-up Engine and AgriTech Accelerator in Iowa. After 10 years, most businesses are financially independent with stockholders or holding companies.

WHEN WERE THE START-UPS FOUNDED?

It is crucial to examine when the start-ups were founded, as an increase in new business ideas can signal a stable and growing economy. Figure 1 shows the number of start-ups in our analysis based on how many were founded that year. Before the 2007–2008 financial crisis, only a few companies explored the possibility of virtual reality and satellite imagery in their agronomic decisions. This was most likely because of a lack of funding and the recession. A significant uptick occurred in the early 2010s when the big data movement created a need for new technologies. For example, drones generate constant data and create a significant need for better data management. Several new businesses filled this niche with products to better manage, organize, understand, and utilize data and new platforms, such as cloud storage, to improve production efficiency or profitability.

PURPOSE OF THE WEBSITES AND APPS

We aggregate website and app services into several categories based on their purpose, which we determine from the main goals and services offered by the company or app. Figures 4 and 5 divide the start-ups and apps into several categories including yield estimation, land valuation, yield data management, crop/soil health, farm data management, commodities/markets, advising, ag news, and machinery sales.

Most services offered by ag businesses focus on farm data management, field data management, and land valuation; and, most are used to compile data and analyze production efficiencies, productivity, and profit management. This is in stark contrast to mobile agriculture apps, the majority of which focus on monitoring crop and soil health and soil levels and nutrient management. Most apps focus on crop and soil health because users have mobile devices with them in the fields and are able to track data and information on site. Most users do not analyze financial profits while crop scouting and would not be using Granular or other accounting programs on their mobile devices. Apps are developed to assist producers with day-to-day activities on the farm, putting professional consultation, market analysis, and nutrient information at their fingertips. Apps make information easily accessible and useful during real-time farming.

In the following section, we discuss services companies offer that best correlate to the purposes listed above — yield estimation, land valuation, yield data management, crop/soil health, farm data management, commodities/markets, advising, ag news, and machinery sales. Although this list is not exhaustive, it features several companies that are changing the way people do business in agriculture and improving productivity, efficiency, and sustainability. Apps provide previously unavailable accessibility to rural agriculturalists that allows them to improve their businesses.

Yield Estimator: Descartes Labs, available through both mobile app and website, is a very accurate source using satellite imagery for predicting crop yields. Descartes Labs releases new yield predictions every two days based on satellite images of crops and weather predictions. Descartes Labs evaluates the health of crops based on satellite images and imputes the predicted yield of the crop at the national, state, and county levels (Brokaw, 2016).

Land Value: FarmlandFinder, a land valuation and sale company, collects all land value and investment information in one place. FarmlandFinder has farmland sale information, soil survey data, crop history, and many other services available for people looking to invest in land. Users can also list farmland for sale and contact real estate professionals through the website. Users with free accounts can view land for sale and various associated data; and, paid subscribers can view past land sales, see auction reports, and access sales databases.

AcreValue is a nationwide website that features predicted parcel-level land value, field characteristics, and water rights. With a free account, users can view information about a land parcel including the name of the landowner.

Accuacre is similar to FarmlandFinder, allowing users to view the number of acres and estimated price per acre, but is currently only available in Indiana. Accuacre was developed by Peak Soil Index and gives users prices based on the whole state, district, county, or specific parcel of land, along with crop yield, soil type, and soil quality.

Field Data Management: OnFarm Systems combines data from several sources and equipment into an easy-to-use application. OnFarm Systems collects soil moisture and weather data and organizes it according to agronomics, weather, and mapping so that it can be used productively.

Monitor Crop/Soil Health: Encirca, developed by DuPont Pioneer, helps growers with managing soils, weather data, and crop scouting. Climate Fieldview, developed by Climate Corporation, monitors productivity, performs analysis, organizes data from various platforms,

and offers unique features to track weather patterns and monitor rainfall in individual fields.

Farm Data Management: Farm data management applications analyze finances, inputs, agronomics, and combinations of such. Granular is a business software that helps improve profitability and efficiency, tracks inputs and inventory, forecasts and analyzes profits, measures yield variability, offers crop and field planning, integrates data from other sources, and offers succession planning assistance for any operation.

