Why the Cell Phone's Social Construction Casts Drone Delivery into Uncertainty

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

> "Here is our mistake, one we all made, the only one we made. You had a hypersensitive project, and you treated it as if you could get it through under its own steam.... [y]ou believed in the autonomy of technology."
>
> -Bruno Latour, *Aramis or the Love of Technology*, 1996

Many advocates of drone technology believe that it has a promising future in the package delivery sector. Management consulting firm McKinsey and Company for one believes that autonomous vehicles like UAVs will "deliver 80 percent of parcels" (Joerss, Schröder, Neuhaus, Klink, and Mann, 2016, pg. 24). While, Amazon, another supporter of the idea, proposes that drone delivery can "increase the overall safety and efficiency of the transportation system" (Amazon Prime Air, 2019). These predictions are valid, to an extent, as drone delivery has been shown to have a large market viability and the technological capability to operate in the transportation sector (NASA, 2018, pg.18).

These perspectives, however, fail to take into account the external factors or actants that will play a crucial role in the technology's implementation. As Bruno Latour warns in the quote above, it is often a mistake to believe in the autonomy of technology or, in other words, its ability to depend on itself for survival. In *Aramis or The Love of Technology*¸ this attitude influences a disregard to reconcile disagreements between parties involved in the failed Aramis project as they believed the technology could succeed on its own (Bruno Latour, 1996). For drone delivery, this threat is already emerging as there are differences in opinion between stakeholders that could make its implementation more difficult than originally believed.

In this paper, I argue that despite these disagreements drone delivery still has the potential to succeed if it has a similar social construction to that of the cell phone. This claim was

derived from conclusions made in Leonardi and Hudson's study on adoption and use of the cell phone in different cultures. Furthermore, using analytical techniques suggested in this study I will evaluate my claim by assessing stakeholder attitudes through a comparison of their motivations for adoption and use between urban and rural environments. These techniques involve using a deterministic approach to study adoption motivations and a social constructivist approach for actual usage.

Part I: Stakeholders Concerned with a Drone Delivery System Have Conflicting Views

The debate over the use of drones as a delivery method has created uncertainty about its feasibility and has introduced many obstacles to its development. As such, it is important to understand the current state of these disagreements and which stakeholders are relevant. Therefore, in this section I will layout the opinions of these parties regarding a drone delivery system using evidence gathered from other studies as well as corporate and government reports.

Stakeholder Opinions

The stakeholders involved in a drone delivery system include the potential consumers, bystanders, regulatory agencies, and delivery companies. In terms of differing opinions, these parties can be divided into two groups: potential consumers & bystanders and regulatory agencies & delivery companies. However, as will be shown, there are still overlapping concerns between these groups especially when it comes to safety.

According to several studies, public opinion on a drone delivery system is relatively split with supporters (potential consumers) having a slight margin over non-supporters (bystanders). A study done by the United States Postal Service (USPS) Office of Inspector General found that 44% of respondents liked the idea of drone delivery, 34% disliked it, and 23% were indifferent

(2016, pg.7). Another study done by McKinsey & Company, showed similar figures with 35% of respondents saying they preferred drones and 25% saying they have no opinion on the matter (Joerss, Schröder, Neuhaus, Klink, and Mann, 2016, pg. 24). However, other studies show a much larger margin between the two stakeholders such as a market study done by the National Aeronautics and Space Administration (NASA) which reported that of 2,500 participants surveyed, only 25% felt comfortable with unmanned aerial technology (2018, pg.26). These differences largely stem from concerns such as UAV safety, privacy, job security, environmental threats, and noise & visual disruption (NASA, 2018, pg. 27). In fact, the same study done by USPS revealed that "liking drone delivery is strongly tied to perceptions of safety" (2016, pg.19). This correlation is further influenced by other factors such as a basic knowledge of the technology. In a public opinion survey on UAVs for cargo, commercial, and passenger transportation, Aydin (2019) found that the public's acceptance of cargo transportation with drones increased 15% when provided with background information on the technology (pg.3). Consequently, according to Ramadan, Farah and Mrad's adapted model of the theory of planned behavior (TPB) towards consumer acceptance of service-delivery drones, these perceptions of risk play a significant role in the attitude towards using drones and ultimately their intention to use (2016, pg 824). **Figure 1** shows this TPB model with other factors such as the functional

