A Battle of Drones: Utilizing Legitimacy Strategies for the Transfer and Diffusion of Dual-Use Technologies

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Abstract

This research endeavor is exploratory in nature; hence, we address a subject for which there are high levels of uncertainty and where the problem is not very well understood. We attempt to uncover where the positions of interest likely reside within the transferring of controversial dual-use technology and the utilization of strategic activities to remove the barriers associated with it. More precisely; we have selected to study the transfer of UAV technology since it has, from its inception, raised multiple issues in the civilian population including privacy and safety concerns. Our data includes fifty videos with durations ranging from one to fifteen minutes; additionally, it includes thirty brochures from five different UAV firms. The data was further identified as being material generated solely by UAV manufacturers; this is relevant since our aim is to understand how UAV manufacturers use legitimacy strategies to manipulate the message for their target audience. Furthermore; selecting media material directly from the UAV manufacturers helped us eliminate the risk of biases toward some incumbents or leading startups.

This research adopts an abductive approach (Dubois and Gadde, 2002), going back and forth between the empirical cases and the theory. The authors independently coded the data and then triangulated it to revise the first coding scheme, using a constant revision process to establish robust constructs. The manifest content analysis was performed using the qualitative data analysis software (QDAS) NVivo 11, a software that permits the organization of the data gathered and its subsequent analysis (Dean and Sharp, 2006).
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Abstract

Technology Transfer and Diffusion happens when the technology developed for applications in one environment is transferred to new environments. Technology transfer implies the adoption of the technology for different applications and a potential shaping of new markets. The analyzed data suggest that firms engage in legitimacy practices to overcome technology transfer barriers innate to the new settings. This study analyzed the types of strategies used by UAV (drone) firms to remove technology transfer barriers in the business, humanitarian and the entertainment sectors. This article contributes to the literature on technology transfer by showing that the technology transfer process resorts to the use of legitimacy strategies to overcome barriers and consequently enables a market stabilization involving tactical communications. The contribution can be extended to additional industries and offer an opportunity for future research on the field and can provide managers with a tool to identify and overcome possible barriers to controversial technology transfers.

Keywords: Technology Transfer, Legitimacy, Dual-Use, UAV, Barriers,
1 Introduction

Technology transfer "refers to the development of a technology in one setting which is then transferred for use in another setting" (Markert, 1993, p. 231). The transfer of technology to new settings represents a challenge for the technology developers because they need to navigate in novel settings; which include new regulatory forces, the entrance to a new business network and the shaping of a potential new market. These difficulties; amongst others, are known as technology transfer barriers that need to be overcome to allow the entrance and posterior adoption of the technology in new locations. Extant literature on technology transfer have categorized many of these barriers including technical, economic, sociocultural, political, and market barriers (Johnson et al., 1997; Balta-Ozkan et al., 2013, Sandberg and Aarikka-Stenroos, 2014, Sena Abrhao et al., 2016; Yeatts et al., 2017).

Some scholars showed that the adoption of new technologies belongs to a social construct process that involves multiple actors that influence the use and diffusion of the technology to be legitimated and institutionalized in each market. In order to analyze such process, Johnson et al. (2006) defined as legitimacy, the process by which a set of practices or institutions becomes acceptable in specific social, cultural and political settings. The process can be considered as the congruence between social values, individual or organizational activities and the norms of acceptable behavior established by social systems (Dowling and Pfeffer, 1975). For example, Humphreys and Latour (2013) analyze the cultural representations on consumer perceptions of legitimacy. They show the influence of media in the framing process and argue that adoption and acceptance in the gambling industry occur through a social process of legitimacy.

The results remind of the results from Johnson et al. (1997) where communication is found to be a key element in the transfer of technology process: the communication channels that support the transfer and diffusion includes printed material, personal correspondence, scientific societies, formal instruction, travel and exploration, mass media, bureaucratic and institutional reform, and research, many other ways exist and it depends on who the targeted user will be. However, the literature on legitimacy in technology transfer is still in its infancy. And it “is necessary to understand the place of technological innovations within the larger and more complex process of industry legitimation, a process that involves cultural, social and material factors” (Humphreys, 2010).