MMP360, developed by EFC Systems, is a unique program for livestock producers, which is used in Iowa to help with manure application rates and completing Department of Natural Resources required paperwork. MMP360 maps manure application, calculates the phosphorus index for individual fields, and compiles data into documents that can be referenced for an audit or MMP records.

Commodity Trader/Market Information: Several companies offer mobile apps for trading commodities from anywhere. Mercaris offers information about organic and non-GMO commodities. Users can analyze price differences between food and feed-grade products, organic and conventional prices, regional basis prices, and cash and forward market prices and can buy and sell contracts directly through Mercaris.

Advising: Agrisync connects farmers and advisors anytime and anywhere. Farmers are able to connect with mechanics, brokers, financial advisors, and agronomists through face-to-face video, which helps efficiency and productivity when solving day-to-day problems and answering questions.

Ag News: AgWeb, Ag Mobile, and Farm Futures offer mobile apps so users can keep up on agricultural news, which is crucial for people on the go who no longer get their news from print sources such as magazines and newspapers. These apps offer market updates, weather forecasts, trading, and economic news, as well as radio shows and podcasts.

Machinery Sales: Tractor House advertises new and used farm equipment for sale. Tractor House uses an app and a website to market equipment and parts and also lists elevators, coops, dealers, and auctions. There is also a want-to-buy section where people can search for the equipment they are looking to buy.

INTENDED CLIENTS AND KEY SERVICES

Understanding the intended clients of businesses helps determine target audiences and the services entrepreneurs should provide. In this article, we divided intended clients into five categories: producers, businesses, retailers, investors, and brokers.

Figure 2 shows that over half of ag start-ups we analyzed were created with producers as their intended user, and Figure 3 shows that a majority of the apps analyzed in this paper were also geared toward producers.

We analyze intended clients for each business and the key services offered by businesses to each type of customer. Key services offered to producers include yield and weather predictions, land valuation, monitoring chemical applications, tracking operations and financials, field mapping, variable rate seeding, soil analysis, crop health imagery, and data management. Key services available for retailers, specifically seed or feed dealers and agricultural sales personnel, include tracking inventory, measuring field data, and overall data management. Key services for brokers include analyzing commodity market data and trading agricultural commodities. Key services for investors include yield estimation, land valuation, management scenarios, commodity market analysis, and agricultural consulting, as well as organic and niche markets. Key services for businesses include market updates, ag news, machinery sales, yield estimation, and analyzing global agricultural data. Few apps are available for businesses, retailers, brokers, and investors, but most offer news, market information, and data management.

Start-ups and apps can be useful to multiple firms and are therefore included in each category; thus, the data in each graph does not add up to the 24 start-ups and 23 apps we cover in our article.

PLATFORMS

All start-ups we evaluate in this article have a website but not all have an app. All apps we researched support iOS and Android systems, which is essential as it ensures broad and fair access by users. Most apps offer new sources or data-recording features such as market updates, weather forecasts, soil sampling, field maps, weed and disease identifications, yield calculators, inventory changes, photos of crops/weeds/diseases, and chemical mixing. Companies that don't have mobile apps offer their services through a variety of platforms, thus they are able to reach more customers and expand their business opportunities.

FEES AND COSTS

All mobile apps we examined have free services, such as previews of their software and programs, but most offer more in-depth services or full access for a fee.

Pricing for the products we investigated fall into three categories: program purchase, subscription, and per acre. Program purchase includes software and technology for a fixed price schedule. Subscription includes free products that can be upgraded for a fee to gain more access and services. Per acre pricing includes products with a cost based on the number of acres analyzed or serviced. One company, SoilWeb, is a free online service created by the UC Davis California Soil Resource Lab.

Figure 6 shows the annual cost to upgrade to the first level of paid access ranges from approximately \$100 to \$1,000 for each company that offers subscription pricing. This range covers the first upgrade available, not necessarily the most expensive. If yearlong plans are not available, we multiplied monthly cost by 12 to determine yearly costs. This is computed on a monthly billed basis.

SPATIAL COVERAGE

Most companies we analyzed offer services for the continental United States or focus on the Midwest only. Coverage is often dependent on company age — more established start-ups from the early 2010s often have greater coverage than recently established companies.

DATA SOURCES

Many companies use data from USDA and other public databases to show information in easily understandable and interactive platforms. USDA soil maps and NOAA satellite imagery are free sources of information that anyone can access, but companies can create platforms that put public and private data in one place to be analyzed. Very few companies have created new technology to track data — many used free public data that already existed and private data submitted by producers/businesses/investors.