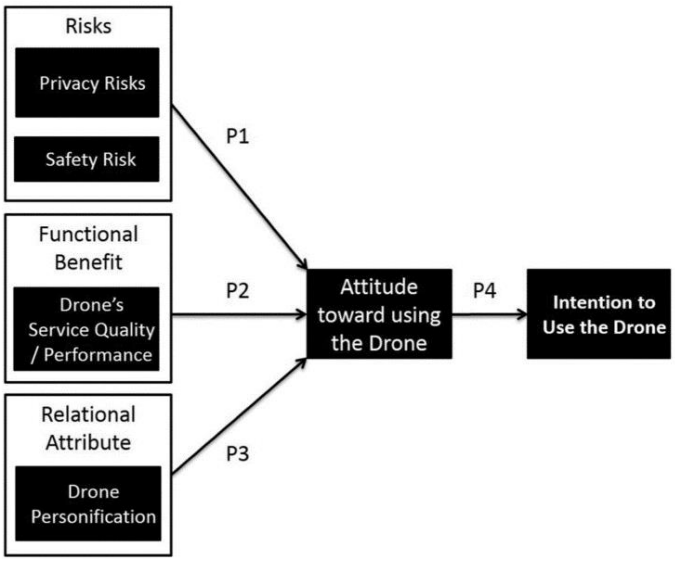

Figure 1: TPB Approach for Drone Delivery (Ramadan, Farah and Mrad, 2017, pg.824)

benefit and relational attribute towards drone also having an important impact on consumer attitudes.

The disparity in drone delivery attitudes between the two other stakeholders, the governing bodies and delivery companies, proves to be more about approach rather than intention. Evidence shows that both parties would like a drone delivery system but the Federal Aviation Administration (FAA) which oversees drone operations, is much more conservative than the delivery companies. Recent FAA statues indicate that the agency is reluctant to allow the lenient oversight of drone operations that these companies would prefer. In fact, according to Burzichelli and Dowlings' legal analysis of Amazon's drone aspirations, "federal regulation is the single greatest obstacle facing commercial drones because it will dictate their operational capability" (2016, pg.166). These restrictions are certainly seen in the regulations that the FAA has enacted over the past few years, especially under the Part 107 and 135 rules. The Part 107 legislation prohibits drone use over people and ensures all drones are remotely controlled rather than autonomous (Foxx and Huerta, 2016, pg. 114). Furthermore, this rule does not allow the drones to fly beyond a visual line of sight, thereby significantly limiting their range (Foxx and Huerta, 2016, pg. 89). In order to curtail such restrictions, corporations must adhere to rules under Part 135. The intent of this legislation is to promote the development of UAVs by allowing greater freedom in drone related businesses. Nonetheless, Part 135 still proves to be a huge barrier to commercial drone operations as it involves tedious requirements such as a lengthy 5 phase application process (FAA, "14 CFR Part 135 Certification Process", 2019). Furthermore, these regulations restrict the development process itself as companies like Amazon are prohibited from conducting drone research in the United States (Lupiccini and So, 2016, pg. 113). While

both the FAA and delivery companies have the safety of the public in mind, they seem to be taking conflicting approaches.

It is clear from this literature review that these stakeholder opinions create much uncertainty about how drones fit into the package delivery environment. What is still unclear, however, is how these attitudes might vary according to location specifically rural and urban areas. In these domains culture often varies drastically and is therefore an important factor to consider, particularly when it comes to motivations for adoption and usage of a technology. Leonardi and Hudson's study on cell phone provides useful insights that effectively consider culture when analyzing reasons for adoption and usage of a technology. This study found that although cell phones were being used in different ways, there were similarities when it came to adoption motivations (2006, pg. 221). Given that the cell phone is a relatively successful device, it can be inferred that if drone delivery can have a similar social construction then its future is much more viable and the disagreements presented may not be as detrimental.

Part II: Insights from A Sociotechnical Study on the Cell Phone Can Be Used as a Framework for Stakeholder Attitude Analysis

In their study titled "Culture, Organization, and Contradiction in the Social Construction of Technology: Adoption and Use of the Cell Phone across Three Cultures" (2006), Leonardi and Hudson study and compare the social construction of the cell phone in the United States, Latin America, and the Ukraine. Although the insights from this study were recommended to be applied towards information and communication technologies (ICTS), I apply the subsequent

analytical techniques as a framework for analysis of stakeholder attitudes in rural and urban environments.