Our research proposes to focus on the role of legitimacy in the transfer of dual use technology. Dual technologies refer to products that have been originally intended for military use but have subsequently transferred to support civilian applications. The technology transfer process and evaluates the use of legitimating strategies to communicate to potential audiences and to remove the barriers for the transfer of technology.

Some of these technologies therefore carry certain controversies and hence present barriers as they are adopted into non-military social system applications. Such setting thus, provides a particularly interesting field of investigation for scholars working on legitimacy.

To the best of our knowledge, whereas there is vast literature on the complexity of networks (e.g. Stinchcombe, 1990; Gee et al., 2017) and regulations (Cowan and Foray, 1995; Belin et al., 2018) around weapon systems and their technologies, the literature on technology transfer and management provides no studies addressing the development of strategies to legitimate the transfer of controversial military technology to new settings. More specifically, there is limited literature addressing strategies utilized to legitimate the transfer of controversial military-use technology. Such caveat is critical since the tech transfer of military technologies and dual use technologies still represent an impressive amount
of new knowledge (Mowery, 2012) that are as much as opportunities to transform and boost economic and social activities.

The article proposes to study the role of legitimacy using the case of Unarmed Aerial Vehicle technology to examine the process of dual-use technology transfer; military-use technology that moves to the humanitarian, business and entertainment environments. The UAV technology was initially utilized in the military industry to perform lethal operations and in recent years there has been a growing interest in civilian applications since the adoption of the Federal Aviation Administration (FAA) Modernization Act of 2012. This act mandated the FAA to safely integrate commercial UAVs into the American airspace by September 2015; the adoption of the UAV technology has been at best ‘controversial’ due to the fact that the technology was transferred from military operations to civilian implementations (Freeman and Freeland, 2016).

We show how the process of legitimation shapes the uses of the UAV technology and its markets, defining different business models in different sectors. Our paper contributes to expand the scope of the literature on the legitimation of technological innovation often focused on civil product innovation (e.g. Hargadon and Douglas, 2001) and thus document the processes and practices at work in sectoral systems of innovation (Pavitt, 1984; Teece, 1996; Malerba et al., 2016).

The remainder of the article is organized as follows. Section 2 develops the theoretical arguments explaining what should be the role of legitimacy and particularly the role of legitimacy in the UAV technology transfer. The next section introduces the method adopted to investigate the UAV case. In section 4 we expose our findings regarding the role of legitimacy. A final section presents and discusses our conclusions.

2 Conceptual background

The transfer of dual use technology is completed only once the end users have fully accepted the utilization of the technology. The technology transfer types encounter barriers (Johnson et al. 1997; Choi, 2009) that are to be considered from the producer of the technology and receivers’ points of view (Gilsing et al., 2011; Robin and Schubert 2013). We consider the technology transfer barriers to identify the carefully crafted strategies that the technology producers execute to remove them.

2.1 Technology transfer and barriers

The simple technology transfer definition addresses the transfer of technology from one utilization site to another (Johnson et al. 1997). A dual-use technology transfer is the transfer of technology from military-use settings to civilian-use settings (Forge, 2010) or vice versa (e.g. Galbraith et al., 2004). A main issue is on the different barriers encountered to transfer dual-use technology toward civilian markets. Technology transfer and diffusion barriers are considered the obstacles that manufacturers must remove so the end user can fully receive/assimilate/use the transferred technologies (Antioco and Kleijnen 2010).

