THE PENNSYLVANIA STATE UNIVERSITY
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DEPARTMENT OF ACCOUNTING

THE EFFECT OF DRONES ON THE AUDIT OF THE ORGANIC CROP INDUSTRY BY
BIG FOUR ACCOUNTING FIRMS

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ABSTRACT

The agricultural segment is projected to be worth $32.4 billion for transformational technologies; this is the second highest opportunity segment for transformational technologies. Being that drones consist of one of the eight essential technologies, drones have the potential to transform the audit of the organic crop farming industry (PwC, 2017).

The organic crop farming industry will be able to support this investment through buyers of organic products, such as General Mills, Inc. and SunOpta, Inc., as the farmers of this industry may not be able to afford the hefty cost of an audit from the Big Four accounting firms (IBISWorld, 2018). These buyers of organic products possess the funds for the bill and desire these services due to recent changes from consumer behavior and frauds surrounding organic inputs.

The Big Four accounting firms will face a number of challenges in the upcoming years, one being the need to control costs to remain competitive with current and future clients (IBISWorld, 2019). By incorporating drone technology into the audit of organic farms, auditors will be able to recover time to focus on the quality and decisions regarding the audit. While the investment of drones will require a significant amount of capital, many the big four accounting firms are already in a position to support this advancement. First, accounting firms will be prepared for potential data breaches and legal positions as they will already require changes to their information infrastructure from other technologies and will be incentivized to protect client information to maintain healthy client relationships. Furthermore, accounting firms will be equipped to handle drone technology through current online-based platforms, digital skills trainings, locations that foster future developments, and 3D imaging software applications.
Drones will prove to be a valuable asset to the Big Four accounting firms in the organic
crop sector as unmanned aerial vehicles will save precious time and money. With continued
investments and research, drones could prove to be promising for other unexplored areas such as
the conflict minerals segment.
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Chapter 1

Introduction

Drones in the Audit of the Organic Food Sector

Drones are becoming increasingly popular among many industries because of their ability to automate tasks, gather information, replace services that could have been tainted with human error or take unnecessary amounts of time, and can be used seamlessly with other transformational technologies (PwC, 2017). In July 2017, the Emerging Insights Report, published by PricewaterhouseCoopers (PwC), listed drones to be one of the essential eight technologies and estimated that the drone services market to be worth over $127 billion (PwC, 2017). Furthermore, PwC estimates the agricultural market for drones to be worth $32.4 billion, the second highest market opportunity for the entire market (PwC, 2017). With all this potential, could drones transform the organic industry sector for accounting firms?

To first determine if drone use could be plausible in this sector, the strategic questions posed by PwC in their 2017 July Emerging Insights Report for drone technologies in companies were applied:

- "Can we use drones in any part of our business to replace expensive, time- and labor-intensive tasks, particularly those that are hazardous?"
- "Have we thought about how we could use drones to collect data and what we might do with that data? Could it help in decision making? Would the data be valuable to our
current or future customers? Could that data help us expand our business model or customer offerings?

- How might drones fit with other emerging technologies we are investing in?
- Have we assessed the related risks of drones, particularly the legal and regulatory aspects?
- Have we considered all of the potential cyber risks or data privacy issues associated with drones and drone services?" (PwC, 2017)

Each of these questions will be answered and explained in detail in order to demonstrate how drones can alter the way the organic sector is audited in the future. However, to first understand how this transformational technology can alter the way the organic sector is audited, this paper will provide a brief explanation of the organic and drone industry and some of the regulations surrounding its application.
Chapter 2

Organic Crop Industry

The organic crop farming industry consists of farmers who partake in growing organic crops and obtaining organic certification from the United States Department of Agriculture (USDA) for those crops (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015 and 2019). As depicted in Figure 1 below, produce under this sector mainly consist of vegetables, field crops, and berries and other fruits; all of which do not apply mass-produced fertilizers, growth regulators, pesticides, and other products that modify the plant (IBISWorld, 2018). Under the USDA, there is a national list of substances that are either deemed to be lawful or prohibited in the growth of organic crops (Electronic Code of Federal Regulations: The National List of Allowed and Prohibited Substances, 2019). A detailed, comprehensive list of those lawful and unlawful substances can be found in Appendix A.
Currently, there are no major players in the organic crop farming sector as it consists of a multitude of farmers across the United States. However, there are a vast number of well-known, substantial companies, such as General Mills, Sunopta Foods, Inc., Albert’s Organics, Inc., and WhiteWave Foods, who purchase these organic outputs from farmers (IBISWorld, 2018 and Mergent Intellect, 2016). These companies have recognized the many opportunities this market has to offer and, as a result, many companies are now becoming more vocal about what is occurring downstream in their supply chain. For instance, companies such as General Mills, are working with farmers to assist in producing organic crops that can later be sold to them.

Additionally, to counteract one of the external threats of space to grow organic products, General Mills disclosed that they are collaborating with farmers on a 34,000-acre farm that produces wheat in South Dakota to become organic. As long as the industry demonstrates strength in the agricultural price index, consumption in crops, stability in the trade-weighted index, and
consumers are able to spend more of their disposable income, buyers of organic crops will only seek to aid the growth (IBISWorld, 2018).

The organic crop farming sector has experienced revenue of $4.3 billion and $759.7 million in profits with an annual growth of 6.8 percent from 2013 to 2018. Annual growth is forecasted to be 1.1 percent for 2018 to 2023. The organic crop farming industry has been able to experience this positive growth as it is still considered to be in the growth stage of its life cycle. This is due to a small constituency of crop producers and producers are able to charge a premium for organic products; on average, the premiums for organic food products hover around 30 percent more than its conventional food products. Furthermore, as mentioned previously, there is a medium level of assistance provided to those involved in the industry from buyers. There is also an average amount of assistance provided to players in the organic crop farming sector from the federal government, through efforts to provide capital and certification, and organic associations, who act as stewards for the organic farming community’s interests. However, regardless of the opportunities and growth in this sector, the organic crop farming sector could find itself in a troubling predicament in the future (IBISWorld, 2018).

Due to heavy regulation, which will be discussed in further detail in the ensuing sections of this paper, economic hardships farmers are currently facing, and an ineffective trade relationship with China, the organic crop farming industry could find itself in a concerning situation. This predicament will also only look to worsen in the coming years as consumers will eventually reach a limit on what price point is considered to be outlandish for the end-product they are receiving (IBISWorld, 2018). As this situation plays out, the organic crop farming industry will be looking to cut costs, and this is where audit companies will be able to step in to assist with drone technology.
Organic Agencies and Regulations

For the growth and sale of products in the United States, the USDA is tasked with implementing and imposing the national organic standards, as referenced by Figure 2. Furthermore, the USDA provides accreditations to certifiers, assists potential, organic candidates with transitioning, and supports current producers who have already received the USDA Organic Seal (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2019).

As evidenced by Figure 2, the USDA works alongside many organizations. The first of which is the National Organic Standards Board (NOSB). NOSB advises the USDA on specific issues relating to the organic industry. NOSB also acts as an external advisory committee for the National Organic Program (NOP) (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2019).

The NOP was established by Congress in 2001 to administer uniform standards for agriculture products in the United States and ensure consumer confidence in the United States Department of Agriculture’s Organic Seal. The NOP is a partnership between the public and private sectors. Furthermore, in the private sector, the NOP bestows private companies with accreditations and assists with training inspectors to ensure that all companies are following national standards (United States Department of Agriculture, 2019).