Describing Leonardi and Hudson's Study on Adoption and Use of the Cell Phone

In their introduction Leonardi and Hudson (2006) argue that few studies have considered culture as an important factor in the social construction of ICTs. Therefore, they claim that:

> "As a consequence, the majority of research on the interplay between ICTs and culture either depict the cell phone as a decisive agent of change that is causing unique cultures to become more homogeneous in their modes of communication (a deterministic perspective) or as an artifact whose meanings and effects are socially situated and thus inherently malleable (a social constructivist perspective) (pg. 205).

As such, the purpose of their study is an attempt to reconcile these deterministic and social constructivist perspectives by exploring the implications of culture on the social construction of the cell phone. To do this, each researcher was tasked with collecting data from one of three focus groups comprised of 58 participants from the "dramatically different" cultures of "Western industrialized" North America, "highly collectivistic economically disadvantaged" Latin America, and "post-communist Eastern Bloc" Ukraine (Leonardi and Hudson, 2006, pg. 207). In these focus groups individuals were asked why they chose to purchase a cell phone and to describe their normal patterns of usage. Each researcher then analyzed the data of the culture of which they were not responsible for collecting. Finally, the data sets within each culture were first coded into two broad etic categories and then into more specific emic categories. The authors claim that this was done to "triangulate the ways in which the cell phone use affected and

was uniformly affected by the culture while still uncovering the specific practices that constituted theses broader effects" (Leonardi and Hudson, 20006, pg. 208).

The following tables summarize the results of this study with the motivations for adoption (**Table 1**) and usage (**Table 2**) categorized according to culture. As shown by **Table 1**, there is a degree of homogeneity for the reasons participants decided to adopt the cell phone. Although the specific themes vary among the cultures themselves, they can still be categorized into broader overarching motivations such as safety and signaling. As Leonardi and Hudson state "what is interesting in these findings is that reasons for adoption appear ubiquitous and somewhat impervious to changes in cultural context" (pg.221). Consequently, it is ultimately suggested by this study that taking a deterministic perspective, in which the technology is seen as an agent of change that influences different cultures to become more similar, is an effective method of measuring patterns of adoption. On the other hand, as shown by **Table 2**, the actual usage of cell phones showed much more cultural variability as indicated by the correlation between the practice of use and corresponding cultural value. Moreover, these usage patterns often contradict stated motivations for adoption such as in the Ukrainian participants who claimed they got their phones to help them fit in (social acceptance) while actually using them to help them stand out (status symbol). Therefore, the study suggests that a social constructivist perspective, where culture is thought to have a more influential role, is better suited to capture technology use behaviors.

In summary, by surveying participants from three different cultures Leonardi and Hudson derived that using deterministic and social constructivist perspectives together are a more

effective means of assessing adoption and usage practices rather than independently as previously suggested.

Practice of Adoption across Three Cultures

Practice	Safety			Signaling		
Theme	Peace of mind	Salvation	Security blanket	Imitation	Not left behind	Social acceptance
Origin	American	Latino	Ukrainian	American	Latino	Ukrainian

Table 1: Practice of Adoption across Three Cultures (Leonardi and Hudson, pg. 220)

Practice of Use across Three Cultures

Cultural Context	American		Latino		Ukrainian
Practice of use	Ego-centric communication	Not being alone	Keeping in touch	Group communication device	Status symbol
Cultural value	Individualism	Need for attention	Importance of family	Collectivism	Socioeconomic awaremness

Table 2: Practice of Use across Three Cultures (Leonardi and Hudson, pg. 221)

Applying Deterministic and Social Constructivist Perspectives to Stakeholder Attitudes

Leonardi and Hudson's suggested analytical techniques will be applied to assessing stakeholder attitudes in terms of adoption and use in rural and urban environments. These represent potential operating areas for the technology that have differing cultural demographics. Therefore, these techniques of deterministic and social constructivist perspectives are particularly useful as they take into account the effect that culture can play and provide a more efficient tool for analysis.