IN-DEPTH INTERVIEWS WITH EXPERTS

Researcher/Entrepreneur: Kevin Kimle, Rastetter Chair of Agricultural Entrepreneurship and Director

of the Agricultural Entrepreneurship Initiative at Iowa State University

This interview was conducted May 4, 2018, to gauge Kevin Kimle's perspectives on the future of agricultural technology, entrepreneurship, and the role of Kickstarter programs. Kimle founded and co-founded several businesses and created the Agricultural Entrepreneurship Initiative at ISU. Students involved in the Agricultural Entrepreneurship Initiative and its classes turn out more than 100 start-up business plans each year, many in the agricultural technology space. Businesses incubated with his direct involvement include ScoutPro, AccuGrain, Agriculture Concepts, SmartAg, Performance Livestock Analytics, Cross-Wen Technologies, and Terva (Ag Start-Up Engine 2018).

When looking at a potential business plan, Kimle always assesses the entrepreneur's skill set. Kimle never knows whether an idea will be viable or successful, but the mindset and skills of the entrepreneur are very important when managing a new company. The skill set of a successful entrepreneur includes adaptability in challenging situations, effective team building, effective persuasion, and a willingness to explore new ideas. Kimle suggests that entrepreneurs also have empathy skills — entrepreneurs should be able to hear other people's perspectives and "see what they are thinking," then turn those ideas into a product or business and persuade others to buy in. They also need to question themselves and evaluate whether a market exists for their product.

It usually takes five years for a business to be "on its feet" and 10 years to profit. Kimle shared a graph (see Figure 7) that describes how he looks at a potential product in the market, which illustrates that a new idea could be very beneficial as well as risky, but older technologies and ideas may not be profitable. When a new product is created, it can be placed in any quadrant on the graph. The bottom left quadrant includes ideas that already have markets and products. The upper right quadrant includes new ideas for which there is not a market for the product. The upper left and bottom right quadrants are combinations of either an existing market and new technology or a new market and existing technology. Products further into the upper right quadrant have more risk, but also possibly greater reward.

Kimle has noticed a trend that people completely outside of agriculture are taking interest in agricultural companies. These people are able to look at agricultural problems and create unique solutions because they have little-to-no experience in agriculture.

Iowa lacks investment companies that support start-ups. There are few accelerators or incubators in agriculture because most investment money is located in Silicon Valley or New York City. The Midwest is underdeveloped for high risk and high reward investment companies; thus, these companies are more likely to form elsewhere. However, places such as Kansas City, Chicago, the Twin Cities, and Des Moines are attractive places to live and are becoming great environments for new business start-ups.

Kimle says he sees the future of agricultural technology heading toward more automation technologies. For example, artificial intelligence technologies and data sensors can be used to track all sorts of measurements and make agricultural businesses more efficient.

Start-up Entrepreneur: Steven Brockshus, founder and CEO of Terva LLC, a technology company founded in 2016 that develops products and services to make farmland information accessible. The flagship product is FarmlandFinder.

This interview with Steven Brockshus was held May 14, 2018, mainly to discuss his experience transitioning from an undergraduate student to business owner of Terva. As the founder and CEO, Brockshus leads the Terva team — setting the vision, building the brand, and growing relations with customers and stakeholders.

The path leading up to this was not an easy one and involved lots of thoughts and research. While attending Iowa State University, Brockshus took two years off school and traveled as a National FFA Officer, during which time he met several entrepreneurs. He admired their lifestyle, perspective of the world, and their passion for their job. This led him to add a minor in entrepreneurship and join the Agriculture Entrepreneurship Initiative when he returned to Iowa State. Additionally, he participated in Cy Starters at Iowa State and Venture School with the University of Iowa. These programs helped him fine-tune his entrepreneurial skills; and, eventually, Terva was incubated in the Iowa State Agricultural Entrepreneurship Initiative.

The idea for Terva came from several small things. Several years ago, Brockshus went with his father to a land auction in northwest Iowa and started asking questions about the quality of the land, who had owned it, and what previous crops had been grown there. His dad suggested he talk to the broker, which led Steven to the realization that “most of the people in the room knew nothing about the land they were

about to spend \$1.5 million on.” He decided to talk to brokers, bankers, and farmers about land auctions and what information was available to them, which is when he realized there was a need for a system to accumulate data about farmland. There were a few early adopters of his idea, and one brokerage firm sent him a check before his program was even developed. Terva combines data from several sources and makes it easily accessible.