The NOP is headed by the Agricultural Marketing Service (AMS) Administrator’s Office. This office is tasked with enforcing USDA organic regulations and providing final appeal decisions that affect certifiers and certified operations conducting business inside of states.
without established State Organic Programs (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

Next in the organizational chart, again referenced by Figure 2, is the prime focus for the organic accreditation process. The NOP Administrator provides accreditation decisions and works alongside the NOSB in recommendations to the USDA. Companies seeking accreditation, otherwise known as becoming an accredited certifying agent or certifiers, look to the National Organic Program’s Deputy Administrator. During the accreditation process, the NOP deputy administrator is tasked with accrediting and evaluating certifiers, administering guidance and training to certifiers, and restoring accreditations to those who were suspended. These responsibilities may be assigned to NOP personnel who are qualified to handle such tasks, however, the NOP deputy administrator still possesses responsibility for how it is executed (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

Further down the organizational structure is the Accreditation and International Activities (AIA) Division. Overall, AIA Division ensures individuals are following NOP’s accreditation activities. Specifically, the AIA division outlines and supervises certifier’s and applicant’s accreditation audits and advises the Accreditation Committee pursuant to NOP 2012 Accreditation Committee Instruction. Additionally, the AIA division gives recommendations, suspensions, and revocations of accreditations to the NOP Deputy Administrator. The AIA division also is responsible for effectively communicating accreditation decisions to candidates and makes certifier’s current status available to the general public. Some of these duties and tasks may be delegated to personnel in the NOP, AMS, or other State or private organizations qualified to carry out the task. However, whoever handles the task, the AIA bears responsibility
for the execution (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

Also, under the USDA is the Accreditation Committee. The Accreditation Committee consists of NOP personnel with a background in applying the USDA organic regulations, agricultural production and processing practices, and/or evaluating audit-based certification programs. Personnel in this committee are tasked with reviewing accreditation applications and decisions. These reviews can be for an initial accreditation or a renewal of a current accreditation; the review of certain decisions is open to “corrective actions, scope expansion or reduction, and proposed suspensions and revocations” (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015). Upon completion of these reviews, a recommendation is given to the NOP Director for the final decision regarding the accreditation (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

As mentioned previously, the NOP has the authority to ensure consumer confidence in the United States Department of Agriculture’s Organic Seal for the growth and sale of products within the United States. Under this duty, the NOP sets forth guidelines for the criteria for an auditor on an organic certification process engagement (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

Employees or auditors contracted by the NOP are able to oversee the audit and act as a NOP auditor. NOP auditors are assessed by NOP evaluators. NOP evaluators consist of NOP employees or qualified USDA personnel. These individuals are able to perform evaluations on contracted auditors, NOP auditors, and related body auditors for the NOP (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2017).
Internal auditors are judged by the same criteria as NOP auditors and NOP evaluators; these specifications include: ability to maintain desirable personal attributes, possess a secondary education, have a post-secondary or higher education, work experience, or combination of the two, possess knowledge of audit criteria, and have audit experience. However, internal auditors are also judged on their ability to organize assessments, be independent, possess experience or knowledge of the field, and maintained that audit activities are at the “acceptable” level. The audit teams for these auditors are put together by the AIA Division Director (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2017).

Under the governance of the AIA Division Director, auditors perform accreditation audits. These audits involve the auditor preparing, managing, and communicating pre-onsite quality manual audits, otherwise known as desk audits, and pre-decisional, mid-term, and renewal audit results. During these audits, auditors are to inform applicants of audit team member’s names prior to beginning the audit to allow time for the certifier to object to any team member’s appointment and also to begin to estimate audit fees; these fees are dependent on the currently advertised user fees and travel services related to the NOP’s accreditation services. Any additional duties to be performed by the auditor must have the approval of the AIA Division (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).
Underneath the USDA, third-party organizations, known as certifiers, provide organic certifications and ensure the enforceability of regulations instituted by the USDA and NOSB (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2019). Certifiers have a number of functions and duties. Certifiers are to attend mandatory NOP training sessions, prepare requested witness and review audits and operational visits, and allow others who show a certifier’s level of independence and impartiality from the related parties when documenting collected information. Furthermore, certifiers must fulfill all of
the required benchmarks set forth by USDA organic regulations and allow those with the designated clearances access to documents, records, and other information necessary to obtain accreditation (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

![Figure 3: National Organic Program Stakeholders](United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2019)

The last group of stakeholders in the organic accreditation process, before reaching the retailers and consumers, consist of farmers, ranchers, processors, and handlers. The farmers and ranchers are the individuals producing the crops and livestock wishing to obtain certification. On the other hand, processors and handlers are the individuals who are processing and handling organic products being produced by the farmers and ranchers. The USDA aids all of these groups by answering questions any certifier, operator, or consumer may have and in return, these groups give feedback to the NOSB and USDA (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2019).
Organic Certification Audit

With an understanding of the organizations and agencies involved, it is now appropriate to dig into the audit process in the organic sector for obtaining or maintaining organic certification.

**Table 1: The Organic Audit Cycle Timeline (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015)**

<table>
<thead>
<tr>
<th>Application Stage</th>
<th>Beginning 5-Year Cycle</th>
<th>Ensuing 5-Year Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 months: Documentation Adequacy Review</td>
<td>3-9 months: Pre-Decisional Audit</td>
<td>0-24 months: Initial Audit</td>
</tr>
<tr>
<td>54-72 months: Renewal Audit</td>
<td>54-72 months: Renewal Audit</td>
<td></td>
</tr>
</tbody>
</table>

The accreditation process begins with the application process which can take up to three months to review. Then, within three to nine months after the documentation review, the audit process begins (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

There are numerous types of accreditation audits that take place onsite. The first are pre-decisional audits. The pre-decisional audit occurs within six months of the document adequacy review. Auditors are required to analyze essential business activities, administer review and witness audits, conduct interviews with certification personnel, and examine certification files. An accreditation certificate may be issued by AMS if the applicant has complied with USDA and the Organic Foods Production Act of 1990 (OFPA) organic regulations (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2005 and 2015).
The second type of onsite audit is the initial audit and affects newly accredited certifiers. This audit takes place two years from the date of accreditation and allows the certifier to demonstrate their competency of the USDA audit criteria (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

Much like the initial audit, the mid-term audit also looks at certifiers. Specifically, this audit examines the certifier’s activities, validates the exercise and influence of the certifier’s actions, preforms witness and review audits, conducts interviews with certification personnel, analyzes certification files, and preforms any other review measures at the direction of the AIA Division. This process occurs during the 24 to 36 months accreditation was received or renewed (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

Lastly, the renewal audit examines many of the same aspects of the initial and midpoint audit. This review takes place six months prior and 12 months after the certifier’s accreditation anniversary date (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).

All the audits referenced above follow the template in Table 2. The template below provides a perfect-world scenario, generalization of the approximate number of days for an audit to be completed based on a multitude of factors, such as the number of countries that have certified operations and the number of certified operations (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015).
### Table 2: The Organic Audit Planning Guide Template (United States Department of Agriculture Agricultural Marketing Service National Organic Program, 2015)

<table>
<thead>
<tr>
<th>Set Duration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Onsite</td>
<td>2 Days</td>
</tr>
<tr>
<td>Onsite</td>
<td>2 Days</td>
</tr>
<tr>
<td><strong>Witness Inspection and/or Review Audits</strong></td>
<td><strong>1 Day</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential Time Amplifiers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Countries with Certified Operations</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>+0 Days</td>
</tr>
<tr>
<td>Number of Certified Operations</td>
<td>Less than 100</td>
</tr>
<tr>
<td></td>
<td>+0 Days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Auditors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

### Auditing Organic Buyers

While farmers may not possess the financial resources or means to hire an accounting firm to provide assurance to its stakeholders or even afford a high caliber, agriculture drone, the buyers of the crops they produce can afford the investment (IBISWorld, 2018 and Mergent Intellect, 2016).

<table>
<thead>
<tr>
<th>Buyers of Organic Crops</th>
<th>2018 Revenue</th>
<th>Principal Auditor</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Mills, Inc.</td>
<td>15,704.4 million</td>
<td>KPMG, LLP</td>
</tr>
<tr>
<td>SunOpta, Inc.</td>
<td>$1.260 million</td>
<td>EY, LLP</td>
</tr>
<tr>
<td>The Hain Celestial Group, Inc.</td>
<td>$2.457 million</td>
<td>EY, LLP</td>
</tr>
<tr>
<td>Tyson Foods, Inc.</td>
<td>$40,052 million</td>
<td>PwC</td>
</tr>
</tbody>
</table>

As referenced by Table 3 above, there are a number of buyers across the organic products market that possess the financial means to support this investment; not only do these companies have the required funds to finance this expenditure, but many of the large buyers of organic crops can afford auditing services from the Big Four Accounting Firms (Sunopta Inc., Tyson Foods Inc., General Mills Inc., and The Hain Celestial Group, Inc. Form 10-K, 2018 and 2019). As seen in recent years through many marketing efforts and changes in recruiting efforts incorporate more STEM talent, the Big Four Accounting firms, have led the movement to incorporate technology in the audit (IBISWorld, 2019). With a relationship already in place with auditing teams to bring this new technology into the audit, buyers of organic products will be able to provide a newfound way of assurance to their shareholders and customers that their inputs are organic and safe. After many scandals in recent years surrounding organic products and farming, this could save companies from the headache of fraud.

Although the application and auditing process for obtaining and maintaining organic certification is quite thorough, it is not without its flaws. In August of 2019, what is considered to be the one of the largest organic food frauds in the history of the United States occurred (U.S. Attorney’s Office Northern District of Iowa, 2019). While the four individuals were sentenced to
federal prison by a federal judge for falsely advertising their grain as organic, the impact to consumers and buyers of the grain was monumental. The result of the deception led to $120 million of damages as it adversely affected consumers and businesses who purchased grain from the accused as they paid a premium for products, they believed to be organic and “better for them and the environment” (Foley, 2019).

