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BA 385
04/31/2018
HW #3

Section 1: Issue Identification and Significance

If the government of one country denies launch clearance to a company, is it ethical for them to turn to a launch service provider in another country which has fewer restrictions?

The issue that I have identified is the illegal launch of micro satellites into space by Swarm Technologies. A Silicon Valley commercial space startup founded by former execs from Apple and Google, Swarm had applied for launch clearance to fly the first four of what they billed as "the world's smallest two-way communication satellites" (Murdock, Newsweek). These satellites, dubbed SpaceBEE 1-4, are meant to demonstrate a proof of concept for "Internet of Things" (IoT) applications using distributed computing and communications technologies.

All commercial satellite companies in the US must get regulatory clearance before any payload can be handed off to a launch provider (such as SpaceX). The Federal Communications Commission denied the application, claiming that the satellites were too small for the Air Force to accurately track. The Air Force's Space Surveillance Network tracks satellites and other objects in orbit to act as a warning mechanism for potential collisions. This is important because debris, or "space junk" is a growing concern around near-earth space and has resulted in damaged space craft in the past. Space junk also poses a safety risk to people in orbit and is just one of the challenges that must be addressed before there can be a valid space-tourism industry (see the movie "Gravity" for a dramatic portrayal of how this may present real dangers of people in space).

When Swarm Technologies received notice that the planned satellite swarm had been denied broadcasting licenses, apparently the decision makers at Swarm chose to go ahead with a launch scheduled with the Indian Space Research Organization (ISRO), telling their launch scheduling and compliance broker, Spaceflight Industries that the FCC license was pending. There is no indication that ISRO was aware of the Swarm's prior rejection by the FCC at that point, and they

agreed to launch the company's products into orbit. This took place on January 12, 2018 (Sheetz, CNBC).

The Triggering Event

The FCC did not learn about Swarm's circumvention until seemingly just prior to March 7, at which point they sent a message to Swarm CEO Sara Spangelo declaring that they had begun an investigation of the company's "apparently unauthorized launch" (The Atlantic) and suspended a grant to Swarm on the grounds that the company may have been non-compliant (space.com). IEEE Spectrum (a magazine written by the electrical engineers' professional association) reported the story on March 9th, thus breaking the story to the public. Neither the FCC nor Swarm commented for the story at the time.

Since the story broke, the FCC has stated that any company that follows Swarm's example will certainly face repercussions, although what those consequences are have not yet been specified (Henry, Spacenews.com). These consequences and other effects of this event will be discussed further below.

Perspective

I had originally planned to take the perspective of Sara Spangelo, the CEO of Swarm Technologies. She is an interesting character not only because of the actions of her company, but also in light of her past history as a systems engineer for both Google and NASA's Jet Propulsion Laboratory. However, she and her company have gone completely dark since this event as of the time that I'm writing this piece.

Due to the lack of information regarding Spangelo's handling of the situation (except that she is staying out of public sight) I have opted to shift away from her perspective and instead to provide my own perspective. There are two closely related reasons for this:

1. I intend to form my own satellite manufacturing company within the next few years, with a focus of working on some experimental designs which might also be subject to regulatory hurdles.

2. Any such venture that I start will be subjected to the changes in legislation that occur partially as a result of this situation.

Therefore, I will write the third part of this report from the perspective of myself. My company is called SmallSat PDX (SS PDX), which has two main business models:

a) Taking contracts to build specialized custom designed CubeSats for businesses and educational institutions.

b) Developing experimental telecommunications technologies for use in low earth orbit. Its would be this secondary function that is most strongly affected by the current events.

We will go forward assuming that I have such an experimental satellite to put in orbit for a very important client, but that it is the responsibility of SS PDX to make sure that it gets there. The client is very eager to have the satellite put in space to demonstrate its capabilities as soon as is possible so that they can swiftly push its capabilities to market, yet the FCC (the same agency that has refused to clear Swarm's satellites for launch) keeps delaying final approval due to lingering concerns about the satellite's unique design (which is proprietary information).

Significance of the Issue

The United States government must take situations like this very seriously, because as Jon Kelvey of Slate Magazine reports, "Swarm's activities may have also made the US non-compliant with its international treaty obligations." According to international law, all nations are responsible for the actions of their citizens in space. Thus, if the satellites fail in orbit, and then due to being too difficult to track, they collided with another nation's spacecraft, the United States would be liable in international court. Swarm's actions may be leading to a tightening of the reigns by regulatory agencies worldwide, making it harder for commercial companies to have spacecraft approved before they can be sent into orbit.

