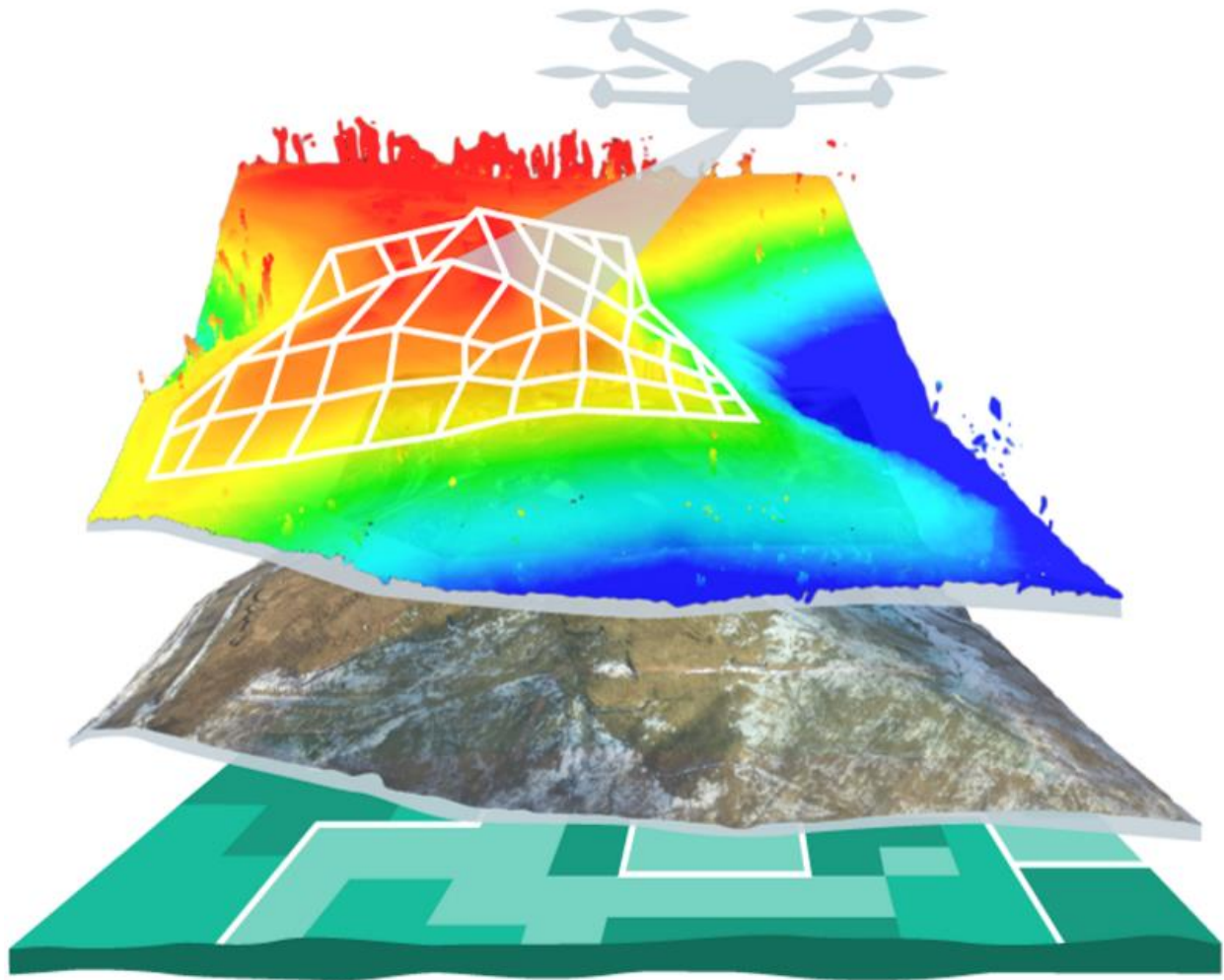


Aerial Survey Mapping Drones

A Non-Market Strategy Report for Identified Technologies



Identified

TECHNOLOGIES

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Disclaimer

Please note that the analysis conducted within this report was completed as part of a course project and is not intended to be referenced, quoted, or used as a primary source. The work presented was completed for our client, Identified Technologies, in the course "New Technology Commercialization: Public Policy Strategies" offered by the Department of Engineering and Public Policy at Carnegie Mellon University in the Spring 2016 semester.

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Executive Summary

Identified Technologies is a Pittsburgh-based startup founded in 2013 that offers a smart drone aerial mapping system called Boomerang, which provides continuous tracking and monitoring of commercial construction sites. The Boomerang Drone is an unmanned aerial vehicle (UAV) that represents a safer, cheaper, faster, and more accurate method of surveying and mapping active projects compared to alternative methods relying on manned surveyor crews, helicopters, and/or airplanes. Today the company's technology platform is primarily serving end-customers in energy and oilfield services and transportation, although expanding Boomerang's reach through new customer acquisition, potentially in new markets, remains the leading focus of management. In addition to the company's historical focus on attracting business from private commercial construction companies, the search for new customers with the potential to represent large revenue streams and long-term business relationships could be extended to capitalize on unique opportunities identified within the non-market environment.