Consumers across the world expect the products they purchase to be advertised truthfully and be safe for themselves and their families to consume. This is noted by megatrends, such as the globalization of food supply chains, empowered consumers, and scandals and increasing scrutiny, as listed in PwC’s 2015 Food Trust report. As a result, a movement within many industries has been created to begin to look at ways to provide a sense of security and transparency with their products (PwC New Zealand, 2015). Drones could be the link to providing customers with a peace of mind.
Chapter 3

Unmanned Aircraft Systems (UAS) in the United States

Types of Drones

There are a number of different types of drones in the marketplace available to buy, however, this paper will focus primarily on drones that are designed for the agricultural and geography segment. One such drone will be the Quest UAV 200 Post-Processing Kinematic (PPK), a drone already tested in the audit process, and three other commercial drones (Datathawk\textsuperscript{AG} Agriculture Drone, 2019, Nixon, 2019, and PwC UK, 2019).

The QuestUAV 200 Post-Processing Kinematic (PPK) drone is specially designed to merge topographic data with aerial photographs of the designated area and generate highly accurate 3D models (QuestUAV PPK Drone, 2019). Traditional methods of obtaining topographic data require individuals to trek through the designated area in question and physically measure the site using ground control points. This can take audit teams hours to walk through the site and obtain this information, whereas a sophisticated drone, such as the PPK, could do it in less. Additionally, this traditional method has a lower accuracy level as there is the potential for human error (PwC UK, 2019).

In the agricultural segment, the PPK drone would provide the best use in audits looking at the value of assets and for high quality images of the crops in question (QuestUAV PPK Drone, 2019). As mentioned previously, the PPK drone specializes in creating a digital twin of the designated area with high resolution, aerial photographs (PwC UK, 2019). This can be
immensely beneficial for auditing teams who are seeking to determine the size of the farm’s yield and, in turn, provide a value for the assets. Furthermore, with the high-quality images, the auditing team can determine if in fact the crops are organic, and the farmers are following the rules surrounding organic crops. The incentive for farmers to overstate their assets or falsely claim an asset as organic could be drastically reduced by these measures.

Another commercial drone applicable to the agricultural segment is the QuestUAV DATAhawk\textsuperscript{AG} Agriculture Drone. The Datahawk drone is a fixed wing drone that weighs approximately 2 kilograms, or 4.40925 pounds, and is designed to acquire crop data. Although it is relatively light, the DATAhawk\textsuperscript{AG} drone is able to fly in inclement weather and obtain data from various fields during a single flight, as referenced below in Figure 4 (Datathawk\textsuperscript{AG} Agriculture Drone, 2019). This could prove to be valuable for auditing teams to test during undesirable weather and test more than one field at a time.

![Figure 4: DATAhawk\textsuperscript{AG} Drone Aerial View of Multiple Fields](Datathawk\textsuperscript{AG} Agriculture Drone, 2019)

Another enticing trait of the DATAhawk\textsuperscript{AG} drone is its multispectral sensor, the MicaSense RedgeEdge\textsuperscript{TM} (Datathawk\textsuperscript{AG} Agriculture Drone, 2019). This technology, when combined with the ATLAS post-processing software, allows users to examine the valuable data
in an effective format (QuestUAV Drone Sensors, 2019). Specifically, users are able to examine nitrogen levels in their yields, overall crop health, potential diseases in the crops, and apply the Normalized Difference Vegetation Index (NDVI), a method to determine if an area contains plant life, to the fields (EOS Project Science Office, 2000 and Datathawk\textsuperscript{AG} Agriculture Drone, 2019). Examples of outputs can be seen in the figure below.

![Figure 5: MicaSense RedEdge\textsuperscript{TM} Output Captured by DATAhawk\textsuperscript{AG} drone (Datathawk\textsuperscript{AG} Agriculture Drone, 2019)](image)

The DATAhawk\textsuperscript{AG} drone could prove to be beneficial to audit teams as it could also disincentivize farmers to falsely claim an asset as organic or overstate their assets. This drone could be better suited for some types of agricultural audits than the PPK drone as it can fly during poor weather and distinguish between multiple yields (Datathawk\textsuperscript{AG} Agriculture Drone, 2019). These characteristics would allow auditing teams to maintain their walkthrough schedule regardless of poor weather and save time by not having to walk through several different types of crop fields.
The third drone that could prove to be effective for auditing organic farms could be the senseFly eBee SQ. This fixed wing drone weighs approximately 2.4 pounds and has a wingspan of 43.3 inches. Additionally, the senseFly eBee SQ is designed to fly across approximately 500 acres during its fifty-five-minute battery life (Nixon, 2019). While not advertised as being able to fly in inclement weather like the DATAhawk AG drone, the senseFly eBee SQ drone is able to operate in winds up to twenty-eight miles per hour (senseFly, 2019).
The senseFly eBee SQ fixed-wing drone will prove itself to be useful in an audit as it is able to obtain plant counts, the temperature of the soil, the soil’s H2O levels, limited topography mapping, and vegetation indices, such as the NDVI (Nixon, 2019 and senseFly, 2019). This is made possible through the Parrot Sequoia+ camera attached to the drone, as referenced in Figure 7. The Parrot Sequoia camera is currently the smallest and most lightweight multispectral sensor for a drone on the market (Parrot Sequoia Technical Specifications, 2019). Much like the other drones mentioned previously, this will allow auditors to determine the total amount of organic assets in question.

![Figure 7: Parrot Sequoia+ Camera (Parrot Sequoia Technical Specifications, 2019)](image)

The final commercial drone that could be used in the audit of organic farms is the PrecisionHawk Lancaster 5, referenced in Figure 8. The PrecisionHawk Lancaster 5 is also a fixed wing drone and weighs about 5.3 pounds without cargo and 7.8 pounds with cargo.

![Figure 8: PrecisionHawk Lancaster 5 Drone (PrecisionHawk, 2019)](image)
Although this drone is not advertised to operate in inclement weather, the PrecisionHawk Lancaster 5 can operate at a maximum temperature of 104 degrees Fahrenheit and uses artificial intelligence technology to adapt itself to any changes in the wind, visibility, weather, and additional weight placed onto the drone. Additionally, the PrecisionHawk Lancaster 5 comes with InFlight; a software designed to allow users to fly more efficiently through intelligent skills, such as emergency options, situational awareness, and battery swap (PrecisionHawk, 2019). Another exciting feature of this drone is that its platform is open source and comes with DataMapper data management and analysis solution. By having an open source platform, users can customize their visual, thermal infrared, lidar, hyperspectral, and multispectral sensors to achieve their desired data set (PrecisionHawk, 2019). The DataMapper tool is also an enticing feature as it can operate as a software or in the cloud to produce two dimensional or three dimensional geo-referenced maps. These geo-referenced maps are made possible through algorithms and indexers provided on the DataMapper’s tool platform, AlgoMarket. Through AlgoMarket, one is able to process data such as plant height, plant count, water pooling, volume measurement, field uniformity, optimized soil adjusted vegetation index (OSAVI), and NDVI (Nixon, 2019).

The PrecisionHawk Lancaster 5 can be an asset to auditors during the audit of organic farms as it will also be able to assist with valuing the assets and determining if it is truly organic. Furthermore, with access to algorithms already created by the company and the public, auditors will not have to invest money in creating new software applications to process the acquired data. Time and money will also be able to be saved with the PrecisionHawk Lancaster as its intelligent software generates a flight plan based on the desired resolution of the area it is surveying and the altitude (Nixon, 2019 and PrecisionHawk, 2019). This will prove to be useful as a significant
investment of time and resources will need to be spent on reviewing the regulations surrounding drones.

Rules and Regulations Surrounding UAVs

The Federal Aviation Administration retains the influence over drones in the United States (Certificated Remote Pilots including Commercial Operators, 2019). If a federal, state, or local government agency were to implement drone use in the audit of the organic sector, there are two rules pertaining to implementing and conducting a drone program. First, under 14 of Code of Federal Regulation (CFR) part 107, drones are permitted to fly if the Unmanned Aircraft Systems (UAS) is under 55 pounds or below 400 feet at the ground level. The second rule states that under 49 of the United States Code (U.S.C.) section 40102(a) and 40125, a certificate of waiver or authorization (COA) must be obtained to self-certify operators and drones for functions within the government (Certificated Remote Pilots including Commercial Operators, 2019).