Other significant factors that this incident brings to light are the lack of coordination between federal government agencies. For example, there are implications that NASA's Small Spacecraft Technology Program out of the Ames Research Center helped to pay for the unauthorized launch.

Section 2: Stakeholder Identification and Prioritization

The stakeholders impacted by the unauthorized launch of the Swarm satellites include astronauts, several government agencies within the United States, foreign and international governing bodies, the commercial space sector, and members of the general public who use satellite-based technologies.

Stakeholders		Stakes
1.	Astronauts in orbit	Risk of death if impacted by orbital space debris.
2.	Swarm Tech management	Potential legal repercussions if involved in decision making regarding the unauthorized launch.
3.	NASA/other space-faring organizations	Risk of personnel loss or damaged assets in orbit.
4.	Federal Communication Commission (FCC)	Needs to investigate and assess appropriate actions to take due to Swarm's non-compliance.
5.	Phi Robotics Research Pvt. Ltd	Potential loss of a business partner, risk of being held liable.
6.	US Federal Government	According to the UN Space Treaty is potentially liable for damages accrued if SpaceBEEs cause damage to foreign assets.
7.	Indian Space Research Agency (ISRA)	May also be complicit under international law.
8.	UN Space Treaty	Regulatory functions need to be assessed and possibly rewritten in light of the incident.
9.	International Telecommunication Union	Must enforce international telecommunication standards and coordinate FCC and other national communication laws, which may need rewriting after this incident.
10.	US Air Force	May need to evaluate satellite tracking policies and repercussions for regulatory noncompliance.
11.	Swarm Tech employees	Risk of lay-off.
12.	Launch Providers	Must assess customer contracting policies to prevent liability in case of future unauthorized payloads.
13.	US Taxpayers	Wasted tax-payer money on subsidies and grants.
14.	US Small Business Administration	Wasted tax-payer money on subsidies and grants.
15.	DARPA	Wasted tax-payer money on subsidies and grants.
16.	US Navy	Wasted tax-payer money on subsidies and grants.
17.	NASA Ames Research	Wasted tax-payer money on subsidies and grants.

18.	Social Capital VC	Wasted capital investment/ no ROI.
19.	National Science Foundation	Wasted research grant money.
20.	Business partners (unnamed)	Wasted product research and infrastructure development for satellite communications.
21.	Consumers	Incident may have pushed back satellite connected Internet-of-Things technology by several years.

Top 3 Legitimate Stakeholders (also in red above)	**1.** Astronauts in Orbit	These are the most legitimate stakeholders because their lives are put at increased risk of collision with space debris in low earth orbit.
	2. US Government	Under international law, the US Government is liable for damages that Swarm Tech's actions may cause to assets and personnel of other nations.
	3. Swarm Technology Employees	Swarm employees are almost certainly laid off, with the most likely repercussion of noncompliance being that the company will no longer be able to operate in space.

Top 3 Most Powerful Stakeholders (also in blue above)	**1.** UN Space Treaty	This regulatory function of the United Nations, being ratified by the United States in 1967, holds the US liable for any damages caused by itself or its citizens in space. The law was not written with individual companies acting on their self-interest in mind.
	2. Federal Communications Commission	This regulatory function of the United States had already denied Swarm Technologies a license to broadcast in space. It is under the FCC's purview that Swarm Technologies will face repercussions.
	3. US Air Force	The Air Force is currently the military branch in charge of monitoring space-based activities. They have the power to leverage additional penalties on Swarm Technologies if it deemed appropriate.

Section 3: Recommended Actions and Response

Now I will outline the steps that this incident has revealed that we must take for our own company, and the long-term strategic response. First, I will outline the potential actions that we could take with an analysis of why that could be an option. Then I will follow with a

recommendation and then discuss the implementation of the recommendation and its implications.

Potential Actions

The first action that we will consider will be the simplest: to wait and see what the ultimate consequences will be for Swarm Technologies. Especially given the uncertainty of this situation and its outcomes, with no clear news either from Swarm or the government in the interim, the safest bet would seem to be to wait and see what transpires and how the regulatory landscape changes.

Another "easy" option would be to cancel the contract for the satellite that the FCC will not approve to broadcast. Testing new technologies in orbit is only one facet of SS PDX, and it does not guarantee future profit. For discussion's sake, we will also consider trying to get away with performing a similar action as Swarm did, by finding a foreign launch provider and taking advantage of the apparent lack of coordination between the different government agencies.

The fourth option would be to meet with our business partner to discuss the situation and the possibility of modifying the satellite design to be within expectations of what the FCC would deem acceptable. Finally, we will consider working more directly with the regulators to try to speed up our process of getting approval.