An analysis of the non-market environment facing Identified Technologies yielded the following factors discussed within this report:

- **Issues:** Regulations imposed by the Federal Aviation Administration (FAA) on UAVs, privacy concerns of the general public, safety of workers on commercial construction sites, pressure to complete construction projects on time and on budget, time to project approval.
- **Interests:** Construction companies, land surveyor unions and trade groups, general public, competing UAV mapping platforms.
- **Institutions:** FAA, Defense Innovation Unit Experimental (DIUx), Pennsylvania Department of Transportation (PennDOT), Federal Emergency Management Agency (FEMA).
- **Information:** Head-to-head performance comparisons of Boomerang to alternative surveying technologies, live field demonstrations and webinars, desires of government agencies to foster public-private relationships, risks and responsibilities of UAV ownership and piloting.

Targeting specific programs and projects where there is a clear alignment of incentives would increase the potential of Identified Technologies successfully developing new channels for customer acquisition while overcoming and leveraging factors in the non-market environment. After careful analysis, the most effective option for Identified Technologies is to target a P3 project within PennDOT.

Recommendations: We recommend that Identified Technologies apply for highway construction projects within the state of Pennsylvania (and perhaps nationally) through PennDOT's P3 program. We also highly recommend that the company's prior experience with large highway construction projects is presented to assigned point of contact(s) in the form of data, results, and customer testimonies at the time of application.

Technology Overview

Commercial construction sites, which can span hundreds or even thousands of acres, place logistical burdens on construction companies tasked with overseeing project development and completion. Tracking the movement of materials and equipment, accurately analyzing the volume of earth required to be moved and sold, and monitoring progress for estimating project and phase completion dates creates safety, liability, monetary, and time issues for construction companies. Despite the need for timely and accurate data, the standard methods for surveying active construction sites rely on manned surveyor crews, helicopters, and/or aircraft. These fallible standards unnecessarily increase the safety risks to workers, add costs and time to projects, force stakeholders to use potentially inaccurate (earth volume estimates) or outdated (topographical maps) data, and create barriers to sharing and analyzing project site data and information among stakeholders.

Identified Technologies is focused on mitigating those risks and delivering value to industrial customers through the use of its smart drone aerial mapping system called Boomerang, which provides a scalable turnkey solution for continuous tracking, monitoring, and analysis of commercial construction projects. The autonomous UAV-driven technology platform is capable of creating 3-D site maps 200x faster than alternative surveying methods at significantly reduced costs.¹ The company also provides on-demand cloud-based data collection, processing, and analysis software tools that allow stakeholders to predict progress, collaborate remotely, and make informed decisions.

The smart drone technology platform comprises three parts:

1. LaunchPad docking station
2. Boomerang Drone
3. Cloud-based data analysis software

The LaunchPad docking station is a purpose-built device that prioritizes ease-of-use for the user and functionality. It serves as the “home base” for the Boomerang Drone throughout the duration of a project; swapping and charging the drone’s batteries when not in use and sending collected data to the cloud for customer analysis. As shown in Fig 1, the Boomerang Drone boasts a compact design with multimodal data acquisition capabilities, in addition to built-in safety features such as the ability to return to the LaunchPad if a GPS signal is lost. Meanwhile, the company’s cloud-based data analysis software is compatible in mobile and PC formats and provides various easy-to-use image and data analysis tools.

