



Falcon V Final Report

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Falcon V Quadcopter

Mission:

- Make engineering inspection safer, quicker, and more versatile.

Problem:

- Engineering site inspections require long trips followed by a manual inspection that requires the inspector to assess many different parts by hand, often in precarious places.
- If the inspection process was quicker, time, money, and lives could be saved.

Product/Services:

- Our product is a remote drone inspection system consisting of a quadcopter controlled by a glove motion sensor and a camera which outputs three-dimensional video to an external headset.
- This solution removes the human factor from inspection sites, and allows the inspector to remotely observe and record without having to traverse dangerous environments.

Target Market:

- The market we intend to corner is the structural engineering inspection market, with the opportunity to further expand into cartography, surveillance, and hobbyist markets.
- We estimate our target market to be worth around \$60 million.

Customers:

- Our main customer for this market will be structural engineering managers working for structural inspection firms.

Sales/Marketing Strategy:

- We intend to distribute our product by going to engineering conferences and marketing to potential buyers in person.
- It is estimated that our system can help save up to a full day in travel time depending on site location, saving the company as much as \$460 per individual inspection.

Business Model:

- We intend to sell our product for \$4,500 in a one-time up front cost to the consumer, with costs for maintenance as required.
- We also intend to have high-margin upgrades as an option, such as extending battery life or premium parts.

Competitors:

- Our main competition is the current system of manual inspection.

Competitive Advantage:

- We are currently the only company addressing the issue of structural inspection time and monetary costs.

Product Status:

- Our quadcopter is capable of flight and all lines of communication from the glove to the motors are operational.
- The android application displays live 3D video to the user phone.

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INTRODUCTION

Problem

Modern infrastructure is large, and thousands of people can be injured in the event of an infrastructure failure. Such failures have occurred many times in the history of the United States, with structures such as bridges collapsing many years before expected and leading to the deaths of many innocent people. It is because of this that these structures are monitored regularly by firms specializing in commercial construction inspection. If more inspections can be done, there is a greater chance at catching potential failures before they happen.

Unfortunately, commercial construction inspections are lengthy and expensive - often spanning several days and involving a team of five or more to complete. In addition, the inspectors themselves are often put in hazardous situations which is a potential liability to the inspection company managing the job. These inspection companies further have to deal with large costs in time spent on each job and personal liability insurance for their inspectors. All of these factors limit the number of inspections which can be done by an individual firm.

Need

Construction inspection companies need to reduce the costs associated with the current way of doing inspections. More specifically, these inspection companies need a way to shorten the time required to complete each job and to reduce risk for their inspectors. This will result in reduced personal liability insurance costs and reduced costs for time saved from each job, and will allow for more inspections to be performed, ensuring the safety of these structures.

Goal

The goal of the Falcon V project is to create a system which decreases the cost and time requirements associated with performing inspections of structures. This system must also allow an inspector to perform all duties they would normally perform on an inspection, and ensure the safety of the inspector during the inspection.

In particular, the Falcon V will be a complete drone package which allows users to fly a quadcopter from far away. It will be able to connect to the internet via Wi-Fi for the transmission of flight commands and live video feed. The user will be able to control the quadcopter from their office with a headset and glove where the tilt of their hand will control the tilt of the drone, and the tilt of the headset will control the rotation and altitude. This system will allow inspectors to perform their inspections as normal without needing to put themselves in danger or waste time and money on travel.

Deliverables

The full Falcon V package includes a fully operation quadcopter with onboard camera, a headset to hold an Android cellphone, a motion sensing glove, an Android app, a lithium ion battery balancer to safely charge the lithium ion battery, and a user manual with detailed instructions about how to use the Falcon V.

Significance

The Falcon V will save engineers' time by enabling them to check up on the sites they are responsible for or are working on without having to take a full day or more simply for travel. This in turn saves the engineer's company money because it does not have to pay the engineer for unproductive time. Additionally, the engineer will be able to manage more sites because they have to spend less time on the ground at each specific site.

This technology may also be of interest to users doing other forms of observation, such as those wishing to perform search and rescue operations. For example, firefighters can use this technology to fly into and search buildings heavily damaged by fire for potential survivors among the damaged structure without needing to put themselves in danger.

MARKET RESEARCH

Market Segmentation

As a first step in establishing the beachhead market, seven markets relevant to the Falcon V project were investigated. The markets were inspection, cartography, search and rescue, virtual tourism, cinematography, surveillance, and racing. The data discovered from this primary market research is displayed in the market segmentation table below.

Table 1 - Market Segmentation

| Industry | Inspection | Cartography | Security | Travel | Search and Rescue | Racing | Movies |
|------------------------|--|--|---|---|--|---|---|
| End User | ◆ Structural Engineers | ◆ Cartographer Technician | ◆ Security Operator | ◆ Tourist | ◆ First responders | ◆ Drone Flyers | ◆ Camera man |
| Application | ◆ Image Acquisition | ◆ Image Acquisition ◆ Create "Street Views" | ◆ Surveillance | ◆ Virtual Tourism | ◆ Surveillance ◆ Initial step to locating object | ◆ Racing | ◆ Filming |
| Benefits | ◆ Ease of Use ◆ Remote Access | ◆ Replace cars | ◆ Always have full view | ◆ Remote access ◆ Ease of use | ◆ Remote access ◆ Cost | ◆ Ease of use | ◆ New perspectives ◆ Cost |
| Lead Customers | ◆ Authorized Inspection Associates LLC ◆ Arise Boiler Inspection and Insurance Company Risk Retention Group | ◆ Google Maps ◆ MapQuest | ◆ Prisons-State and Local Gov. ◆ Malls | ◆ Vantage ◆ Global Work and Travel Co. ◆ Global Vacation Network ◆ smarTours | ◆ Coast Guard ◆ Explorer SAR ◆ Mountain Rescue Association | ◆ Aerial Drone Prix Participant ◆ International Drone Racing Association Participant | ◆ Warner Bros. ◆ Disney ◆ Sony Pictures |
| Market Characteristics | ◆ Pressure to reduce errors | ◆ Hiring drivers is expensive | ◆ Well funded | ◆ Cheap alternative to physical travel | ◆ Cheaper to get aerial views | ◆ Market lacks a go-to place to buy racing drones | ◆ Well funded |
| Size of Market | ◆ 20,000 | ◆ X,000 | ◆ X00,000 | ◆ X0,000 | ◆ X00 | ◆ X00 | ◆ X,000 |