There is extensive literature on technology transfer barriers (Johnson et al., 1997; Boldt et al., 2012; Balta-Ozkan et al., 2013; Sena Abrhao et al., 2016; Yeatts et al., 2017; Sandberg and Aarikka-Stenroos, 2014; Björkdahl and Linder, 2015; Gronhaug et al. 1999) where some consider different public-private technology transfer tools and processes (e.g. Bercovitz and Feldman, 2006; Rasmussen, 2008).
Extant literature on technology transfer barriers, for the most part, focuses on the inter-organizational transfer or technology; that is, between organizations (and not between the end user of the technology, which is addressed under technology adoption, Battistella et al. 2015). The organizations involved in the dual-use technology transfer include those research institutions and/or technology organizations funded by the government and the commercial enterprises that will create UAV technologies for civilian applications. Technology transfer barrier literature typologies include, amongst many; the trust in the relationships between organizations (Battistella et al. 2015), government subsidies, legislation, barriers and protections of the current market (Bozeman 2000), the overall economic potential, price trends for the technology, its substitution, the added value compared to the technologies used today (Kingsley et al. 1996). Liyanage et al. (2009) further suggests the inclusion of the more general PEEST factors (Political, Economic, Environmental, Social and Technological barriers). Additional barriers include the perceptions associated with the ethics and transparency of the UAVs and their utilization for national security purposes. These ethical and moral concerns stem from the potential misuse of the technology for pernicious purposes rather than using the technology as its original dual-use intention was.

Technology transfer barriers at the Inter-organizational level had to be overcome for the technology to diffuse and reach the end user for final adoption. Furthermore; Rao et al. (2016) provides an example of another technology initially created for military purposes; the Internet, which did not just allow users to share information faster and cheaper; it completely changed the way users conceive of and use information. He further argues that these changes are not just related to the features of the technology, but also how we interpret their usability. Rather than the technology itself, it is the users’ implementation of it that affects our perception, and thus our behavior. The way in which users implement the technology could create negative sensitivities towards the UAV technology. Dual-use technology carries the controversial perception of being misused instead of being implemented for its originally intended dual-use.

The user’s perception of the new technology (suggested by Rao et al., 2016) when introduced to the civilian market for implementation, carries certain level of acceptance evasion mainly because of social and cultural concerns. Comparable to the internet, the acceptance of the UAV technology has a crucial dependency on how the civilian users will interpret the UAV implementations. Additionally; Antioco and Kleijnen (2010), identify psychological barriers associated with technology adoption, which include conflicts consumers may experience when innovations require them to change existing beliefs or break with entrenched traditions and accepted societal norms. They also consider image barriers as another psychological impediment for technology adoption. The fact that the technology was once used for surveillance and for carrying out active combat attacks carries a stigma that many potential users cannot overlook because of their moral values. Because of these psychological, moral, social and cultural implications associated with the UAV technology and its implementation by the end user; we consider these implications as sociocultural barriers to the transfer and diffusion of the UAV technology.

Antioco and Kleijnen (2010), also identify an additional type of barrier associated with technology adoption; called functional barrier, where consumers evaluate the consequences of adoption in terms of usage, value and associated risks. The effect of perceived value on the adoption of technology is well known and documented (Kleijnen et al., 2007; Parasuraman and Grewal, 2000) and it is widely understood that unless an innovation offers good value over alternatives, there is no incentive for consumers to change. Additionally, there are barriers associated with the existing level of knowledge of the new technology. Claudy et al. (2015) argue that uncertainty regarding performance often arises when consumers cannot evaluate the functionality or performance of a product. We understand the concerns
associated with utility, perceived value, perceived risk, uncertainty level, perceived ease of use and knowledge of technology as technology related barriers to the transfer and diffusion of technology.

The way in which the UAV technology affects and challenges the user’s societal values and beliefs is addressed by Rao et al (2016); specially the impacts to the notions of safety and security, privacy and ownership, and further individual and commercial liability. Nakamura and Kajikawa (2016) also comment on the exitance of concerns on the safety such as the impact against people, buildings, vehicles, and manned aircraft and on the security of such as privacy threat or intentional attacks. They further recognize that policy makers in many countries are still struggling over how to balance social and economic benefit from UAV applications and the security of the society. We understand these impacts as political barriers to the transfer and diffusion of UAV technology embodied in legal aspects to address the perceptions of the users. Barriers to the transfer and diffusion of technology encompass those political barriers associated with the potential enactment of regulations for privacy, safety, security, ownership, and liabilities.