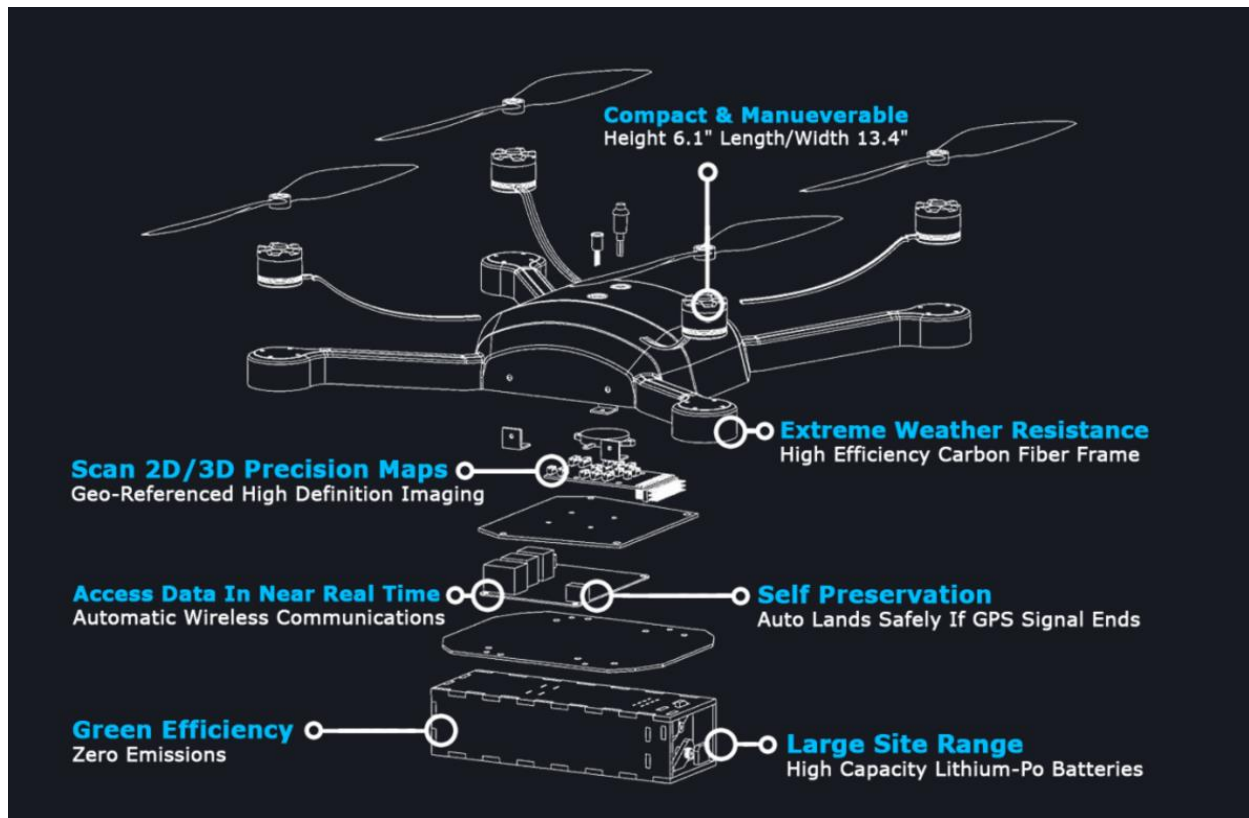


Figure 1: A breakdown of the components powering the Boomerang Drone.²

These three components of the technology platform combine for a powerful and effortless user experience. First, a user identifies and outlines the project site using the software provided by Identified Technologies. This information is provided to the drone as GPS coordinates. Second, the user opens the briefcase containing the LaunchPad docking station, places the Boomerang Drone on the docking station, and runs through a safety and compliance checklist to ensure safe and proper use of the UAV. Third, the user presses a button to initiate the autonomous mapping system and monitors progress until the Boomerang Drone completes its flight and returns safely to the LaunchPad docking station. The collected data is streamed to the cloud, where it can then be analyzed, processed, and discussed to inform project-related decisions and timelines.

Challenges & Opportunities

Challenges

Identified Technologies' efforts to develop additional channels for customer acquisition face several unique challenges inherent to the use UAVs and surveying systems that require consideration for any proposed strategy. After careful analysis and discussion these have been identified as follows:

Privacy concerns: The general public has expressed concerns about personal privacy from prying eyes in the sky. There exists an information gap between what data UAVs collect -- or even have the ability to collect -- and what the public thinks is possible when an aerial drone is spotted overhead. While privacy represents a challenge for any company leveraging UAVs, it does not currently represent a primary challenge for Identified Technologies. The majority of commercial construction projects completed by the company occur in areas that are not bordered by residential buildings. In the minority of projects that have raised public concerns, Identified Technologies has shifted the liability to the site managers, which requires them to educate the affected public and gain proper permissions where required. This has not represented a significant hindrance to customer acquisition to date, but may in the future as the industry matures or the business expands.³

FAA regulations: The FAA requires any operator of a UAV used for commercial use to gain a Commercial Exemption Authorization under Section 333 of Public Law 112-95. After achieving authorization, operators must obtain a Certificate of Authorization that alerts local FAA Air Traffic Control centers of proposed work and allows a full consideration of potential airspace conflicts. Even then, only licensed pilots may operate a drone for commercial purposes specifically outlined in the petition to the FAA. This represents a barrier to entry for companies looking to utilize UAVs for commercial use and forces Identified Technologies to not only apply for exemptions every two (2) years, but also to navigate regulatory pathways for its customers.^{4,5}

Opposition from competitors: Many emerging technology companies face fierce competition from market incumbents and other emergent innovators. Identified Technologies must compete head-to-head with other startups and with unauthorized and "rogue" UAV operators. Additionally, the company faces the risk of competing against established market incumbents with vested interests in using existing surveying technologies. Although we can find no occurrences to date, this competition has the potential to ally with key policymakers concerned with non-market factors including personal privacy of nearby residents and job losses of workers in incumbent industries. In a worst case scenario, such alliances could erect additional regulations and operating requirements that are detrimental to the company.³

Communication of benefits: While not uncommon for new companies, Identified Technologies has encountered challenges related to attracting the attention of potential customers and key

stakeholders and, of primary concern, convincing surveyors of the benefits to using UAVs for aerial surveyor mapping. “Once I’m in front of a potential customer the pitch is pretty straightforward. But our customers don’t always have full authority over the use of drones on a project,” said CEO Dick Zhang. That’s because construction companies -- Identified Technologies’ customers -- must earn approval from their clients -- the owner of the construction site or highway -- before utilizing UAVs for survey and/or site mapping. Getting client approval for commercial drone use isn’t always an issue, but it has resulted in some potentially large projects remaining off limits to the company after site owners objected to the use of UAVs for liability, privacy, internal policy, and other reasons. Additionally, surveyors may object to using drones for similarly broad reasons. Identified Technologies has responded to this challenge by creating case studies and white papers with key customers, updating its website in April 2016, running a company blog, and holding live (and webinar) field demonstrations of Boomerang Drones in action.³

Opportunities

Identified Technologies’ efforts to develop additional channels for customer acquisition face several unique opportunities inherent to the use UAVs and surveying systems that require consideration for any proposed strategy. After careful analysis and discussion these have been identified as follows:

FAA regulations and certifications: Identified Technologies can exploit FAA regulations, certifications, and liability coverages to acquire customers. In July 2015 the company was granted FAA Commercial Exemption Authorization 333 with thirty-one (31) conditions and limitations. The exemption remains current through July 2017. The company is also a registered ISN Contractor in ISNworld, which streamlines the process of vetting industrial contractors for safety records, insurance information, quality reports, and regulatory exemptions. Additionally, Identified Technologies maintains a \$5 million general liability insurance policy. Together, these combine to provide a powerful reassurance to potential customers about the ability of the company to remain in compliance and navigate regulatory pathways.^{3,4,5,6,7}

Safety: Annual data from the Bureau of Labor Statistics, the National Safety Council, and the Occupational Health and Safety Administration routinely rank occupations closely affiliated with surveying as the most dangerous jobs based on fatality rates and number of workers employed. These include construction, logging, and extractive occupations such as mining and well drilling. While the Occupational Health and Safety Act (OSHA) continues to improve worker safety and reduce worker fatalities, current best practices such as wearing fluorescent vests and hard hats and “remaining vigilant” still require workers to operate in potentially risky environments.⁷

These safety issues inherent to construction sites are uniquely mitigated and potentially eliminated by the use of the company’s aerial survey mapping system. Bill Clifford, Head Surveyor of Identified Technologies customer Kokosing Construction, strongly recommends the

company's autonomous solution to safety issues, saying, "The Boomerang Drone takes workers out of harm's way. You can just sit back safely and watch it work."⁸

Infrastructure budget concerns: Several analyses of Department of Transportation (DOT) projects in various states have discovered that highway and infrastructure projects are routinely completed over budget. This is particularly worrisome considering that budget cuts have resulted in a severe gap in available funds and required funds. In May 2015 WRAL, a local news organization in Raleigh, North Carolina, reported that 269 of 482 DOT projects in the state were over budget. The investigation found that one leading source of delays in the state was "the difficulty of building roads in mountainous regions", while moving earth represented another delay. Similarly, a 2012 report from the office of New York Governor Andrew Cuomo found that the state's DOT "consistently had overruns on its projects in the range of 7% to 11%, resulting in \$530 million in total overruns over the past five years. " As in North Carolina, geographical challenges also played a role in the delays.^{9,10}

Identified Technologies has experience working on highway construction projects in mountainous terrain, namely with Kokosing Construction in an expansion project completed in Elkhorn City, Kentucky. The project required the continuous monitoring of two 1,000 acre sites and the extraction of 33 million cubic yard of earth. By utilizing the Boomerang Drone, Kokosing Construction surveyed the entire site in a half day, compared to two months using manned survey crews and aircraft, and reduced project costs for those activities by \$105,000 -- a reduction of 86% compared to traditional methods.⁸

Job creation: The ability of surveyors to use the Boomerang Drone in a fraction of the time of manned survey crews allows construction companies, surveyor groups, engineers, and architects to reduce bottlenecks in their individual workflows, save costs, and increase the number of projects they can contribute to over a given period of time. Therefore, Identified Technologies' technology platform could represent an opportunity to create jobs in incumbent industries by leveraging emerging technology, which could be used as a powerful bargaining chip when interacting with policymakers and government stakeholders. This challenges of communicating this to surveyors remains an obstacle, however.³

The FAA requirement that UAVs used in commercial work must be operated by a licensed pilot presents another opportunity to create jobs. Pilots that complete their initial certification often face long wait times before becoming fully licensed to fly aircraft, while Identified Technologies needs access to licensed pilots. Thus, the company has created an on-demand network of intermediary pilots that can be tapped into for operating Boomerang Drones for customers.^{3,4}

Policy Context

After detailing the non-market challenges and opportunities facing Identified Technologies it was decided that targeting government projects and programs would have the greatest potential to result in increased customer acquisition while mitigating risks from non-market challenges and exploiting non-market opportunities. A successful relationship with a government agency may increase the company's market penetration, develop strong allies within key political bodies and geographical regions, help to communicate the benefits to surveyors, and reduce barriers to adoption of the technology platform. Therefore, the neutral policy question to be examined for the proposed strategy becomes:

What actions, if any, should Identified Technologies take to acquire government customers that can help to expand the reach of and educate key stakeholders about the advantages provided by its technology platform?

The following non-market strategy options were investigated for their ability to achieve an optimal outcome for the neutral policy question above.

Option	Description
Status Quo	Identified Technologies continues pursuing existing channels to acquire customers and respond to non-market factors.
Option 1	Identified Technologies engages with Defense Innovation Unit Experimental (DIUx) office to develop channel that provides matchmaking with and access to various Department of Defense (DoD) agencies.
Option 2	Identified Technologies applies for a P3 project with the Pennsylvania Department of Transportation (PennDOT) to work on new highway construction projects.
Option 3	Identified Technologies engages with the Federal Emergency Management Administration (FEMA) by providing emergency response solutions to first responders.

Table 2: Public policy strategy options for Identified Technologies.

These options are analyzed in more detail below.

Status Quo

As explained above, Identified Technologies is currently focus on expanding its business and acquiring customers through existing channels, which include working with previous industrial construction companies. In addition, the company has made a strong marketing effort with online

advertisements, a revamped website, media representations on TechCrunch and other platforms, and through conference presentations. In an attempt to address certain non-market factors and extinguish doubts, concerns, or questions about the ease of use and overall advantages of using aerial mapping systems the company has also held several live field demonstrations and webinars for interested parties, members of the media, and members of the general public.