Action 1: Waiting it out

As mentioned above, this would be the simplest action to take. SS PDX's main channel of business should be able to provide enough of a contribution to annual profit that we could get away with deferring any action on this particular contract in the meantime. This is not a satisfactory option, however for because our client could be an important long-term business partner. This partner is hoping to use this technology to roll out a new consumer telecommunications service that stands to bring in a significant amount of revenue if successful, but they are not the only company working to provide this type of service.

Action 2: Cancel the Contract

This option has similar problems to the first one, though it could be worse. In addition to the aforementioned issue of wanting to keep our customer's long-term business, we also don't want to start a precedent of canceling already established contracts that are near completion. Not would SS PDX lose the initial investment in the project, but we would also risk losing business to competitors with a better reputation for following through with their commitments.

Action 3: Circumvent the US Government

Given the issues discussed in the previous two action alternatives, it would be tempting to go ahead and try to find a circumvention similar to what Swarm Technologies did. However, because they already went forward with such an action, we have an idea of what the consequences will be based on statements made by the government entities involved with Swarm. The FCC has declared that there will be penalties, and will likely prohibit Swarm from ever broadcasting. Meanwhile, NASA and the Navy have pulled funding and canceled all contracts with Swarm. Our considerations of this option are below:

1. By circumventing the US government, we are breaking US and international law. This means that in order to continue operation, we would need to establish a relationship with a foreign government that is also willing to shirk international law and convention in favor of building up its own space industry. This leaves two primary candidate countries: Russia and China. These nations have a reputation for acting against the US's express wishes in regard to space-based operations, and each have their own space-launch capabilities.
2. This assumes that one or both of these nations would even be interested in the business that we could bring, and we would have to physically relocate to the country before hand. This is because by knowingly circumventing the government, we are signing the death warrant of our company and very likely risking both heavy fines and incarceration.
3. By taking asylum in another country, we are putting ourselves at their mercy. Both nations have precedents of nationalizing civilian companies to benefit their governments and militaries.

As can be seen from the items listed above, this option goes from bad to worse the more that it is analyzed. There are also serious ethical problems with this approach. Assuming that a foreign government would even want to work with us, it would strain US relations with that country. There is also the possibility that the government had good reason to hesitate in granting us launch clearance. If our devices were to fail in orbit and be untrackable, they would add to an already growing mess of "space junk" that potentially endangers the lives of people in orbit. This is not in our best interest, because we are betting on the growth of the commercial space sector, including the eventual start of the space tourism industry which our business could easily expand into to provide communications and other types of services via infrastructure that we are currently putting into place.

Action 4: Discussion with our Client

With none of the previous options being actionable, we must consider two more possibilities. First, we could discuss design changes to the satellite to bring it closer to the specifications that FCC has approved in the past. In Swarm's situation, this would have meant increasing the size of the satellites, which in turn would mean higher costs to launch. We could discuss sharing this cost with the client in favor of going ahead with the technology demonstration and accruing the flight heritage. If also done in conjunction with the following action alternative, it may be possible to keep the costs minimal and to progress back t the form factor that we had originally intended to use when we are sending commercial satellites to orbit en-mass.

Action 5: Coordinate with the Government Regulators

In conjunction with the previous action alternative, we would do well to actually set up a pointed coordination strategy with the government. I believe that this could actually be turned into a longer-term opportunity. It has already become apparent the launch regulations need to be seriously reconsidered, and that the government agencies need to establish more effective protocols of cross-communication. The idea here is that we could propose to our contacts within each agency to help them to streamline the processes and information sharing by identifying redundancies in the various processes and perhaps establishing a database that shares relevant information across each regulatory body.

Decision

The decision that I have is that we will pursue Actions 4 and 5. It is clear from the ongoing situation with Swarm that circumventing the government is not a good option, but it would also be bad for business to simply wait for a change in the regulations that are currently preventing us from launching.

By going forward with these actions, we could actually be setting ourselves up in a stronger position that before by building stronger relationships with both our client and the government. We would have a voice in the long-term legislative changes and we would demonstrate initiative n contacting our client about making near-term design changes for the sake of the long-term viability of our joint business venture.

Conclusion

In conclusion, I have determined that the best actions to take would be to work with our clients and the government to alleviate concerns on both sides and improve future prospects of launching experimental technologies. I also believe that this is the most ethical solution, both in terms of our business and governmental stakeholders and the sake of the larger commercial space industry. Swarm's actions are disrupting the industry and changing the landscape, but not in a positive sense. I believe that we can have a similar impact, but for the better by choosing this alternative.

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