Antioco and Kleijnen (2010) recognized that consumers’ perceptions of financial risks will hinder the adoption of the new technology. These findings, confirm the importance of reassuring the consumer about making the right investment when buying new technology. Ability to demonstrate a good performance-to-price ratio at the time of purchase as well as low financial risk seem to be a barrier which need to be overcome to significantly convince potential technology adopters. Song and Chintagunta (2003) identified that the price of technology is an influential factor in consumer decision-making regarding innovations, even when other positive signals are present. The degree of uncertainty regarding the financial consequences of adopting an innovation may include the perceived risks of incurring in future maintenance and repair costs, the unacceptable results or the return on investment and the potential lack of economic profitability or time savings after adopting the new technology. All these perceived issues are considered economic barriers to the transfer of dual use technology.

Finally; There are also obstacles that may encountered when transitioning from a market with one or few buyers to a mainstream market for dual-use products in a non-military setting. The UAV producer would implement strategies for the obvious advantages of market share growth and increase of its consumer base. However, the obvious strategies may not be the only ones used by the UAV producers to either create or grow their markets but to also penetrate different industry sectors and a wider range of users. Additionally, the UAV producer may have to reshape or create new markets for the newly transferred dual-use technologies. We recognize these as market barriers to be overcome for the transfer and diffusion of technology.

Extant literature offers very limited insight into the UAV technology transfer and diffusion barriers; we consider an all-encompassing set of barriers associated with the transfer of dual-use technology. In our study, we consider a representative set of barriers that will provide a well-rounded analysis of the strategies used by the UAV producers to remove them. This set of barriers is meant to encompass a multitude of further granular obstacles that are applicable to the transfer and diffusion of not only the UAV technology but other controversial dual-use technological innovations. The representative set includes political, economic, technical, market and sociocultural barriers as defined in preceding paragraphs.

Consider the transfer of UAVs initially used in the military environments for collecting surveillance and reconnaissance information and ultimately utilized as a vessel for delivering precision-guided weapons for increased lethality; this technology is then transferred to support humanitarian missions in support of surveying post-earthquake locations. In general, one would expect that this type of
technology transfer would carry certain level of controversy and aversion towards its acceptance by the ‘new’ end users.

The tensions created between dual-use technology and the new users engender privacy and safety concerns which in turn make the dual-use technology transfer much more difficult to crystalize. Unless all the barriers associated with these technologies are strategically removed, every future controversial technology transfer will be hindered by those barriers. Similar safety concerns and policy making barriers may be encountered in the implementation of driverless vehicles; likewise, the implementation of IoT for smart cities can awake the users’ privacy concerns and hence, the political mobilization to enact policies to protect user’ privacy.

Rao et al. (2016) contends that UAVs have been legitimized by regulations and licenses from federal agencies, the usage by companies for surveying, inspecting, and imaging, and their technological development are driven by active communities of hobbyists and enthusiasts. Furthermore, he also asserts that drone use in Hollywood film production has already been legitimized through the creation and use of specialized high-definition imaging drones. Whether the legitimation of UAVs for non-military use is legitimated by enacting regulations or by the creation of specialized UAVs to perform specific tasks; the legitimation of the mainstream market for multiple users is still in its infancy. The UAV producer needs to overcome the barriers for legitimating the transfer and diffusion of UAV technology to the civilian users.

Technology transfer relies on different barriers that actors have to overcome. We now turn our attention to legitimacy, which we consider critical to successfully transfer and diffuse dual-use technologies.