Option 1 (DIUx)

The DIUx was established in summer 2015 to foster relationships between various agencies within the DoD and innovative startups. The pilot office is located in Mountain View, California -- near Silicon Valley -- and exists to act as the “point of contact” and “technical matchmaker” for entrepreneurs looking to expand their business while providing solutions to technology challenges identified by the DoD. Despite the focus in Silicon Valley, DIUx routinely engages with startup clusters in Boston, Massachusetts and Austin, Texas, among others. Not unlike investment-oriented startup accelerator programs, DIUx may require that a representative(s) from a young company establish a presence at the office for a brief period of time (i.e. months) to solidify potential relationships within the DoD.

Identified Technologies could leverage such a relationship to gain access to DoD agencies that could benefit from its aerial survey mapping technology. For example, the U.S. Army Corps of Engineers maintains various construction, maintenance, and restoration projects throughout the country that require monitoring, tracking, and surveying. Additionally, the U.S. Air Force needs to expand Eielson Air Force Base in Alaska to make room for two new squadrons of the F-35A joint strike fighters. Construction is expected to begin in 2017, while the squadrons may arrive by 2020. Given the controversial and significantly delayed development of the F-35A it will be important for the Air Force to reduce any risks of further delays to the next-generation fighter’s arrival.¹¹

Meanwhile, CEO Dick Zhang had previously been in contact with a three star general in one branch of the military discussing the difficulties and safety concerns of building new military bases in conflict regions, and how the company’s Boomerang Drone could significantly reduce those risks. Those discussions have since ceased, which means working with DIUx could provide a way to resurrect a potential partnership.³

Option 2 (PennDOT)

As with many other state Department of Transportation offices, PennDOT has established the P3 program, which aims to foster public-private partnerships that can address technology challenges identified by the agency. This program was established by the Public-Private Transportation Partnerships Act of 2012. There are two groups of P3 projects ^{12,13}:

1. *New Build Facilities*: Adding capacity to the system by building something new.
2. *Existing Facilities*: Improving capacity or performance of the current system through a P3 arrangement.

The application process can be completed by paper and online, although the decision making process can take months or longer. However, the application process could be aided by the fact that Identified Technologies has experience with large highway construction projects -- in mountainous terrain -- in Kentucky. That may allow data, customer testimonies and presentations, and other information to be submitted or presented as a case study to expedite a decision by PennDOT.⁸

Option 3 (FEMA)

CEO Dick Zhang expressed that he would entertain the idea of utilizing Boomerang Drones in emergency response applications in the future.³ As part of the Department of Homeland Security, FEMA has various opportunities for collaborating as vendors to provide any service for emergency response activities such as search and rescue or damage assessment operations. This occurs simultaneously with increased use of aerial drones in emergency response events, such as dropping supplies to stranded motorists, combatting and monitoring forest fires, and post-response surveying tasks.^{3,14}

There are three steps that could be taken by the company to build a partnership with FEMA. There is an emergency management agency for each state and Identified Technologies can liaise with Pennsylvania Emergency Management Agency to offer their services at the time of emergencies. This partnership can be further extended to the national level given the capacity and scale of the company.

Register the company with the System for Award Management (SAM). The free application is a requirement to do business with federal agencies and can be completed at www.sam.gov.

FEMA has an Industry Liaison Support program that facilitates the collaboration between industry vendors and emergency management agencies of state. It connects the company with the FEMA projects as and when required to give timely support to the disaster impacted in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act. A completed FEMA Profile needs to be submitted to the Industry Liaison Support Center, with two routes to completion:

1. Request a Vendor Profile Form or request a form via email.
2. Request a copy of the Program's Fact Sheet for reference.

Policy Forum

A diverse group of stakeholders, or actors, are affected by the proposed non-market strategy options, either sharing the benefits or absorbing the negative consequences. These include competitors, policymakers, program managers, and others who may play a role in advancing or opposing the actions taken by Identified Technologies. The relationships between each option and the stakeholders affected are presented and discussed below.

Option	Actors For	Actors Against
Status Quo: Continue pursuing existing channels to acquire customers and respond to non-market factors.	--	--
Option 1: Engage with DIUx office to develop channel that provides matchmaking with and access to various Department of Defense agencies.	DIUx, Pentagon officials, California lawmakers supporting DIUx program	Competing drone platforms within DIUx program
Option 2: Apply for a P3 project with PennDOT to work on new highway construction projects.	PennDOT, general public (taxpayers and motorists), local government officials eyeing infrastructure projects	General public (opposition to drones), NGOs against emerging technologies
Option 3: Collaborate with FEMA on emergency response programs.	FEMA, First responders, general public (faster response)	Competitors, Manned surveyors

Table 3: The forum for which the public policy strategy options for Identified Technologies will take place includes the actors above.

The relationships between actors and each option are explained in more detail in following sections.

Policy Option Analysis

We are evaluating policy options for Identified Technologies targeting government projects and programs in terms of their potential to result in increased customer acquisition while mitigating risks from non-market challenges and exploiting non-market opportunities. However, the four options considered exhibit varying degrees of effectiveness, efficiency, equity, and ease of political acceptability that must be evaluated for proper analysis. These are investigated below in Range of Outcomes and Bargaining Context.