Using this framework, the following viewpoints will be taken on the effect of culture on adoption and use regarding drone delivery when analyzing relevant data. First, stakeholders will consider adopting drone delivery for the same reasons in rural and urban areas and culture will not play a significant role. Second, that, largely due to the influence of culture, drone delivery will be used for different purposes between the stakeholders and areas of interest.

Although conducting a survey of these attitudes as done in the cell phone study is beyond the scope of this paper, there is sufficient similar data that is useful. For the most part, this includes surveys done by other researchers such the study done by USPS's Office of Inspector General which includes a breakdown of public attitudes in urban, suburban, and rural areas. This includes only half of the stakeholders relevant to this study as there are still the governing bodies and delivery companies to consider. The analysis of the latter will involve looking at how the companies Amazon, Wing, and Zipline are planning to or already carrying out drone delivery in rural and urban areas. Lastly, to analyze the governing bodies, the research will consider the FAA's statutes on drone use to determine whether there are any differences in policy between the areas of interest.

Part III: Drone Delivery Will Not Have a Similar Social Construction to the Cell Phone

As stated, if drone delivery can have a similar social construction to the cell phone then its implementation is much more viable. However, although drone delivery can accommodate differences in usage, it does not have the same degree of commonality in adoption motivations that the cell phone displayed. **Tables 3** & **4** below show these findings in a similar format to that of

Leonardi and Hudson's study. The following discussion reveals how these differences in usage, and more importantly, adoption occur according to both stakeholder and location.

Usage Intentions	Urban	Rural
FAA	No flight beyond VLOS	Flight beyond VLOS allowed
Amazon	Expand profitability and capability	No use intention
Wing	Deliver local goods	No use intention
Zipline	No use intention	Deliver emergency medical supplies
Consumers and Bystanders	Fast and convenient delivery	Deliver to hard-to-reach places

Table 3: Usage Intentions across Stakeholders Considered (Created by author)

Adoption Motivations	Urban	Rural
FAA	Use allowed	Use allowed
Amazon	Increase safety and efficiency of transportation	No adoption motivation
Wing	Decrease congestion and support local businesses	No adoption motivation
Zipline	No adoption motivation	Increase medical supply distribution efficiency
Consumers and Bystanders	Inconclusive	Inconclusive

Table 4: Adoption Motivations across Stakeholders Considered (Created by author)

Differences in Both Usage and Adoption Motivations Exist

When applying Leonardi and Hudson's model to usage motivations among the stakeholders it became clear that drone delivery would be able to accommodate differences. Each stakeholder had different use intentions for the technology both between each other and between the environments considered. Furthermore, it is shown that drones have the technological capability to meet these usage requirements.

For the FAA, these differences are mostly evident in their visual line of sight (VLOS) regulation attitudes between rural and urban areas. Normally, this rule dictates that drone pilots

must be able to see their UAV at all times. However, according to the FAA's "Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap", the agency is open to waiving this requirement in strictly rural areas (2018, pg.13). In fact, the FAA has already allowed these types of operations in the sparsely populated counties of Clovis and Playas, New Mexico as well as Laurel and Milk River, Montana (FAA, 2018, pg. 15). At the same time, the administration strictly prohibits this type of drone operation in urban areas and has made only one exemption to the United Parcel Service (UPS) Forward Flight in Raleigh, North Carolina (FAA, "Press Release", 2019).

Meanwhile, the delivery companies had other intentions for drone usage. In fact, due to the range of capabilities that drones offer and their distinct business goals, use intentions further varied among these stakeholders. For Amazon, their focus is to use drones to expand the capability and profitability of their already immensely successful delivery service. As stated in Sudbury and Hutchinson's "A Cost Analysis of Amazon Prime Air (Drone Delivery)", this means that "Amazon will set up its drone system in cities where it will be expected to increase efficiency and profitability. For example, the drone system would be costlier and less profitable in a low density/low population city versus a high density/high population city" (2018, pg. 4). Therefore, Amazon prefers being able to deliver in urban areas with large market potential over less profitable rural areas. Furthermore, this focus on urban delivery can be seen in Amazon's latest drone design itself. The drone contains many hazard avoidance technologies and has max range of 10 miles that make it ideal for metropolitan areas (Jung and Kim, 2017, pg. 4). Similarly, another company Wing is focused on using their drones to deliver local goods in cities with the goal of strengthening neighborhood businesses (Wing, "We've Landed In" 2019). To do this Wing designed a drone with a roundtrip range of 12 miles and carrying capacity of 3.3 pounds making it ideal for urban