Section 14 of CFR part 107 also pertains to commercial operators seeking to become certified remote pilots. To first become eligible, the drone must weigh less than 55 pounds and a comprehension of the rules under Part 107 is required (Certificated Remote Pilots including Commercial Operators, 2019). This second requirement is essential as many of the tasks required in the audit may necessitate the use of waivers. Some instances subject to a waiver requirement and pertinent to the audit may include:

- “Section 107.25: Flying in populated areas
- Section 107.29: Flying at night
- Section 107.31: Flying beyond vision
- Section 107.33: Visual Observer
- Section 107.35: Flying multiple drones with a single pilot
- Section 107.39: Flying over people
- Section 107.51: Flying over a certain speed, height, or visibility” (Part 107 Waivers, 2019)

After a comprehension of Part 107, applicants are required to pass the Knowledge Test. To be eligible for the knowledge test, applicants must be 16 years of age, able to read, write, and speak in English, and be physically and mentally fit to fly. Upon completion of the knowledge test and acquiring the FAA remote pilot certificate, applicants must register their drone under the FAA. Each drone license is valid for three years and costs a meager five dollars to register. In part with following part 107, it is required that drone pilots stay up to date within FAA guidelines and regulations (Certificated Remote Pilots including Commercial Operators, 2019). One way this is possible is through the B4UFLY mobile application from the FAA.

Figure 9: B4UFLY Mobile Application (B4UFLY Mobile App, 2019)
In 2015, Kittyhawk, a FAA Approved UAS Supplier, created the B4UFLY application (About Kittyhawk, 2019). The B4UFLY application provides access to nearby airspace restrictions based on the pilot’s location (B4UFLY, 2019). This application also furnishes access to the Low Altitude Authorization and Notification Capability (LAANC). LAANC acts as a medium between the FAA and the industry and allows users to automate the application and approval for flying authorization (B4UFLY, 2019 and B4UFLY Mobile App, 2019). While the application does not yet have real-time capabilities, it does provide users with important information from many sources within the FAA UAS Data Exchange system. For users that may not have mobile capabilities on a smart device, such as a smart phone or tablet, there is also a desktop application so users may have access to the same information. This current, available technology is able to be accessed by the general public (B4UFLY, 2019).

**Drones in the Audit**

*Figure 10: QuestUAV Fixed Wing Drone at Stock Count Audit (PwC UK, 2019)*
On January 3, 2019 PwC announced it had performed its first stock count using drones in the audit process in the United Kingdom. The process was performed on a coal power plant in South Wales and employed a QuestUAV drone, pictured in Figure 10, to fly over the power station (PwC UK, 2019). During the stock count, the drone flew over the plant and took pictures of coal piles as referenced by Figure 11.

![Aerial View of the Coal Power Station](image)

**Figure 11: Aerial View of the Coal Power Station (PwC UK, 2019)**

Using these aerial images and photogrammetry, auditors were able to measure the volume of the coal pile with 99% accuracy and provide a value for what the pile is worth. The drone data was measured and valued using PwC’s Geospatial application (PwC UK, 2019). This process overview can be seen in Figures 12 and 13 below.
While the primary purpose of this stock count was to focus on the accuracy, effectiveness, and advantages of employing drones in the audit process, many other impressive and appealing findings were discovered. First, the team found that a drone could complete the stock count in approximately thirty minutes. This was an 85 percent reduction in time as the
conventional method for stock counts with coal piles could take a team of auditors up to four hours. Additionally, the drone was able to achieve an accuracy of two centimeters and obtained 900 data points per cubic meter and furnish a more accurate portrayal of the coal pile. Furthermore, the use of a drone in the stock count limited the level of a health and safety risk to the auditing team as they were not exposed to potential unstable coal piles and coal dust. Lastly, the coal-fired power station employees experienced less of a disruption in their normal course of operations with the drone utilized in the stock count as it did not require the employees to use any machinery on the coal pile (PwC UK, 2019). PwC UK drone leader, Elaine Whyte, also voiced her excitement about the stock count in a PwC press release:

“It demonstrates the powerful new perspective that we believe drones can offer for businesses across a wide variety of industries. Sectors with large assets in hard to reach areas are the most obvious starting points for expanding this kind of work further - from mining to agriculture and forestry. Our recent economic report showed that drones have the potential to not only improve UK productivity, but also offer significant net cost savings for businesses to the tune of £16bn by 2030. In this case, drones have allowed us to trial a more efficient service which has the potential to save both money and time, while allowing us to deliver greater insight too. There is also a clear health and safety benefit to using drones for this type of work, without someone having to climb over the coal pile” (PwC UK, 2019).

While this first of its kind moment is exciting, it is important to highlight the potential security and privacy concerns that are at play.
In 2019, the average cost of a data breach across all industries in the United States was $8.2 million dollars. Globally, an average of 25,575 data records were obtained per breach which cost businesses an average of $150 per record. While the consumer sector is less than the average, at $7.8 million dollars in damages from data breaches, that is still a significant amount of funds at risk (IBM Security, 2019). With data breaches becoming increasingly commonplace, it is important for companies to adapt, especially if they wish to add drones, which capture data that may need to be protected.

The 2019 IBM Cost of a Data Breach Report found that the majority of data breaches were caused by a criminal attack or malicious attack as opposed to a system glitch or human error, as shown below (IBM Security, 2019).

![Figure 14: Data Breach Sources Per Record Cost (IBM Security, 2019)](image-url)
On top of being the most common type of data breach, malicious attacks are also the most expensive per record. To counteract these costs, there are a number of things businesses can do to protect their information. The most impactful per record and total cost of a data breach are the creation of an incident response team, the widespread use of encryption, and performing thorough and comprehensive tests to the incident response plan (IBM Security, 2019). A detailed outline of the per record and total cost of data breach amplifiers and mitigators can be seen below in Figures 15 and 16.

![Figure 15: Data Breach Cost Amplifiers and Mitigators per Record (IBM Security, 2019)](image-url)
While the use of the Internet of Things (IOT) devices, mobile platforms, and the application of the cloud all augment the per record cost and total cost of a data breach, these potential risks are almost unavoidable (IBM Security, 2019). In a survey conducted by Deloitte, it was discovered that approximately 76 percent of members on an audit committee thought that cutting-edge technology should be utilized more in the audit process (Audit Value Survey, 2018 and The Deloitte Audit: Solve for now. Build for Next, 2019). As mentioned previously, there are numerous benefits that progressive technologies can provide to the audit. To neutralize the
risk of using these technologies, businesses will need to do more than just the bare minimum in protecting their data, and be cognitive of future legislation.

In January of 2020, if a business is providing services to or employs residents from the state of California, they must adhere to the California Consumer Privacy Act (CCPA). Under the CCPA, California residents will have access to how their personal data is collected for information obtained during the past 12 months and be able to opt-out of having their personal information sold. Additionally, in some circumstances, California residents are able to have their personal information that was collected on them erased. Also, under this legislation, there are floor and ceiling limits placed on damages per data breach and penalties for intentional and unintentional violations of data breaches (PwC US, 2019).

Outside of the United States, other countries have their own version of the CCPA. Individuals in the European Union (EU) possess many of the same luxuries of the CCPA, perhaps even more, as the CCPA was derived from the EU’s General Data Protection Regulation (GDPR). While the CCPA may be the first legislation of its kind in the United States, it certainly will not be the last piece of legislation regarding data protections for consumers as California is already having voters vote on a far more extensive addition to the CCPA in 2020 (PwC US, 2019).
Chapter 4

Investment Costs

Initial Drone Investment

As mentioned in earlier chapters of this paper, there are four drones on the market that could prove to be an asset in the audit of organic crops: the QuestUAV 200 Post-Processing Kinematic (PPK), QuestUAV DATAhawk\textsuperscript{AG} Agriculture, senseFly eBee SQ, and PrecisionHawk Lancaster 5 drone (Datathawk\textsuperscript{AG} Agriculture Drone, 2019, Nixon, 2019, and PwC UK, 2019). All of the drones listed have additional features and software systems that can be added onto the base price of the drone. For simplicity, the base cost of the drone has been provided in Table 4 below to provide clarity as to what funds may be required for this initial investment.

<table>
<thead>
<tr>
<th>Unmanned Aerial Vehicle</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>QuestUAV 200 Post-Processing Kinematic (PPK)</td>
<td>~$ 8,389</td>
</tr>
<tr>
<td>QuestUAV DATAhawk\textsuperscript{AG} Agriculture</td>
<td>~$ 8,389</td>
</tr>
<tr>
<td>senseFly eBee SQ</td>
<td>$12,000+</td>
</tr>
<tr>
<td>PrecisionHawk Lancaster 5</td>
<td>$25,000+</td>
</tr>
</tbody>
</table>

It is important to note that the costs listed above were not provided by the manufacturer’s website, as the sales prices were not publicly listed and could only be provided through a consultation. While an unfortunate setback, the costs listed above were provided through
estimates by buying guides and base model prices and still allow for a general understanding of
the significant investment drones can pose to businesses. Additionally, another note to add
regarding the price of the drones in Table 4 is, if accounting firms were to place a significant
order of drones from a single drone manufacturer, an agreement could be made to provide the
number of drones at a discounted price to incentivize future business and the purchase of
additional drones. As a result, the price of drones to assist in the audit of the organic crop
industry will tend to vary with time and transaction size, but auditing firms should understand the
significance of the amount of funds that may be required to implement drones in an audit.