Range of Outcomes

Effectiveness is defined as the likeliness that the proposed strategy achieves its desired outcome in the real world. *Efficiency* is defined as the costs of the proposed strategy weighed against the outcome achieved. Analysis of these two metrics provides insight into an option's ability to address the issue at hand.

Status Quo: The status quo involves using existing channels within the company's network to acquire customers and respond to issues in the non-market environment. This could successfully achieve the desired outcome with relatively low monetary and time investments, but the platform's current strategy may require longer to gain significant traction and expand the business than alternative strategies. In other words, the company's growth month-to-month and annual revenue run rate may attain a higher trajectory in the medium- to long-term under alternative strategies.



Option 1: The first alternative involves developing and subsequently leveraging a relationship with DIUx to gain access to partners and customers within the DoD. The mission of DIUx is to “cultivate and facilitate lasting relationships” between new innovators and the DoD, specifically the branches of the military and all Defense Agencies, by serving as the “point of presence” for the DoD. This includes a broad set of agencies representing all branches of the military and, perhaps of significance for the company's aerial survey mapping technology, the U.S. Army Corps of Engineers.

Given the alignment of incentives between Identified Technologies and DIUx, successfully building a relationship with the office could be a very effective strategy. While this alternative focuses on building a channel rather than pursuing a specific government customer or specific project, DIUx would help to pair the company's technology platform with customers that could derive the most value from it. However, there are several potential drawbacks to this policy

option. DIUx is a very new concept, having only opened a pilot office in Mountain View, California in August 2015, and appears to be primarily focused on innovation occurring within Silicon Valley. This does not rule out the potential for Identified Technologies to engage with DIUx, but the company will need to appoint a dedicated point of contact and may need to send a representative to the DIUx pilot office for a period of time to coordinate projects. This partially offsets the gains in efficiency obtained from the relatively frictionless alignment of incentives.



Option 2: The second alternative involves working with PennDOT to work on new highway or other construction projects. This option scores high in effectiveness for several reasons. Acquiring projects with the PennDOT could lead to a long-term relationship with the agency and result in a significant new source of revenue. Additionally, Identified Technologies could leverage PennDOT projects to build relationships with new industrial construction companies that previously would have been inaccessible, potentially leading to additional future work on non-PennDOT projects. The company's application could be further bolstered by past experience working on large highway construction projects in Kentucky that can be presented as a case study.

However, the costs to acquire such a project are relatively high. First, the company will need to appoint a dedicated point of contact to approach PennDOT. Second, the application and decision-making process for the public-private partnership program sponsored by PennDOT can take a significant amount of time to complete. Thus, this would not represent an ideal short-term strategy.



Option 3: The third alternative involves working directly with FEMA for its emergency response activities. FEMA can use the drone technology to assess the risks faster and obtain more accurate information on the emergency activity. It prevents putting lives to risk when they can deploy drones to do a task in risk-prone situations. Hence, this policy option would be very effective for FEMA first responders to use to deal with emergency response situations. However, pursuing this strategy requires developing the proper contacts and channels to gain access to the institution. Recently FEMA has been exploring new technologies like drones to make their response activities more effective. The Industry Liaison Support Program

facilitates the connection of the companies providing the required service to the FEMA projects at the time of need and hence improves the efficiency of this policy option. The company needs to go through two steps to build this liaison such as getting SAM certified and register for the liaison program. A successful liaison can prove to be beneficial to the company as the government agencies can first hand witness the utility of the product and can go a long way in affecting the FAA regulations to be in favor. While that may constitute some time investments to get the required documentation work done and potentially a point of contact to facilitate exchanges between FEMA and the company, the potentially high value to be gained from a successful outcome result in a positive efficiency score.

Effectiveness is scored using the following marks:

Plus (+): Outcome is likely to be achieved.

Minus (-): Outcome is not likely to be achieved.

Neutral (0): Outcome may or may not be achieved.

Efficiency is scored using the following marks:

Plus (+): The monetary and time costs are relatively low.

Minus (-): The monetary and time costs are relatively high.

Neutral (0): The monetary and time costs may or may not be relatively low or high.

The status quo and three identified options are evaluated in Table 4 below:

Option	Effectiveness	Efficiency
Status Quo: Continue pursuing existing channels to acquire customers and respond to non-market factors.	0	+
Option 1: Engage with DIUx office to develop channel that provides matchmaking with and access to various Department of Defense agencies.	++	0
Option 2: Apply for a P3 project with PennDOT to work on new highway construction projects.	++	0
Option 3: Collaborate with FEMA on emergency response programs.	+	+

Table 4: Range of Outcomes evaluation of the public policy strategy options for Identified Technologies.

Based on our analysis all options have the same rough scores for effectiveness and efficiency. Deeper analysis led us to believe that Option 1 (DIUx) and Option 2 (PennDOT) tie for the highest combined scores in effectiveness and efficiency. The potential requirement to send a company representative to the DIUx office in California significantly impacts the efficiency

score of Option 1, offsetting the efficiency gains from using the matchmaking channel to gain exposure and potential access to the DoD.