FarmlandFinder is supported by the Ag Start-up Engine in Ames, Iowa. Most of FarmlandFinder’s customers are land investors, appraisers, and people looking for information on land value. Farmers are not a large percentage of the client base but are utilizing FarmlandFinder’s information through their bankers and brokers. The main marketing strategy of FarmlandFinder is to provide valuable information to professionals, who in the long run assist farmers. They are analyzing how the residential and real estate online platforms have developed and are “putting an ag industry twist on it.”

Brockshus believes that entrepreneurship is growing in central Iowa through educational and financial support — programs are being created to support business start-ups and several universities offer entrepreneurship studies in their curriculum. He says the entrepreneurship lifestyle is not for everyone because of the responsibility of running your own business. However, the perks of being an entrepreneur involve designing your own job, work hours, and travel plans.

Brockshus believes that agricultural automation, blockchain, artificial intelligence, and satellite imagery have potential for opportunity. Currently, there is a lot of interest in artificial intelligence and machine learning within agriculture, as well as blockchain, which would offer complete traceability of a product from the farm to the public. Additionally, Steven believes that any sector that has a lack of data would be a good place to look for a new business.

Established Entrepreneur/Investor: Steve Bruere, President of People’s Company, which is the host of the famous Land Investment Expo and also one of the six investors of the newly founded Iowa AgriTech Accelerator

This interview was conducted June 12, 2018, and details how Steve Bruere started his company, expanded his business, and became an investor. In addition, it covers how People’s Company incorporates new technologies into its business.

Growing up, Bruere always knew that he wanted to be an entrepreneur; he simply needed to find a way to combine his passions for real estate and agriculture. Immediately after graduating from the University of Northern Iowa, opportunity came knocking. At age 22, he took over a small agricultural real estate company. Fifteen years ago, People's Company was an office with one computer and four pieces of land for sale, now it offers agricultural land brokerage, land appraisal, management, and investment services in 20 states. Bruere credits his supportive family and young start for the success of the business. Because he was young when he took over the company, he was willing to take on challenges and put in the extra hours to make the company successful. After 15 years, the company is still expanding, and each day there are new challenges to be faced.

People's Company utilized new technology to expand. Fifteen years ago, they did not have a website, but now they use drones and software to better manage land and assist customers. People's Company developed its own farm management software to help farmers and landowners be more efficient. They also use AgSolver technology to create profitability maps, FarmlandFinder to find land for sale, and AcreValue to determine the fair value of land. These new technologies have significantly helped the company expand its footprint to other states and other types of farmland.

People's Company also presents the annual Land Investment Expo in Des Moines. In 2008, the conference began as a group of 300 people interested in discussing the future of agricultural real estate and has grown into an annual event that attracts landowners, farmers, policy makers, economists, political leaders, and land investors. Each year they host several keynote speakers to discuss land investment strategies and the farm economy. Attendance has grown to over 700 people annually. Their goal is to help people build connections and learn from investors and professionals from around the world. This event has attracted speakers such as then-businessman Donald Trump and helped Bruere to build a national reputation in the real estate industry.

People's Company is one of the six companies that co-founded the Iowa AgriTech Accelerator in 2016 with the Greater Des Moines Partnership and the Cultivation Corridor. The five other companies include Farmers Mutual Hail Insurance Company, Grinell Mutual, John Deere, Kent Corporation, Dupont Pioneer, and Sukup Manufacturing Co. AgriTech Accelerator is designed to build upon one of the region's key industries — agriculture — and Greater Des Moines' success in advancing start-ups and technology through its many resources available to entrepreneurs. It is part of the Global Accel-

erator Network, an ecosystem of accelerators whose mission is to work with start-ups toward scalable and sustainable growth. So far, this accelerator has founded five companies, namely Farrpro, Rabbit Tractors, HINTECH AG, WISRAN, and Phenomics Labs.

Bruere believes that interest in entrepreneurship is continuing to grow, and he is constantly learning of new business ideas being developed. Bruere reinforced the idea that owning a business is a lot of responsibility and there is hard work and long hours involved, but if you are pursuing a passion it will be fun. He also mentioned that it is important for entrepreneurs to have a long-term vision and embrace challenges and changes in business plans.