2.2 Legitimacy in tech transfer activities

To successfully transfer the technology, the producer needs to implement barrier-removing activities. These activities fall under the organization’s capability to commercialize the technology. The ability of the organization to overcome these barriers to exploit the benefits of the new technology transfer is part of the technology management theory (Story et al. 2014). Developing this competence involves exploitative activities that stimulate market demand, manage production, supply, marketing and sales capabilities (Story et al., 2011).

The adoption of new technologies in organizations belongs to a social construction process that involves multiple actors that influence the use and diffusion of the technology. Humphreys (2010) argues that “is necessary to understand the place of technological innovations within the larger and more complex process of industry legitimation, a process that involves cultural, social and material factors”.

Institutionalization has been defined as a legitimation process that is accompanied by a managerial discourse (Abrahamson, 1991). Suddaby and Greenwood (2005) assert that legitimacy is based on the comprehensibility of the actions taken and the level of congruence between the attributes of the technology adopted and the organizational logic. Furthermore, Suchman (1995) asserts legitimacy as the common perception of the desirable, appropriate and useful actions taken by managers which must be aligned with the organizational logic, including the system of norms, values, beliefs assumptions and definitions embedded in the core of each organization. Identifying three types of legitimacy; cognitive, pragmatic and a moral legitimacy.
The knowledge of the legitimacy process inside a firm helps sellers to tailor marketing strategies that are able to engage multiple stakeholders and facilitate the comprehension of the adoption to all the organization. A grasp of legitimacy dynamics gives to the seller tools to develop legitimacy strategies to explain the technological innovations to different stakeholders allowing to easily navigate through complex regulatory societal environments (Humphreys and Latour, 2013). Therefore, this process determines how the technology will fit in the society, having impacts in the implementation and diffusion of the same.

Likewise, legitimacy strategies have been explored through the lens of discursive and rhetoric, arguing that they play a central role in this process and the use of rhetorical strategies complement and enhance the process of institutionalization. Suddaby and Greenwood (2005) consider that rhetoric is used to create and maintain ideological and meaning systems within the organization allowing to control institutional elements as agency, conflicts and power. Similarly, Vaara and Tienari (2008) affirm that, through textual strategies, particular interest in the organizations can be reproduced or silenced in order to adapt managerial positions in controversial situations. Consequently, the use of multiple strategies of legitimacy is often the most effective form of legitimation.

Different typologies regarding legitimacy has been proposed. Among these typologies, Vaara et al. (2007) described five legitimacy typologies; (1) Normalization is described as a category of authorization to emphasize that events are constructed as normal or natural. (2) Authorization is related to legitimacy obtained through law or individuals who hold some kind of institutional authority. (3) Rationalization refers to legitimacy obtained through specific knowledge claims that are accepted in a given context. (4) Moralization is built around social ethical systems that grant validity and legitimacy. (5) Narrativization refers to the process of legitimating an action by placing it in a relevant and accepted narrative structure that relates the action to the past or the future. In other words, how telling a story provides a plausible and socially acceptable framework where actors involved can be dramatized in order to attract and engage targeted audiences.

Freeman and Freeland (2016) report on the influence that media framing has in the perception of UAV in the US. From its inception, the UAV technology raised indeed multiple issues in the civilian population including privacy and safety concerns. Freeman and Freeland (2016) even declared that “UAV supporters had reason to fear that legitimacy would never develop; proposed legislation in some states would prohibit UAV ownership or make it illegal to take aerial photography”.

The transfer UAV technology should thus allow us to understand the way its risks and benefits are strategically manipulated to convey messages aimed at legitimating the UAV technology transfer and hence supporting the potential shaping the its market. The UAV technology case is a role model for legitimation strategic analysis, providing us a significant representation of the barrier removal strategies utilized by UAV manufacturers.