Meanwhile, the potential for the P3 program application to take months or longer partially offsets benefits provided by the company's experience in highway construction. If the company can make a convincing case by providing data and customer testimonies, perhaps with representatives from the Kentucky Department of Transportation, then Option 2 could have an improved efficiency score.

While Option 3 (FEMA) has the potential to be both effective and efficient, the magnitude of the net benefits is lower than that for Option 1 and Option 2. Even if a partnership is formed the ability to use UAVs is dependent on the occurrence of emergency response events. Additionally, we considered that time to response is a significant factor in emergency response efforts. That will make it difficult from a logistical standpoint to have UAVs in the right hands at the exact locations of emergencies at the time of the event.

Bargaining Context

Equity is defined as the consequences of the proposed strategy with respect to stakeholders. The metric provides an answer to the question, "How fair is the proposed policy?" *Ease of Political Acceptability* is defined as the likeliness that actors within the policy arena will accept or oppose the proposed strategy. Analysis of these two metrics provides insight into the likeliness that a proposed strategy is accepted by affected stakeholders and evaluates the amount of friction that may be encountered by the company.

Status Quo: The status quo involves using existing channels within the company's network to acquire customers and respond to issues in the non-market environment. Identified Technologies has worked to mitigate the negative equity consequences from competitors by positioning the Boomerang Drone as a value add for surveyor crews on its blog, with live demonstrations and webinars, and through customer relationships. However, due to size, funding, and focus the company has not engaged with policymakers about the potential advantages and benefits of its technology platform. This extends additional benefits to and increases the importance of acquiring a government customer, which could potentially serve as a powerful ally. Overall, and as stated in the previous section, the lack of traction with the status quo to date makes it worth evaluating alternative policy strategies.



DEFENSE INNOVATION
UNIT EXPERIMENTAL

Option 1: The first alternative involves developing and subsequently leveraging a relationship with DIUx to gain access to partners and customers within the DoD. If this strategy is successfully pursued there are many fewer direct stakeholders to consider, which are mostly concentrated in government and the DoD. Overall, Option 3 is highly equitable due to the alignment of incentives between DIUx and Identified Technologies. The office will need high profile wins to showcase, especially considering that DIUx is a new experiment. Politicians could similarly use successful partnerships grown from DIUx to describe how innovation is taking place. There is no reason that equity or ease of political acceptability would be negatively affected by from potentially working with the company.



Option 2: The second alternative involves working with PennDOT to work on new highway or other construction projects. The second option is highly equitable for the customers (PennDOT) and the public. While PennDOT benefits from the use of drones because they save time and money, the public also benefits because less taxpayer money is spent on construction projects and the use of drones also mitigates traffic issues during construction phases. Other aerial surveying groups relying on helicopter and aircraft would be negatively affected through loss of work, but they are not powerful stakeholders and thus exhibit little, if any, influence.



FEMA

Option 3: The third alternative involves working directly with the Pennsylvania state agency of FEMA for emergency response activities. If this strategy is successfully pursued there are numerous stakeholders to consider. It is assumed that Identified Technologies would displace existing surveying crews and companies, if not immediately, then at least gradually over time. This would represent a major net benefit to FEMA, which would acquire higher quality data at a fraction of the cost, in a fraction of the time, and from a greatly consolidated list of partners. Communities would benefit from the faster and more efficient solution of analyzing and assessing the risk of the disaster situations by getting timely support. Additionally, since the cost would also go

down from using the technology platform of Identified Technologies, then taxpayers would get monetary benefits. Since this policy option entails a broader social viewpoint of drone technology use for risk mitigation, the competitors stand neutral on equity as the most relevant vendor will be selected for the job as needed.

Equity is scored using the following marks:

Plus (+): The strategy represents a net benefit to stakeholder(s).

Minus (-): The strategy represents a net negative to stakeholder(s).

Neutral (0): The strategy may or may not have net consequences for stakeholder(s).

Ease of Political Acceptability is scored using the following marks:

Plus (+): The strategy is likely to be accepted by stakeholder(s).

Minus (-): The strategy is likely to be opposed by stakeholder(s).

Neutral (0): The strategy may or may not elicit a reaction from stakeholder(s).

The equity with respect to specific groups of stakeholders of the status quo and three identified options are evaluated in Table 5 below:

Option	Equity (Customers)	Equity (Public)	Equity (Competitors)
Status Quo: Continue pursuing existing channels to acquire customers and respond to non-market factors.	+	0	-
Option 1: Engage with DIUx office to develop channel that provides matchmaking with and access to various Department of Defense agencies.	+++	0	0
Option 2: Apply for a P3 project with PennDOT to work on new highway construction projects.	+++	+	-
Option 3: Collaborate with FEMA on emergency response programs.	++	++	0

Table 5: Equity evaluation of the public policy strategy options for Identified Technologies.

The overall equity and ease of political acceptability to all stakeholders of the status quo and three identified options are evaluated in Table 6 below:

Option	Equity (Overall Score)	Ease of Political Acceptability
Status Quo: Continue pursuing existing channels to acquire customers and respond to non-market factors.	0	+
Option 1: Engage with DIUx office to develop channel that provides matchmaking with and access to various Department of Defense agencies.	+	+++
Option 2: Apply for a P3 project with PennDOT to work on new highway construction projects.	++	++
Option 3: Collaborate with FEMA on emergency response programs.	++	++

Table 6: Bargaining Context evaluation of the public policy strategy options for Identified Technologies.