Concluding Thoughts and Practical Implications

By analyzing two dozen firms' services and entrepreneurial characteristics, we document general trends in agricultural start-ups and entrepreneurship and find a growing number of agricultural companies recently established to improve or revolutionize many sub-sectors within agricultural industries, including yield estimation, land valuation, crop and soil health, management and trading information services. We find that many successful start-ups leverage big data readily available in agriculture and employ newer technologies such as artificial intelligence in analyzing satellite images, collecting and synthesizing public and private datasets in one platform, conducting on-site monitoring and assessment of crop and soil information, and/or providing higher-resolution estimates using techniques such as predictive analytics (Linne, 2018, Griffins et al., 2016). Finally, the experts interviewed agree that automation, artificial intelligence, and sensors could present opportunities for future agricultural start-ups.

Agricultural start-ups have increasingly important practical implications for rural property professionals, presenting both opportunities and challenges. We argue that farm managers, rural appraisers, and agricultural consultants should be more aware of relevant technological developments, even though initial services provided by start-up companies may seem piecemeal and inaccurate. With the aid of big data and artificial intelligence, these new start-ups pose challenges or provide alternatives to some of the services regularly provided by rural property professionals. For example, information about general market trends, physical or agronomical characteristics of the property, and sometimes alternative estimates of crop yields or land values are more readily available for producers. This sometimes presents questions regarding the necessity and value of hiring rural property professionals, and could be

subject to misinterpretation and misuse. However, the plethora of new data such as timely and more accurate satellite images have and will continue to enable a more complete understanding of the property and its market and thus aid rural property professionals (Linne, 2017). New data, tools, and technology are increasingly available for agricultural professionals, and the industry should be more aware of, strategically respond to, and take advantage of these newer technologies amid the profusion of data. For example, soil and nutrient sensors could provide more up-to-date measures of true productivity, and newer analytical techniques such as regression analysis and matching could help appraisers better identify suitable comparable sales and value agricultural real estate. In sum, our paper presents a snapshot analysis of the changing face of the agricultural entrepreneurship landscape.

REFERENCES

Ag Start-Up Engine LLC. 2018. "Current Portfolio." <http://www.agstart-upengine.com/current-portfolio>.

Agricharts. 2018. "AgMobile Features." <http://www.agricharts.com/app/>.

Brokaw, Alex. 2016. "This Start-up Uses Machine Learning and Satellite Imagery to Predict Crop Yields." *The Verge*. <http://www.theverge.com/2016/8/4/12369494/descartes-artificial-intelligence-crop-predictions-usda>.

Griffin, Terry W., Tyler B. Mark, Shannon Ferrell, Todd Janzen, Gregory Ibendahl, Jeff D. Bennett, Jacob L. Maurer, and Aleksan Shanoyan. 2016. "Big Data Considerations for Rural Property Professionals." *Journal of ASFMRA* 167-180.

Hopkins, Matt. 2017. "17 Agriculture Apps That Will Help You Farm Smarter In 2017." *CropLife*. <http://www.croplife.com/editorial/17-agriculture-apps-that-will-help-you-farm-smarter-in-2017/>.

Kimle, Kevin. 2018. "Building an Ecosystem for Agtech Start-ups: Submitted Testimony U.S. House of Representatives Small Business Subcommittee on Agriculture, Energy, and Trade." https://smallbusiness.house.gov/uploadedfiles/2-15-18_kimle_testimony.pdf.

Linne, Mark R. 2018. "Artificial Intelligence and the Future of Appraisals: A Tale of Two Teslas." Presentation at the 2018 ASFMRA Annual Conference.

Linne, Mark R. 2018. "Valuation 2: How to Navigate the Brave New World of Appraisals." <https://www.valuescape.com/articles/Valuation2.pdf>.

Potter, Ben. 2016. "Farmers Reveal Top Ag Apps." *AgWeb*. <http://www.agweb.com/article/farmers-reveal-top-ag-apps-ben-potter/>.

Texas A&M AgriLife Extension et al. 2018, "Apps for Agriculture." <http://aged.illinois.edu/files/documents/Apps--for--Ag--Revised--AgEd.pdf>.