environments (Wing, “How it Works”, 2019). On the other hand, medical delivery company Zipline Inc. is targeting more rural and harder to reach places where supplies are scarce. Unlike Amazon and Wing’s prototype, Zipline’s drone is specifically designed to operate in rural areas. The “Zip”, as the company calls it, can deliver packages weighing up to 3.86 pounds, has a flight range of 99 miles, and a max speed just shy of 80 miles per hour making it the fastest delivery drone in operation (Zipline, “How it Works”, 2019). Furthermore, as Akerman and Koziol state in their review of the company, “Zips can carry relatively large payloads long distances because they’re fixed-wing aircraft, which are significantly more aerodynamically efficient than rotorcraft (such as today’s common quadcopters)” (2019, pg. 5).

For the last set of stakeholders, potential consumers and bystanders, Leonardi and Hudson’s model was able to show that culture does influence use motivations for drone delivery. In the aforementioned USPS study, urban and rural groups ranked their preferences for drone usage according to a set of functional options (2016, pg. 32). According to this data, urban participants preferred using drones for fast and convenient delivery while rural respondents favored them for getting important packages to hard-to-reach places. However, although this data does provide an indication of usage, at this stage in drone delivery’s implementation it difficult to distinguish these results from adoption motivations. This is largely due to the fact that drone delivery, unlike cell phones, has not yet been implemented and thus there is no data that can provide a clear distinction between adoption and usage for these stakeholders. Regardless, this proves to be inconsequential as the disparity in adoption motivations between the other stakeholders already invalidates drone delivery’s ability to have a similar social construction to the cell phone.

In terms of adoption reasons, the FAA and delivery companies all had different views on the technology’s role in urban and rural areas. In the FAA’s opinion, drones have the potential to

be adopted in both settings for a variety of purposes. This includes granting drones permission to inspect railway infrastructure in rural areas as well as delivering supplies to people in urban cities like Raleigh, North Carolina (FAA, 2018, pg. 14). Meanwhile, Amazon looks to adopt an urban drone delivery system that will "increase the overall safety and efficiency of the transportation system" ("Amazon Prime Air", 2019). Wing, on the other hand, wants to implement drones because it will decrease road congestion and support local businesses in cities (Wing, "How it Works", 2019). And lastly, Zipline's goal is to adopt drone delivery to increase the efficiency of medical supply distribution in rural areas. From these stakeholders alone it is easy to see that drone delivery lacks the homogeneity in adoption motivations required to have a cellphone-like social construction.

In conclusion, although drone delivery can accommodate differences in usage, its disparity in adoption motivations prevent it from having a social construction like that of the cellphone. Therefore, considering the previously mentioned stakeholder disagreements, its potential for a successful or simple implementation is doubtful.

Conclusion

Through this paper I have shown the differing attitudes of stakeholders concerned with drone delivery. I argued that, despite these disagreements, if this technology can have a similar social construction to that of the cell phone then its implementation might be successful. This claim was developed by drawing on conclusions made in Leonardi and Hudson's study on the cell phone that suggest its success as a technology. Furthermore, to test this claim the analytical techniques of deterministic and social constructive perspectives provided by this study were applied. As a result, it was shown that although drone delivery can accommodate differences in use it does not create the common motivations for adoption required between both stakeholders

and regions. Therefore, drone delivery will not have a similar social construction to the cell phone and, as a result, has led me to conclude that it will not be as easily integrated into society as many involved parties such as McKinsey & Company and Amazon suggest.

Although drone delivery will not be implemented in a similar manner to cell phones, this does not suggest that it will not be possible. In fact, all technologies go through some level of controversy and in many ways it is necessary. What this study really shows is that more focus should be placed on adhering to Bruno Latour's warnings on the autonomy of technology. The parties responsible for the success of drone delivery should recognize that it is part of a complex sociotechnical system and, as such, sensitive to the attitudes of its stakeholders. If this is done and disagreements are reconciled, then a fate similar to that of Aramis can be avoided.

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