Reclaiming Time and Money

The potential for drones in the audit is vast and constantly growing as technology and
new ideas emerge. If audit companies are going to consider incorporating drone technology into
their audits, the benefits are going to need to outweigh the costs discussed earlier. Unfortunately,
a definitive, quantitative number of the benefit is not able to be applied as there are many
monetary and nonmonetary factors that influence the overall effect drones will have on each
business. Additionally, each audit will possess some uniqueness and auditing firms will be at
different levels of incorporating technology in the audit which will influence how much of a
benefit they will receive from drones. As a result of these many factors, a review of the potential
benefits drones can offer auditing firms was conducted to provide an overall understanding for
firms looking to invest into this technology and how it can benefit them.

Currently, all of the Big Four accounting firms are not publicly traded due to a potential
number of independence and regulations set forth by governing agencies, such as the Securities
Exchange Commission (SEC) and Public Company Accounting Oversight Board (PCAOB) (IBISWorld, 2019). As a result, quantitative data regarding information on travel costs is not able to be evaluated in detail for this paper. However, through some studies completed by the Big Four, information pertaining to the cost and time savings of the use of drones has been obtained.

As mentioned previously, PwC conducted the first stock count using a drone in January of 2019 and was the first to come out with quantitative results in how the use of drones benefitted their audit. Specifically, there was an 85% decrease in the amount of time it took to complete the count compared to traditional methods which could take up to four hours. This decrease in time also led to a reduction in error and potential harm to auditors and coal-fired power station employees. The QuestUAV 200 Post-Processing Kinenmatic (PPK) drone was able to obtain an accuracy of two centimeters and acquired 900 data points per cubic meter to generate an accurate model of the coal pile. Additionally, auditors were able to lessen their risk of potential harm by not having to climb the coal piles for measurements and employees of the plant were able to go about their regular schedule with minimal to no interference from the count (PwC UK, 2019).

In another analysis by PwC, it was discovered that there are two common problems facing infrastructure projects. The drone powered solutions study found that the first issue regarding infrastructure projects was delays in projects. The second issue was that businesses were going overbudget in their infrastructure projects. Both problems were able to be reduced and made an impact on the business process as these delays and costs can typically go beyond forty to two-hundred percent of an initial budget. Also, in this study conducted by PwC, found that with the information collected by drones, auditors were able to set up a defense against any
potential environmental penalties in approximately seventy percent of plans regarding how land was to be used (PwC Poland, 2019).

PwC was not the only Big Four accounting firm to discover potential returns from using drones in other industries. In July of 2018, Courtney Vien, of the Journal of Accountancy hosted an interview with Hermann Sidhu, CPA and EY Global Assurance Digital Leader to discuss EY’s movement to use drones in warehouses and outdoor inventory counts. During this interview, the effect drones would have on time savings was explained. In the tests with using drones in the audit of warehouses and outdoor counts, Hermann stated that by using drones, the test was able to be completed 21 times quicker than traditional methods. Additionally, the use of drones interfered less with the client’s employees as it could fly quickly and provided flexibility for when it could be run (Vien, 2018).

During this interview, concerns were also raised regarding the readiness of drone technology in the audit. Specifically, Hermann mentioned that there would need to be an ideal environment, a willing client, room in the budget for an investment in drone technology, and an initial investment in time and resources to design a flying plan for the drone (Vien, 2018). While these are all genuine concerns, audit companies must incorporate technology into their audits in order to become more efficient, deliver quality work, and remain competitive. This was demonstrated in a study of the accounting services industry. In this analysis, it was determined that the key success factors for this industry are upholding a favorable reputation, ability to control quality effectively, maintain relationships with clients, demonstrate an apparent position in the market, be competitive, and attract a talented group of individuals to work for your company (IBISWorld, 2019). In order to accomplish these key factors to success, accounting firms will need to find efficient ways to use technology in the audit.
With any new project, there is going to be an initial time and monetary cost to the firm. However, as time progresses, these companies will become more efficient with their methods and the returns, monetary and nonmonetary, will be enjoyed. This point was brought up by Hermann when discussing potential uses for drones. Particularly, Hermann states that while he may not currently see a widespread use for drone technology due to the significant investment and limitations, technology and costs are constantly changing and evolving, so potential uses for drones can expand. In regard to the financial and nonfinancial benefits drones can provide, Hermann discusses inventory counts conducted annually on December 31st and January 1st (Vien, 2018).

Every year, a selected few of the first-year employees at EY are tasked with conducting inventory observations on New Year’s Eve and New Year’s Day. As these are typically days one has off and spends with friends and family, it is not ideal to be selected for this task. If able to incorporate drones in the audit and use automation technology, first-year employees might not have to lose their typical day off and auditing firms can save money by not having to pay overtime (Vien, 2018).

Much like EY, KPMG has remained cautious about integrating drones in the audit. While KPMG has not been as active in promoting its use of drone technology to the public, they have been active in sharing their belief that technology will change the future and the audit. In a 2018 article, KPMG provided further insight into how the company is beginning to experiment with technology, including drone technology, that can impact the audit. The use of drones is noted in this publication as KPMG explains how they are experimenting with drones with inventory and storage sites and probing for obsolescence with data analytics technology (KPMG, 2018). KPMG further explains their belief in the possibilities of technology in the audit through a
demonstration of the future audit. In Audit 2023: Audit technology fit for the future, KPMG illustrates how data analytic technology can be used to detect fraud and incorporates drone technology and intelligent automation to discover evidence of the fraud in the span of a few days. What normally might not have been detected or as easily traced, is reported and researched with ease with KPMG Clara; KPMG’s virtual assistant that is already in development (KPMG, 2017). Also, in development, is Deloitte’s plan for drones in their practice.

Deloitte is no stranger to incorporating new technology into the audit in order to increase efficiency and quality. In 2018, Deloitte won the “Audit Innovation of the Year” award from the Digital Accountancy Forum on October 4th in London for its cloud platform, Cortex (Deloitte Wins 2018 ‘Audit Innovation of the Year’ at The Digital Accountancy Forum & Awards, 2018). Jon Raphael, Deloitte Managing Partner of Audit Transformation, stated on this event:

“We are constantly investing, evolving, and transforming the audit process with leading edge technologies, and our innovation capability will continue to accelerate thanks to groundbreaking advancements such as Cortex…The effectiveness of our technology toolset allows our auditors to spend more time on analysis and exceptions rather than data wrangling. This, in turn, helps to identify risks and outliers, as well as the completion of audit procedures. Auditors can focus on what matters – consistent audit quality along with meaningful insights” (Deloitte Wins 2018 ‘Audit Innovation of the Year’ at The Digital Accountancy Forum & Awards, 2018).

Deloitte has already begun to leverage these technological advancements in the audit through its drone services offering. Assisting both the public and private sector, Deloitte seeks to provide guidance through drone technology by providing drones-as-a-service to its clients. Specifically, Deloitte seeks to assist with business operations to further client’s returns on
investments, provide guidance on current regulations and potential threats to the client, and give direction as to what hardware and software might be necessary to support future investments. This movement and openness to change among Deloitte and other big four accounting firms towards data-driven decision making will allow for the continued and future investment into drone technology to improve the overall quality of the audit (Drone Services, 2019).

Applications and Current Investments

There are a number of programs and applications in the assurance sector for incorporating technology in the audit to assist with drone technology. As referenced by the table below, the Big Four accounting firms are already implementing programs and resources to explore these current and future applications.

Table 5: Current Investments by the Big Four Accounting Firms

<table>
<thead>
<tr>
<th>Current Programs in the Big Four</th>
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<tbody>
<tr>
<td><strong>PwC</strong></td>
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<tr>
<td>→ Digital Accelerator Program</td>
</tr>
<tr>
<td>(Fenlon, M. and McEneaney S., 2018)</td>
</tr>
<tr>
<td>→ Digital Fitness (PwC, 2019)</td>
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</table>

Some of the current programs that focus on the talent in these Big Four firms include PwC’s Digital Accelerator and Digital Fitness programs (PwC US, 2015 and PwC, 2019) and
EY’s Audit Digital Ambassador Program (Student Programs, 2019). Under PwC’s Digital Accelerator program, employees can apply to temporarily leave their current position and undergo training on a number of digital skills to then assist other teams in how their current methods could be improved for a designated period before they return back to their original team (PwC US, 2015 and Fenlon, M. and McEneaney S., 2018). For the rest of their employees, PwC also provides access to a platform to upskill their digital fitness (PwC, 2019). Similar to PwC’s Digital Accelerator Program, EY has an Audit Digital Ambassador Program that provides incoming talent, specifically college students, a two-week experience in how technology and data analytics can impact the business (Student Programs, 2019).