Based on our analysis all options have the same rough scores for equity and ease of political acceptability. Deeper analysis led us to believe that Option 2 (PennDOT) and Option 3 (FEMA) score the highest in combined scores in equity and ease of political acceptability, with an edge to Option 2. To determine the outcomes we utilized a Prince Analysis to weigh the power, position, and priority of stakeholders affected by each option and to determine a score that represented the ability of Identified Technologies to implement each option.

The final scores, with 100% representing a very frictionless path to implementation, are presented below.

- Option 1 (DIUx): 78.6%
- Option 2 (PennDOT): 90.7%
- Option 3 (FEMA): 85.4%

Our analysis led us to believe that budget pressures and significant delays in transportation-related construction projects (which further increase budget overruns) are a significant concern of PennDOT, which extends a relatively high priority score. Combined with being a powerful stakeholder, this results in a very high impact on this policy option. Meanwhile, Identified Technologies’ prior experience with highway construction projects presents an opportunity to potentially persuade land surveyors, which are net opposers to the policy option, to lessen their opposition with the correct campaign and/or allies.

Option 3 scores highly due to the circumstances surrounding emergency response, which we believe would result in less opposition to utilizing an emerging technology based on cognitive biases in risk assessment. In other words, the potential benefits to using UAVs in emergency response supersede concerns such as privacy. However, as in Range of Outcomes above, this strategy is limited by the occurrence of emergency events and logistical limitations to distributing Boomerang Drones.

Option 1 scores the lowest in the Prince Analysis due to several factors. Although DIUx and the company share aligned incentives to foster a relationship, the office has no particular preference for Identified Technologies over competitors, nor is the potential for real business guaranteed. If the company goes into a DIUx partnership with previous experiences (discussions with the military general) or specific projects (working with the U.S. Air Force to expand Eielson Air Force Base in Alaska) in mind, then the score may improve. Given the power of the U.S. Air Force and the pressure to ensure a smooth arrival for the F-35A next-generation fighter jet, this could result in a significant increase in score.

Strategy & Arguments

What actions, if any, should Identified Technologies take to acquire government customers that can help to expand the reach of and educate key stakeholders about the advantages provided by its technology platform?

Based on the analysis and discussion presented above we recommend that Identified Technologies take action to acquire customers and educate key stakeholders about the advantages of its aerial survey mapping technology platform by targeting projects through PennDOT's P3 program. This can be initiated with several first steps:

1. Apply for a P3 project in Pennsylvania of either type:
 - a. *New Build Facilities*: Adding capacity to the system by building something new.
 - b. *Existing Facilities*: Improving capacity or performance of the current system through a P3 arrangement.
2. CEO Dick Zhang mentioned that he was aware of several planned highway construction projects in Pennsylvania. If these are still available and can be identified, then we recommend making the assigned point of contact(s) within PennDOT aware of these projects.
3. We highly recommend that the company prepare data, results, and customer testimonies from prior highway construction projects in Kentucky with Kokosing Construction. Additionally, it is paramount to make the assigned point of contact(s) within PennDOT aware of this experience at the time of application.

Additionally, given that prior highway construction occurred out of state, Identified Technologies could also apply for national P3 projects with the U.S. Department of Transportation Federal Highway Administration (FHWA). For nationwide P3 projects, we recommend contacting FHWA Office of Innovative Program Delivery, specifically P3 Project Manager Patrick DeCorla-Souza at 202-366-4076 or patrick.decorla-souza@dot.gov or Senior Advisor Darren Timothy at 202-366-4051 or darren.timothy@dot.gov.

References

- [1] "Why Land Mapping Drones Are a Surveyors Best Friend - Identified Technologies." *Identified Technologies*. 08 Apr. 2016. Web.
- [2] *Identified Technologies - Tech*. 15 Mar. 2016. Web.
- [3] "Interview with Identified Technologies CEO Dick Zhang." Personal interview. 1 Apr. 2016.
- [4] "U.S. Department of Transportation, Federal Aviation Administration Notice of Exemption Status Regarding Section 333." Letter to Identified Technologies Legal Counsel. 20 July 2015.
- [5] "White Paper: Ready for FAA Inspection?" Rev. of *Identified Technologies Website*. Identified Technologies, 2015.
- [6] "Contractor Management Services: Our Process." *What We Do*. ISN.
- [7] Glassey, R. William, LS. "Developing a Safety Plan." *American Surveyor* Dec. 2004. Web.
- [8] "White Paper: How Can Drones Stop My Projects From Going Late and Over Budget?" Rev. of *Identified Technologies Website*. Identified Technologies. 2015.
- [9] "Progress Report: Many NC Road Projects Are over Budget, Overdue :: WRAL.com." *WRAL.com*. 12 May 2015. Web.
- [10] "Governor Cuomo Announces New Reforms Designed to Keep State Highway Construction Projects on Budget and on Time." *Governor Andrew M. Cuomo*. 28 Sept. 2014. Web.
- [11] "Alaska Air Force Base To Get F-35s in 2020." *Defense News*. Web.
- [12] H.R. 2012-88, 88 Cong. (2012) (enacted).
- [13] "PennDOT Public-Private Partnerships." *Public-Private Partnerships*. Web.
- [14] "Pennsylvania Emergency Management Agency." PEMA. Web.