In the following, we propose to analyze what are the five different legitimation strategies (normalization, authorization, rationalization, moralization and narrativization) deployed by UAV manufactures in order to remove the five different technology transfer barriers (market, technical, sociocultural, political and economic). The intersection of the two dimensions elucidates the contextual evidence of implementing a legitimating strategy in each industry to remove targeted barriers. The context depends on each industry and the perceived barriers that each dual-use manufacturer aims at removing. We now present our methodology to analyze these sectors.
3 Methodology

In order to identify legitimation strategies in different contexts, we propose to use a discursive approach that is widely used in management and organization sciences analyzing legitimacy (Phillips and Hardy, 2002; Czarniawska, 2004; Grant and Hardy, 2004; Vaara and Tienari, 2008) or in information sciences explaining phenomena related to technology ideology and power (e.g. Roderick, 2016).

We first propose a method to collect publications that are relevant for our purpose; we then apply a second step when the content of the selected publications is analyzed. Our document selection commenced with querying the Lexis Nexis data bank (one of the world's largest electronic database for legal and public-records related information) with an initial set of keywords to search for UAV advertising material and to construct a classification scheme for the data content. In order to capture a broader number of relevant publications, we choose to use two keywords: “unmanned aerial vehicles” cross-referenced with “advertising”. The choice was done after scanning multiple articles and videos thanks to which we determined what are the most relevant keywords of interest. The use of these keyword in a query generated an extensive number of worldwide newspapers, blogs, newswires, journals, broadcast transcripts and videos where the analysis of content is feasible. In front of the large amount of texts available, we narrowed our search to the last ten years of material that is to texts published from 2007 to 2017. Note that the Federal Aviation Administration (FAA) Modernization Act was enacted in 2012, in the middle of the period. This first stage selection process yielded media material amounting to 870 items.

We then examined the embodied messages in the 870 items. The examination of each items let us to select only items with relevant advertising content for UAV technology. Because the intent is to identify UAV producers and the strategies used by those UAV producers; the data was examined to classify advertising material generated by UAV producers themselves; namely, videos, brochures, pamphlets, etc. Through this process, we identified a final data set of 50 videos with durations ranging from one to fifteen minutes. In our sample, we selected thirty brochures from five different UAV firms explaining the different typologies of UAVs. This data set thus included material disseminated by UAV manufacturers; other data which was not generated by UAV producers and hence was deemed irrelevant to our analysis.

Our data analysis gathered the most compelling messages communicated by the following global UAV manufacturers: Airwave, DJI, Northrop Grumman, Parrot, Redbird and Sensefly. This is relevant because our central aim is to understand what legitimacy strategies the UAV manufacturers use to manipulate the messages sent to their target audiences to remove TT barriers.

To identify and classify the target audiences within our dataset; we focused on analyzing the storyline, characters, settings, explicit narratives and explicit intended messages. We then coded our data to facilitate the discovery of patterns of occurrence. The content analysis was performed using the qualitative data analysis software (QDAS) NVivo 11, a software that permits the organization of the data gathered and its subsequent analysis (Dean and Sharp, 2006).

From our NVivo classifications; we identified that the advertisements were aimed at three main audiences; general-public, for profit and non-profit organizations. We further coded the first theme as entertainment to include the audiences that use UAVs for leisure activities including; personal film making, photography and remote controlling UAVs for entertainment. Second, we identified several
targeted businesses sectors including the film making, surveillance, mining, etc. We coded this theme as *business* to encompasses all possible business activities. Third, we uncovered several efforts to advertise UAV utilization to the non-profit organizations mainly for humanitarian and disaster relief activities; we coded this theme as *humanitarian*.

With regards to the contextual content of the data; we drew on existing literature that highlights the utilization of legitimating narratives (Vaara et al. 2007); we found recurrent structural patterns of the legitimacy strategies and its orchestration. We coded those legitimization narratives as they are used legitimate the transfer of UAV technology. First, we coded *rationalization* the data instances that had rational explanations as of why the UAV should be acquired. Second, content that included messages constructed with narrative stories was coded as *narrativization*. Third, we coded *normalization* those pieces of data that portrayed the UAVs as an everyday technology or as a normal tool to use in ordinary life. Fourth, the data that contained elements that appeal to human morals, ethics or other behaviors were identified as *moralization*. Finally, those data pieces that used any reference to authority figures in the storylines were identified as *authorization*. The data was analyzed following a qualitative content analysis (Hsieh, 2005), this approach permits to understand the contextual use of elements placed in the data. The analysis started with searches for occurrences of the identified categories, this is defined by Potter and Levine-Donnerstein (1999) as manifest content analysis, followed by a process of content interpretation, denominated latent content analysis (Holsti, 1969).