Figure 17: KPMG Lakehouse Experience (KPMG US, 2019)

As referenced again in Table 5 and previewed in Figure 17, KPMG and Deloitte have embraced the role of technology in the way they conduct their business by investing in establishments to house their technological innovations and foster development (Deloitte Innovation Centers, 2019). While PwC and EY have also invested in centers, such as the Experience Center and wavespace™ (PwC US, 2015 and wavespace™, 2019), these investments
represent an exciting adumbration in the Big Four’s commitment to its employee's development and education (KPMG US, 2019).

Another current measure, many of the Big Four accounting firms have already implemented, are online-based applications for performing audits of companies. Some current examples include, EY Canvas, EY Helix, and PwC’s Aura (Audit Technology, 2019 and PwC US, 2018). These programs represent the readiness of accounting firms to support technology in the audit. One other application currently being used in the audit with drone technology is PwC’s Geospatial application.

Mentioned briefly in the discussion of the first stock count audit with drones, the Geospatial application gathers data through aerial images and photogrammetry to generate models of the geographic location or assets in question (PwC UK, 2019). Using this information provided by the drone, the geospatial application then compiles the data and presents it in a format that is clear and manageable. This is significant to potential customers as the acquisition and assembly of this data can assist business leaders and audit teams in making more informed and efficient business decisions. Additionally, as this application operates using the cloud, audit teams have access across multiple device types and locations to furnish timely decision-making and efficient delivery. These capabilities have reduced delays in projects and allowed for adherence to the budget (PwC Poland, 2019). With technologies such as this, audit companies are in a compelling position to continue expanding, or begin development of, drones in their audit practices.
Chapter 5

Discussion of Future Applications and Conclusion

In the beginning of the paper, the following questions were posed regarding the applicability of drones in the organic crop sector:

- “Can we use drones in any part of our business to replace expensive, time- and labor-intensive tasks, particularly those that are hazardous?
- Have we thought about how we could use drones to collect data and what we might do with that data? Could it help in decision making? Would the data be valuable to our current or future customers? Could that data help us expand our business model or customer offerings?
- How might drones fit with other emerging technologies we are investing in?
- Have we assessed the related risks of drones, particularly the legal and regulatory aspects?
- Have we considered all of the potential cyber risks or data privacy issues associated with drones and drone services?” (PwC, 2017).

To reaffirm the position of this paper, unmanned aerial vehicles are pertinent to the organic crop sector and are plausible to apply to the audit with current and future investments into transformational technologies.

Drones present a multitude of enticing possibilities to auditing firms of the organic crop industry. Unmanned aerial vehicles will reduce the amount of time it takes to complete sections
of the audit, decrease the health and safety risk of auditors, and diminish the cost of the audit 
(PwC UK, 2019). A decrease in costs to adhere to the client’s proposed budget will be required to 
remain competitive with other Big Four accounting firms. Furthermore, buyers of organic 
crops will require the services that drones will be able to provide to the audit of their suppliers 
due to a rise in public opinion and frauds surrounding claims of the organic products (PwC New 
Zealand, 2015). As many of the buyers of organic products already retain the services of Big 
Four accounting firms, this addition of services will be a way accounting firms will be able to 
leverage a competitive advantage and provide assurance to these buyer stakeholders (Sunopta 
Inc., Tyson Foods Inc., General Mills Inc., and The Hain Celestial Group, Inc. Form 10-K, 2018 
and 2019).

While many accounting firms already have safeguards in place to protect their client’s 
information and privacy, additional measures will need to be put in place to control the data 
received by drones. Specifically, accounting firms may need to construct an incident response 
team, incorporate the use of encryption across the company, and conduct thorough and 
comprehensive tests to the incident response plan. By implementing many of these data breach 
risk deterrents, the risk of a data breach will able to be minimized. Additionally, amplifiers of a 
data breach risk, such as cloud-based services and internet of things devices, accounting firms 
will be able to be incorporated into the audit as there will be plans in place to lower their risk of 
implementation (IBM Security, 2019). Along with preparing for these risks to privacy and the 
protection of data, accounting firms will need to stay up to date with upcoming or current 
legislation regarding drones and collecting information. Due to the significant legal teams 
accounting firms employ and the firm’s own interest in publishing information about current
topics, this risk can be mitigated, as demonstrated by PwC’s preparation for the California Consumer Privacy Act (PwC US, 2019).

I believe that an enticing future application of drones could be applicable to the conflict minerals industry. Currently, if a United States’ public company or foreign company issuing stock in the United States is believed to be using conflict minerals, they must disclose so on their financial statements (Alali, F. (PhD) and Wang, S. (PhD), 2018). Specifically, companies are required to:

“Determine whether it manufactures or contracts to manufacture products for which conflict minerals are necessary to the functionality or production; conduct a reasonable country of origin inquiry (RCOI) concerning the origin of conflict minerals used, if any, and file a Specialized Disclosure Report (Form SD); and exercise due diligence, if appropriate, to determine the source and chain of custody of conflict minerals used and file a conflict minerals report (CMR) as an exhibit to Form SD to document due diligence process, facilities used to produce conflict minerals, information about products using conflict minerals, and the country of origin of the minerals” (Alali, F. (PhD) and Wang, S. (PhD), 2018).

Due to the uncertainty as to what is fully meant by “due diligence” companies may not be conducting these investigations responsibly. As a result, companies could be misleading to investors and consumers about the product being offered and hurting the countries where these atrocities are taking place (Alali, F. (PhD) and Wang, S. (PhD), 2018).

From 2002 to 2003, Bosco Ntaganda, a warlord known as “The Terminator” from the Democratic Republic of the Congo, committed a combined total of 18 counts of crimes against humanity and war crimes. Because Ntaganda was in a mineral-rich area, he was able to hold his power as a military commander and commit murder, rape, and enslaved individuals (Corder,
2019 and Lynch, 2017). To hold companies responsible and prevent the crimes that surround conflict minerals, drones could be implemented in this sector.

While there is still progress to be made with drones, the first stock count by PwC reaffirmed the capabilities of drones to dramatically advance the audit (PwC UK, 2019). With continued investment into innovative technologies, it is my stance that drone technologies will change the game for how sections of the audit are conducted.
Appendix A


§205.601 Synthetic substances allowed for use in organic crop production.

In accordance with restrictions specified in this section, the following synthetic substances may be used in organic crop production: Provided, That, use of such substances do not contribute to contamination of crops, soil, or water. Substances allowed by this section, except disinfectants and sanitizers in paragraph (a) and those substances in paragraphs (c), (j), (k), and (l) of this section, may only be used when the provisions set forth in §205.206(a) through (d) prove insufficient to prevent or control the target pest.

(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.

(1) Alcohols.

(i) Ethanol.

(ii) Isopropanol.

(2) Chlorine materials—For pre-harvest use, residual chlorine levels in the water in direct crop contact or as water from cleaning irrigation systems applied to soil must not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act, except that chlorine products may be used in edible sprout production according to EPA label directions.

(i) Calcium hypochlorite.

(ii) Chlorine dioxide.

(iii) Hypochlorous acid—generated from electrolyzed water.

(iv) Sodium hypochlorite.

(3) Copper sulfate—for use as an algicide in aquatic rice systems, is limited to one application per field during any 24-month period. Application rates are limited to those which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent.
(4) Hydrogen peroxide.

(5) Ozone gas—for use as an irrigation system cleaner only.

(6) Peracetic acid—for use in disinfecting equipment, seed, and asexually propagated planting material. Also permitted in hydrogen peroxide formulations as allowed in §205.601(a) at concentration of no more than 6% as indicated on the pesticide product label.

(7) Soap-based algicide/demossers.

(8) Sodium carbonate peroxyhydrate (CAS #:15630-89-4)—Federal law restricts the use of this substance in food crop production to approved food uses identified on the product label.

(b) As herbicides, weed barriers, as applicable.

(1) Herbicides, soap-based—for use in farmstead maintenance (roadways, ditches, right of ways, building perimeters) and ornamental crops.

(2) Mulches.

(i) Newspaper or other recycled paper, without glossy or colored inks.