Walter, John. 2016. "Top 10 Ag Apps to Try." *Successful Farming*. <http://www.agriculture.com/technology/crop-management/top-10-ag-apps-to-try>.

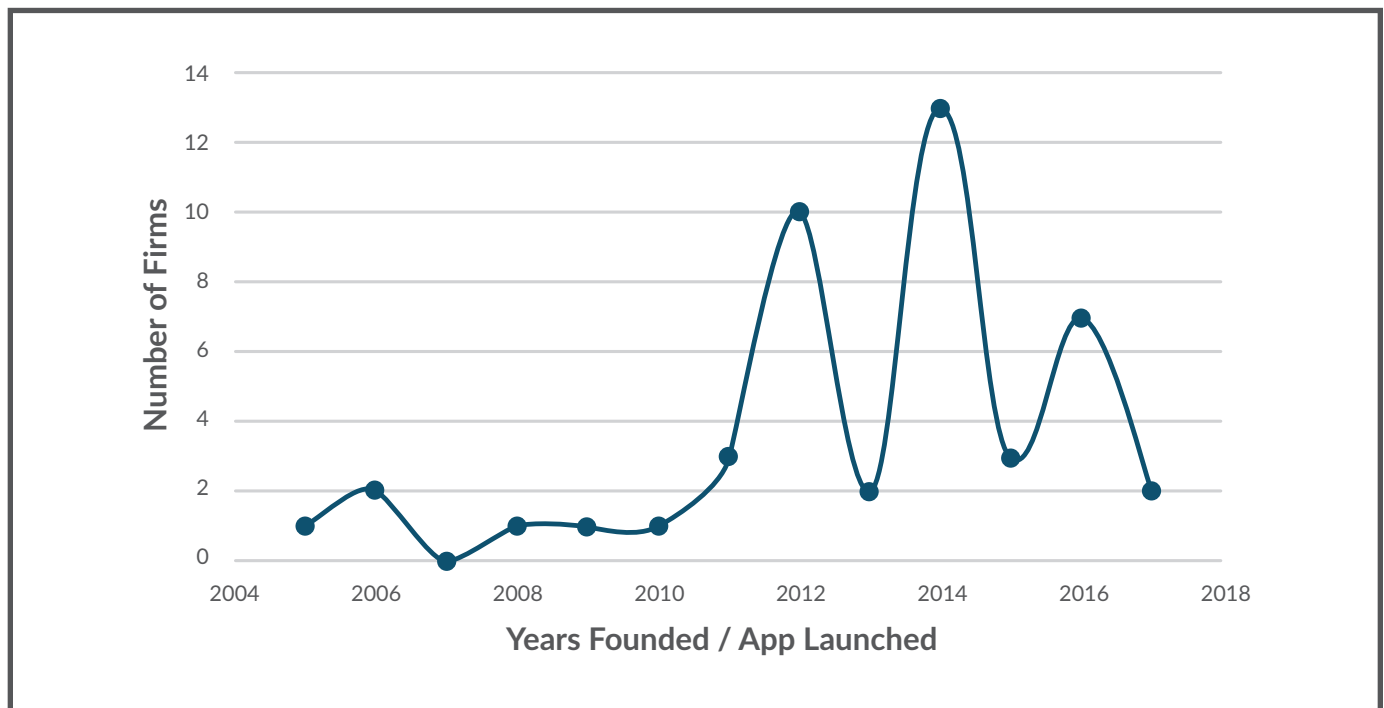


Figure 1