With the legitimation strategies and the target audiences coded; we commenced our analysis and identified the most logical barrier targeted for removal based on the contextual messages provided in the advertisement data. For example; if an advertisement focused on sending the message of how easy and effortless it is to pilot a UAV to make professional films; we determined that the most logical barrier targeted for removal would be a *technical barrier*. In other words, the message attempted to reach technology averse audiences to communicate the ease of operating the UAV without formal training. Similar logic was utilized to analyze the different barriers defined earlier, namely: *market*, *economic*, *sociocultural* and *political barriers*; the findings of this analysis are presented in the next section.
4 Findings

This section provides the categorization of legitimating strategies and offer compelling illustrations on the most recurring strategies executed by the UAV firms to support the removal of barriers for UVA technology transfer and diffusion.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Market Barriers</th>
<th>Technical Barriers</th>
<th>Sociocultural Barriers</th>
<th>Political Barriers</th>
<th>Economic Barriers</th>
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<td><strong>Humanitarian Industry</strong></td>
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<td>Normalization</td>
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<td>Moralization</td>
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<td>Authorization</td>
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<td>Rationalization</td>
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<td><strong>Entertainment Industry</strong></td>
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<td>Rationalization</td>
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<tr>
<td>Narrativization</td>
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Table 1 Legitimation Strategy by Industry to remove Tech. Transfer Barriers

Table 1 shows occurrences of discursive techniques utilized by the UAV firms to facilitate the removal of technology transfer barriers. The percentages reflect the instances that the specific legitimation strategy was observed for a specific industry; for example, we found that within the humanitarian industry, the narrativization strategy was identified 100% of the times to remove market barriers.

Table 1 documents the resulting three categorizations of industries based on intended UAV utilization as follows: business, entertainment and humanitarian industries. The Military industry represents the starting point of the UAV technology market since it was developed to support military operations remotely; hence, we consider the military industry to be the origin of the transferring technology. As such, we do not include the military industry on the table of results. Rather, we address it separately because from its inception there was a monopsony where the military was the sole buyer of the UAV technology; as such, the UAV manufacturers did not need to engage in any formal legitimating strategy or barrier removals. Divergently, when the technology is transferred to other industries; the monopsonistic market no longer exists and the technology transfer requires legitimation and consequently a strategic removal of technology transfer barriers.

Typical military applications included the collection of intelligence, surveillance and reconnaissance (ISR) information and the weaponization of UAVs in case of war. The Business category includes firms that require the support of UAVs to perform tasks efficiently, quickly or cheaply. The types of applications include, mining, filmmaking, infrastructure inspections, mapping, surveying, precision agriculture, etc. The Entertainment category focuses on the average individual user who likes
to use the latest technological gadgets for either taking pictures, aerial videos, mapping places of interest or to use a toy drone for personal entertainment. Finally, the Humanitarian category comprises organizations that focus on providing humanitarian services around the world. Some applications include the mapping of disaster areas to assess damage, to map potential evacuation routes or to support delivery of humanitarian aid.

The next subsections elaborate on the most relevant results encountered for strategies that occurred more than 50% of the times and offers further insight directly from the data source.