(ii) Plastic mulch and covers (petroleum-based other than polyvinyl chloride (PVC)).

(iii) Biodegradable biobased mulch film as defined in §205.2. Must be produced without organisms or feedstock derived from excluded methods.

(c) As compost feedstocks—Newspapers or other recycled paper, without glossy or colored inks.

(d) As animal repellents—Soaps, ammonium—for use as a large animal repellent only, no contact with soil or edible portion of crop.

(e) As insecticides (including acaricides or mite control).

(1) Ammonium carbonate—for use as bait in insect traps only, no direct contact with crop or soil.

(2) Aqueous potassium silicate (CAS #:1312-76-1)—the silica, used in the manufacture of potassium silicate, must be sourced from naturally occurring sand.

(3) Boric acid—structural pest control, no direct contact with organic food or crops.
(4) Copper sulfate—for use as tadpole shrimp control in aquatic rice production, is limited to one application per field during any 24-month period. Application rates are limited to levels which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent.

(5) Elemental sulfur.

(6) Lime sulfur—including calcium polysulfide.

(7) Oils, horticultural—narrow range oils as dormant, suffocating, and summer oils.

(8) Soaps, insecticidal.

(9) Sticky traps/barriers.

(10) Sucrose octanoate esters (CAS #s—42922-74-7; 58064-47-4)—in accordance with approved labeling.

(f) As insect management. Pheromones.

(g) As rodenticides. Vitamin D₃.

(h) As slug or snail bait. Ferric phosphate (CAS # 10045-86-0).

(i) As plant disease control.

(1) Aqueous potassium silicate (CAS #-1312-76-1)—the silica, used in the manufacture of potassium silicate, must be sourced from naturally occurring sand.

(2) Coppers, fixed—copper hydroxide, copper oxide, copper oxychloride, includes products exempted from EPA tolerance, Provided, That, copper-based materials must be used in a manner that minimizes accumulation in the soil and shall not be used as herbicides.

(3) Copper sulfate—Substance must be used in a manner that minimizes accumulation of copper in the soil.

(4) Hydrated lime.

(5) Hydrogen peroxide.

(6) Lime sulfur.

(7) Oils, horticultural, narrow range oils as dormant, suffocating, and summer oils.
(8) Peracetic acid—for use to control fire blight bacteria. Also permitted in hydrogen peroxide formulations as allowed in §205.601(i) at concentration of no more than 6% as indicated on the pesticide product label.

(9) Potassium bicarbonate.

(10) Elemental sulfur.

(i) As plant or soil amendments.

(1) Aquatic plant extracts (other than hydrolyzed)—Extraction process is limited to the use of potassium hydroxide or sodium hydroxide; solvent amount used is limited to that amount necessary for extraction.

(2) Elemental sulfur.

(3) Humic acids—naturally occurring deposits, water and alkali extracts only.

(4) Lignin sulfonate—chelating agent, dust suppressant.

(5) Magnesium oxide (CAS # 1309-48-4)—for use only to control the viscosity of a clay suspension agent for humates.

(6) Magnesium sulfate—allowed with a documented soil deficiency.

(7) Micronutrients—not to be used as a defoliant, herbicide, or desiccant. Those made from nitrates or chlorides are not allowed. Micronutrient deficiency must be documented by soil or tissue testing or other documented and verifiable method as approved by the certifying agent.

(i) Soluble boron products.

(ii) Sulfates, carbonates, oxides, or silicates of zinc, copper, iron, manganese, molybdenum, selenium, and cobalt.

(8) Liquid fish products—can be pH adjusted with sulfuric, citric or phosphoric acid. The amount of acid used shall not exceed the minimum needed to lower the pH to 3.5.

(9) Vitamins, B1, C, and E.

(10) Squid byproducts—from food waste processing only. Can be pH adjusted with sulfuric, citric, or phosphoric acid. The amount of acid used shall not exceed the minimum needed to lower the pH to 3.5.
(11) Sulfurous acid (CAS # 7782-99-2) for on-farm generation of substance utilizing 99% purity elemental sulfur per paragraph (j)(2) of this section.

(k) As plant growth regulators. Ethylene gas—for regulation of pineapple flowering.

(l) As floating agents in postharvest handling. Sodium silicate—for tree fruit and fiber processing.

(m) As synthetic inert ingredients as classified by the Environmental Protection Agency (EPA), for use with nonsynthetic substances or synthetic substances listed in this section and used as an active pesticide ingredient in accordance with any limitations on the use of such substances.

(1) EPA List 4—Inerts of Minimal Concern.

(2) EPA List 3—Inerts of unknown toxicity—for use only in passive pheromone dispensers.

(n) Seed preparations. Hydrogen chloride (CAS # 7647-01-0)—for delinting cotton seed for planting.

(o) As production aids. Microcrystalline cheesewax (CAS #'s 64742-42-3, 8009-03-08, and 8002-74-2)—for use in log grown mushroom production. Must be made without either ethylene-propylene co-polymer or synthetic colors.

(p)-(z) [Reserved]

§205.602 Nonsynthetic substances prohibited for use in organic crop production.

The following nonsynthetic substances may not be used in organic crop production:

(a) Ash from manure burning.

(b) Arsenic.

(c) Calcium chloride, brine process is natural and prohibited for use except as a foliar spray to treat a physiological disorder associated with calcium uptake.
(d) Lead salts.

(e) Potassium chloride—unless derived from a mined source and applied in a manner that
minimizes chloride accumulation in the soil.

(f) Rotenone (CAS # 83-79-4).

(g) Sodium fluoaluminate (mined).

(h) Sodium nitrate—unless use is restricted to no more than 20% of the crop's total nitrogen
requirement; use in spirulina production is unrestricted until October 21, 2005.

(i) Strychnine.

(j) Tobacco dust (nicotine sulfate).


§205.605 Nonagricultural (nonorganic) substances allowed as ingredients in or on
processed products labeled as “organic” or “made with organic
(specified ingredients or food group(s)).”

The following nonagricultural substances may be used as ingredients in or on processed
products labeled as “organic” or “made with organic (specified ingredients or food group(s))”
only in accordance with any restrictions specified in this section.

(a) Nonsynthetics allowed:

Acids (Citric—produced by microbial fermentation of carbohydrate substances; and Lactic).

Agar-agar.

Animal enzymes—(Rennet—animals derived; Catalase—bovine liver; Animal lipase;
Pancreatin; Pepsin; and Trypsin).

Attapulgite—as a processing aid in the handling of plant and animal oils.

Bentonite.

Calcium carbonate.

Calcium chloride.
Calcium sulfate—mined.

Carrageenam.

Dairy cultures.

Diatomaceous earth—food filtering aid only.

Enzymes—must be derived from edible, nontoxic plants, nonpathogenic fungi, or nonpathogenic bacteria.

Flavors—nonsynthetic flavors may be used when organic flavors are not commercially available. All flavors must be derived from organic or nonsynthetic sources only and must not be produced using synthetic solvents and carrier systems or any artificial preservative.

Gellan gum (CAS # 71010-52-1)—high-acyl form only.

Glucono delta-lactone—production by the oxidation of D-glucose with bromine water is prohibited.

Kaolin.

L-Malic acid (CAS # 97-67-6).

Magnesium sulfate, nonsynthetic sources only.

Microorganisms—any food grade bacteria, fungi, and other microorganism.

Nitrogen—oil-free grades.

Oxygen—oil-free grades.

Perlite—for use only as a filter aid in food processing.

Potassium chloride.

Potassium iodide.

Sodium bicarbonate.

Sodium carbonate.

Tartaric acid—made from grape wine.
Waxes—nonsynthetic (Wood resin).

Yeast—When used as food or a fermentation agent in products labeled as “organic,” yeast must be organic if its end use is for human consumption; nonorganic yeast may be used when organic yeast is not commercially available. Growth on petrochemical substrate and sulfite waste liquor is prohibited. For smoked yeast, nonsynthetic smoke flavoring process must be documented.

(b) Synthetics allowed:

Acidified sodium chlorite—Secondary direct antimicrobial food treatment and indirect food contact surface sanitizing. Acidified with citric acid only.

Activated charcoal (CAS #s 7440-44-0; 64365-11-3)—only from vegetative sources; for use only as a filtering aid.

Alginates.

Alginic acid (CAS #9005-32-7)

Ammonium bicarbonate—for use only as a leavening agent.

Ammonium carbonate—for use only as a leavening agent.

Ascorbic acid.

Calcium citrate.

Calcium hydroxide.

Calcium phosphates (monobasic, dibasic, and tribasic).

Carbon dioxide.

Cellulose (CAS #9004-34-6)—for use in regenerative casings, powdered cellulose as an anti-caking agent (non-chlorine bleached) and filtering aid. Microcrystalline cellulose is prohibited.