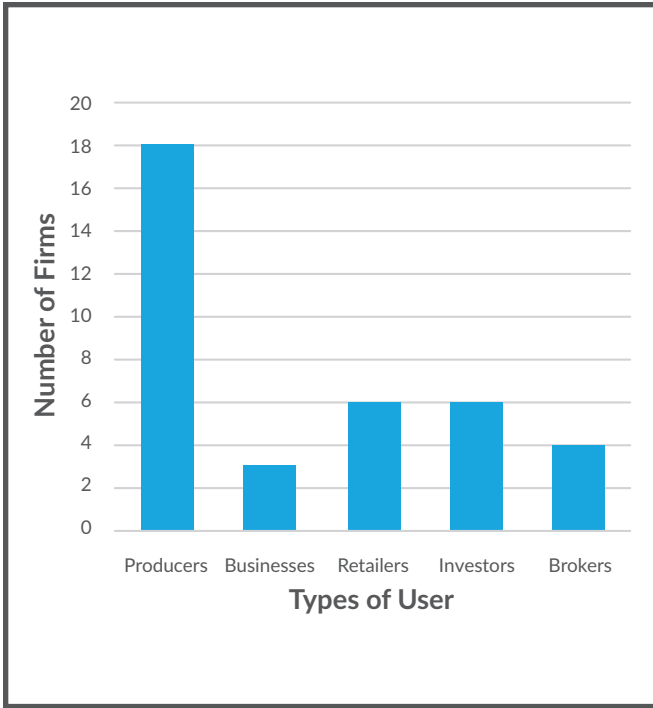


Figure 2

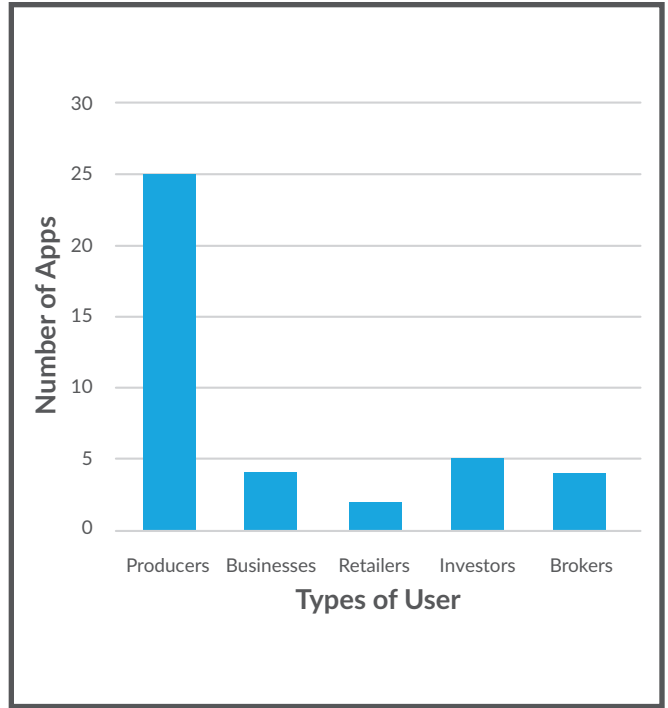


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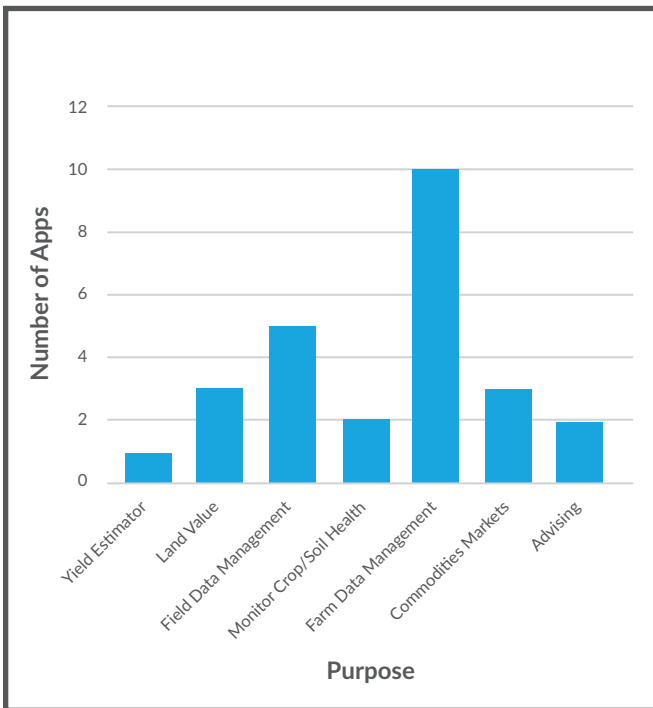