| Industry | Inspection | Cartography | Security | Travel | Search and Rescue | Racing | Movies |
|-------------|--------------|--------------|-------------------------|----------------|-------------------|---------------------------------------|-----------------------------|
| Competition | ◆ None found | ◆ None found | ◆ Large Military Drones | ◆ Google Earth | ◆ Helicopters | ◆ Enthusiasts ◆ Small online shops | ◆ Current Camera technology |

Beachhead Market (BHM)

The inspection market was chosen to be the beachhead market, with an emphasis on structural engineers in Texas. This geographic area has the most need for the Falcon V system since the state of Texas is large relative to others and has more bridges than any other state. Out of all researched markets, it also has the least known competition. Currently, the technology that enables structural engineers to perform drone inspections remotely from their office does not exist.

Also considered were several other markets. Cartography, surveillance and racing were the next best options. Google currently uses cars to create their maps, which is costly. The Falcon V system could replace the cars entirely to perform these scans; however, this would require a significant redesign to the system since current design focuses on streaming video rather than 3D renderings. It also may be hard to convince Google to switch to the system since the need may not be as great anymore given that they have already created maps for a large percentage of the world.

Surveillance was the next highest consideration, particularly focusing on security systems for areas such as prisons. Currently, cameras rotate back and forth to cover an area, which means that there will be blind spots. However, the Falcon V quadcopter system would be able to provide a view over a large area with minimal blind spots. Unfortunately, this may be viewed as only a minor upgrade over current cameras. Therefore, it was decided that the market need was not significant enough.

Finally, racing drones is a relatively new market. There does not currently exist a single go-to place to buy racing drones. Customers rely on buying these drones from hobbyists who build them and sell them on their personal website. The need for a commercial business that sells racing drones does exist, however the size of the market is too small at this time. After weighing all of these factors, it was decided that the inspection industry had the best balance of need and market size. If successful in this market, the Falcon V could then be easily modified to suit similar applications in order to expand at a later date.

Total Addressable Market (TAM)

In order to calculate the initial total addressable market, data gathered from the Bureau of Labor Statistics was collected. In Texas, according to the BLS, there are 24,000 structural engineers. It was also found that, on average, most companies have a 5 to 1 ratio of engineers to managers. The actual field engineer would be the end user, so this ratio was used to reduce the market size to 20,000 engineers.

In order to price the product, basic quadcopter selling price was researched. Our product is similar to the Phantom quadcopters, which has a minimum price of \$800. Our product does much more than this basic model, and after researching the prices of the more advanced quadcopters, it was decided that around \$4,500 would be a good price. This is also in the price range of inspection quadcopters for other industries.

Since structural engineers perform a large number of inspections, it would make sense for every engineer to have one in order to avoid scheduling conflicts when using it. Therefore, in order to calculate the TAM the number of end users (20,000) was multiplied by the price of one unit (\$4,500); this calculation comes out to \$90 million. This TAM is a good size since it falls within the desired range of \$20 to \$100 million.

In the future, it would be needed to perform more PMR to create categories for the companies that are potential customers. These categories would more accurately predict the ratio of engineers to managers. This ratio largely depends on the size of the company and the scope of the work. Some companies have a ratio as high as 20 to 1 and as low as 2 to 1. Due to this wide variety, the total number of end users will probably change. However, the TAM is well within the healthy range, so it is not expected that this will cause the market to end up being either too small or too large.

End User Profile

The end user of the Falcon V quadcopter will be a structural engineer in the state of Texas. Particular focus is given to engineers in the age range of 25-35 because it is assumed that the younger age groups are more likely to adopt new technology. Gender does not impact the product design, but it is worth noting that in this sector of work there are two times more men than women. The end user would have an undergraduate degree in engineering, as well as a possible graduate degree. The end user will believe that this drone inspection system can replace the antiquated system of sending people out to the field. Engineers are motivated by the desire to be recognized for their work. They are prideful people and want to do the best job possible. Therefore, they will want to use technology that will make it less likely to make mistakes. The Falcon V system will allow engineers to more frequently check-up on structures around the state which will allow them to be more certain about their findings.

Table 2 - End User Profile

| Engineering Inspector | |
|-----------------------|--|
| Gender | Male (66%) Female (33%) |
| Age | 25-35 |
| Income | \$65,000 - \$120,000 |
| Education | At least a bachelors degree in engineering |
| History | Believes that the Falcon V drone inspection system can replace the antiquated system of sending people out to the field and can save time, money, and man-hours. |
| Context | It is assumed that engineers frequently enjoy using new technology, so an inspector would likely see this product as an improvement |
| Personality | Engineers are typically prideful with a desire to be recognized for their performance. They tend to take only calculated risks. |