Chlorine materials—disinfecting and sanitizing food contact surfaces, equipment and facilities may be used up to maximum labeled rates. Chlorine materials in water used in direct crop or food contact are permitted at levels approved by the FDA or EPA for such purpose, provided the use is followed by a rinse with potable water at or below the maximum residual disinfectant limit for the chlorine material under the Safe Drinking Water Act. Chlorine in water
used as an ingredient in organic food handling must not exceed the maximum residual disinfectant limit for the chlorine material under the Safe Drinking Water Act.

i. Calcium hypochlorite.

ii. Chlorine dioxide.

iii. Hypochlorous acid—generated from electrolyzed water.

iv. Sodium hypochlorite.

Ethylene—allowed for postharvest ripening of tropical fruit and degreening of citrus.

Ferrous sulfate—for iron enrichment or fortification of foods when required by regulation or recommended (independent organization).

Glycerides (mono and di)—for use only in drum drying of food.

Hydrogen peroxide.

Magnesium chloride—derived from sea water.

Magnesium stearate—for use only in agricultural products labeled “made with organic (specified ingredients or food group(s)),” prohibited in agricultural products labeled “organic”.

Nutrient vitamins and minerals, in accordance with 21 CFR 104.20, Nutritional Quality Guidelines For Foods.

Ozone.

Peracetic acid/Peroxyacetic acid (CAS # 79-21-0)—for use in wash and/or rinse water according to FDA limitations. For use as a sanitizer on food contact surfaces.

Phosphoric acid—cleaning of food-contact surfaces and equipment only.

Potassium carbonate.

Potassium citrate.

Potassium hydroxide—prohibited for use in lye peeling of fruits and vegetables except when used for peeling peaches.

Potassium lactate—for use as an antimicrobial agent and pH regulator only.
Potassium phosphate—for use only in agricultural products labeled “made with organic (specific ingredients or food group(s)),” prohibited in agricultural products labeled “organic”.

Silicon dioxide—Permitted as a defoamer. Allowed for other uses when organic rice hulls are not commercially available.

Sodium acid pyrophosphate (CAS # 7758-16-9)—for use only as a leavening agent.

Sodium citrate.

Sodium hydroxide—prohibited for use in lye peeling of fruits and vegetables.

Sodium lactate—for use as an antimicrobial agent and pH regulator only.

Sodium phosphates—for use only in dairy foods.

Sulfur dioxide—for use only in wine labeled “made with organic grapes,” Provided, That, total sulfite concentration does not exceed 100 ppm.

Tocopherols—derived from vegetable oil when rosemary extracts are not a suitable alternative.

Xanthan gum.

(c)-(z) [Reserved]

§205.606 Nonorganically produced agricultural products allowed as ingredients in or on processed products labeled as “organic.”

Only the following nonorganically produced agricultural products may be used as ingredients in or on processed products labeled as “organic,” only in accordance with any restrictions specified in this section, and only when the product is not commercially available in organic form.
(a) Carnauba wax

(b) Casings, from processed intestines.

(c) Celery powder.

(d) Colors derived from agricultural products—Must not be produced using synthetic solvents and carrier systems or any artificial preservative.

(1) Beet juice extract color—derived from *Beta vulgaris* L., except must not be produced from sugarbeets.

(2) Beta-carotene extract color—derived from carrots (*Daucus carota* L.) or algae (*Dunaliella salina)*.

(3) Black currant juice color—derived from *Ribes nigrum* L.

(4) Black/purple carrot juice color—derived from *Daucus carota* L.

(5) Blueberry juice color—derived from blueberries (*Vaccinium spp.*).

(6) Carrot juice color—derived from *Daucus carota* L.

(7) Cherry juice color—derived from *Prunus avium* (L.) L. or *Prunus cerasus* L.

(8) Chokeberry, aronia juice color—derived from *Aronia arbutifolia* (L.) Pers. or *Aronia melanocarpa* (Michx.) Elliott.

(9) Elderberry juice color—derived from *Sambucus nigra* L.

(10) Grape juice color—derived from *Vitis vinifera* L.

(11) Grape skin extract color—derived from *Vitis vinifera* L.

(12) Paprika color—derived from dried powder or vegetable oil extract of *Capsicum annuum* L.

(13) Pumpkin juice color—derived from *Cucurbita pepo* L. or *Cucurbita maxima* Duchesne.
(14) Purple sweet potato juice color—derived from *Ipomoea batatas* L. or *Solanum tuberosum* L.

(15) Red cabbage extract color—derived from *Brassica oleracea* L.

(16) Red radish extract color—derived from *Raphanus sativus* L.

(17) Saffron extract color—derived from *Crocus sativus* L.

(18) Turmeric extract color—derived from *Curcuma longa* L.

(e) Fish oil (Fatty acid CAS #'s: 10417-94-4, and 25167-62-8)—stabilized with organic ingredients or only with ingredients on the National List, §§205.605 and 205.606.

(f) Fructooligosaccharides (CAS # 308066-66-2).

(g) Gelatin (CAS # 9000-70-8).

(h) Glycerin (CAS # 56-81-5)—produced from agricultural source materials and processed using biological or mechanical/physical methods as described under §205.270(a).

(i) Gums—water extracted only (Arabic; Guar; Locust bean; and Carob bean).

(j) Inulin-oligofructose enriched (CAS # 9005-80-5).

(k) Kelp—for use only as a thickener and dietary supplement.

(l) Konjac flour (CAS # 37220-17-0).

(m) Lecithin—de-oiled.

(n) Orange pulp, dried.

(o) Orange shellac-unbleached (CAS # 9000-59-3).

(p) Pectin (non-amidated forms only).

(q) Potassium acid tartrate.

(r) Seaweed, Pacific kombu.

(s) Starches.
(1) Cornstarch (native).

(2) Sweet potato starch—for bean thread production only.

(t) Tragacanth gum (CAS #-9000-65-1).

(u) Turkish bay leaves.

(v) Wakame seaweed (Undaria pinnatifida).

(w) Whey protein concentrate.

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Academic Vita
Caitlin Hickey
cmh6196@psu.edu

EDUCATION
The Pennsylvania State University                             Date of Graduation: December 2019
Schreyer Honors College, Smeal College of Business                       University Park, PA
Master’s degree in Accounting Candidate

WORK EXPERIENCE
PricewaterhouseCoopers (PwC)                  June 2017- August 2019
Start and Advance Intern
Richmond, VA
• Designed an app particular to each of the three schools PwC recruits from
• Prepared audit documents with senior associates and associates within different sectors of PwC
• Created and used workflows and bots with different software programs to enhance future year audit work
• Presented and spoke with clients, business associates, and partners in meetings

The Bryn Student Housing                        August 2017-August 2018
Community Assistant (20-30 hours/week)          State College, PA
• Administered approximately 100 tours of the property for prospective residents
• Maintained professionalism in stressful situations during work and after-hours calls
• Assisted with bookkeeper duties through charges and payments to resident’s accounts
• Created and organized current and future resident’s files and leases

Gunter Hensley, P.C.                              May 2016- January 2017
Law Intern (27-28 hours/week)                      Winchester, VA
• Composed diligent notes for jury selection and consulted with lawyers about possible jury members
• Closed nearly 400 files and verified if balances had been paid in full
• Assembled and arranged court files as the case progressed through certain stages or as directed
• Organized and maintained approximately 1,400 criminal defense case files

Carmike Apple Blossom 12                              June 2016- August 2016
Concessions Staff Member (24-32hours/week)                               Winchester, VA
• Utilized upselling and cross-selling to exceed or meet 80% of sales quota
• Managed sales and transactions so cancelled sales remained under 10%

LEADERSHIP AND ACTIVITIES
Schreyer Student Council (StuCo)                         Fall 2015- Spring 2017
Member                                                   University Park, PA
• Achieved member status by attending weekly meetings and volunteering at events
• Led 9 Schreyer Honors College tours and sat on a discussion panel for prospective students and families around the Honors College
• Collaborated with other Student Council members in Schreyer’s merchandise sale to package and distribute beyond 50 orders
• Communicated with community members about the Schreyer Honors College at college events such as the Schreyer Tailgate and Accepted Students Day
• Volunteered with Student Council at State Day of Service and packaged about 10,000 meals for Stop Hunger Now

CONFERENCES/CERTIFICATIONS/ SKILLS/ INTERESTS
• Conferences: PwC Explore Penn State 2017 and 2018
• Certifications: Smeal Honor Code
• Skills: Intermediate level of understanding with software programs such as Word, Alteryx, and Excel
• Interests: Movie enthusiast, dedicated PSU and New York Giants football fan, and zealous music listener