Figure 4

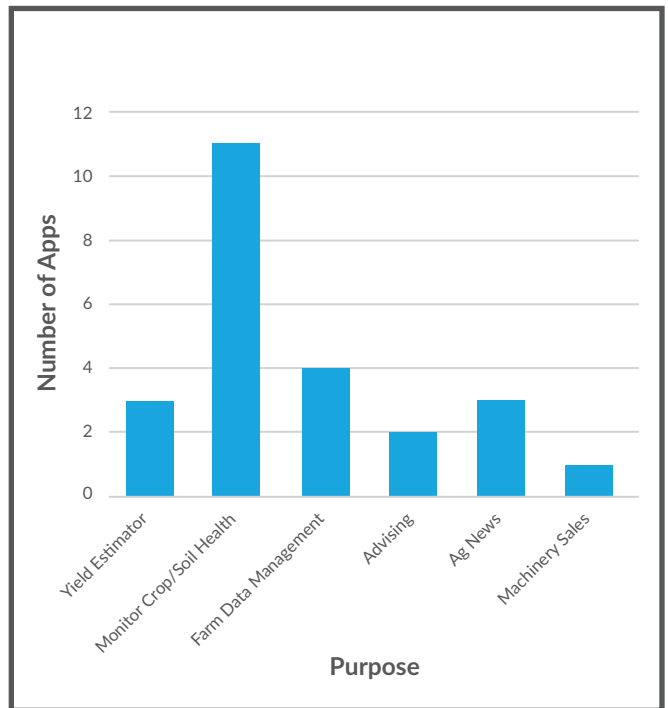


Figure 5

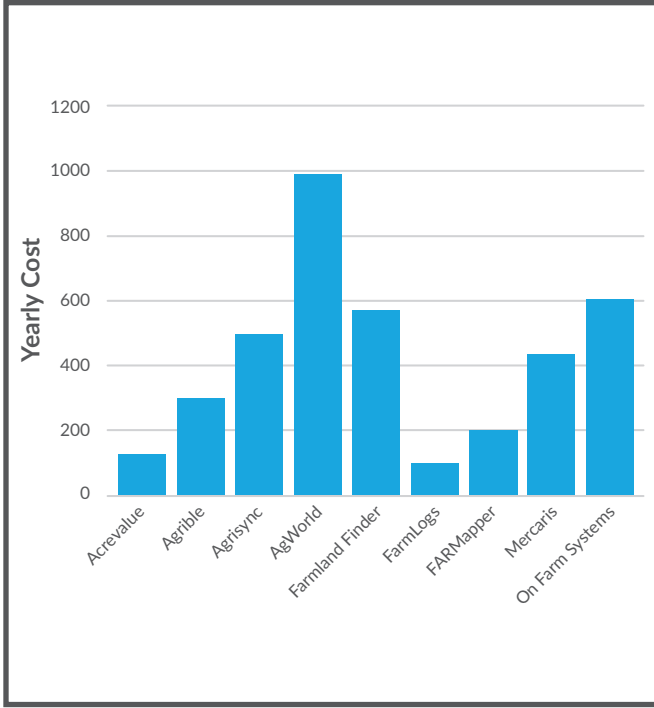


Figure 6

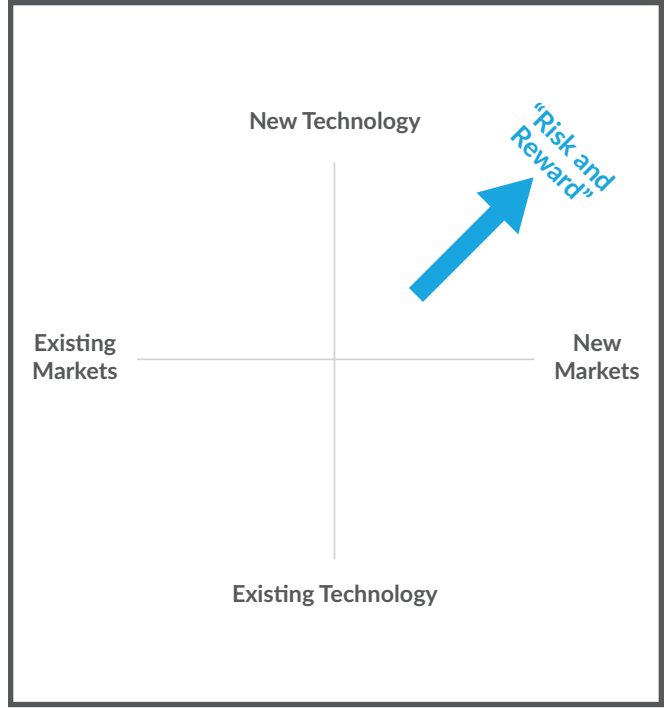


Figure 7