### 4.1 Removal of Market Barriers

**Narrativization Strategies to remove Market Barriers**

The identified narrativization strategies include the utilization of storytelling to convey a sense of acceptable, appropriate or preferential behavior towards the UAV adoption in multiple markets. The stories are presented in different scenarios and provide solutions to problems from a variety of potential markets and industries locally and internationally. One of the recurrent perceived barriers includes the ‘small market potential’ or ‘low consumer demand’. To remove these barriers, the stories take place in different settings where problems in different industries are solved. The data includes stories from industries such as mining, surveying, personal, infrastructure inspection, filmmaking, humanitarian, etc. The fact that there exist a large variety of applications shows the effort from the firms to implant the UAVs into different settings this as an attempt to expand the small markets and increase consumer demand. By allowing the firm to set their footprint into a new potential application for the drone, the market potential is increased and is conducive of a larger density of consumer demand. Furthermore; the fact that the UAV applications transcend borders, allows for international market expansion and catapults the market for broader and far reaching applications.

In the Humanitarian industry, the narrativization strategies encountered were specifically identified as stories of how the UAVs have been utilized to help people in need after natural disasters or to help people to better their living conditions. Data from *UAV participative mapping in Haiti* narrates a story of creating a collective map of a settlement in Haiti; “We realized how useful the data we produced was for the authorities and NGOs, who used our data to help people in need. So, we asked ourselves: if mapping is relevant, why not create an open street map community for Haiti? and this is how we created COSMHA”. Other, time critical support has been provided in humanitarian support as identified in *Drones in Humanitarian Action*; “humanitarian drones collect real time information at the place where a disaster has occurred, they assist in search and rescue operations using infrared cameras and they transport lightweight goods like medication and other medical supplies”.

For the Business industry, the data from *Aeronavics Ltd 2015* provides a story of the firm as an evolving company that is changing from an airframe manufacturer to turnkey solution provider. The data emphasizes the company's capabilities as well as the industries that it serves; ”When we look at the market there's three primary segments of that. The military, commercial and consumer. We are focus on the commercial area and that makes about 25% of the market”. The story continues; “we target the four industries, we look at the agriculture, utilities, film and media industry and then government services”. This type of narrative attempts to help the company to open new markets or at least to target new customers by providing turnkey solutions. The use of famous cases is also part of the narrative of the firm "we know that our systems has been used for producing the twilight saga. The formula 1 was
live broadcasted with our equipment”. Additional data showed that companies offer bundled solutions which include the data-gathering with post processing software tailored to meet the businesses’ specific needs; this conveys the one stop shop solution and hence appealing to a larger market.

In the entertainment industry, analyzed data from DJI - Introducing the DJI Mavic highlights the capabilities of the featured UAV as well as the multiple specific applications for personal utilization. It showcases the DJI goggles and special smart phone applications that can be used to enhance the user experience when operating the drone. The data narrates that the Mavic “automatically follows you or whatever you want without a bracelet or a tracker, avoids obstacles, and comes pack with a 4k stabilized camera, 27 flight time and a lot more. “it's got 24 high performance computing cores, dual satellite connectivity with a 4.3-mile range”. Furthermore, the narrative goes on to ask “Sound complicated? It’s not, it’s easy”. “The Mavic knows where it takes off from, where it is in the air, where it is going and what its capturing” implying that the user does not have to worry about any technical difficulties to operate the UAV and hence,

Rationalization Strategies to remove Market Barriers

In the humanitarian industry data from senseFLY and Surface Pro – Mapping with Civilian Drones shows how the drone and the software provided by the computer Surface Pro is utilized to create amazing maps and models for humanitarian and conservation efforts. “Surface Pro provides the computing power necessary to process data virtually anywhere in a small, lightweight package”. This instance provides evidence of appealing to a set of users who already have a tablet by providing a rationale of using drones and a tablet to obtain high definition maps for humanitarian purposes.

In the business industry, data from Delair-Tech - Drone-It! provides a problem/solution approach to explain how problems can be resolved with the support of a drone. The story provides explicit solutions to multiple industrial problems; for example: in the oil industry, ”How to locate a potential hazard over 1800 kilometers of underground pipeline” or ”how to best fertilize 20000 hectares of crop fields?” in the agricultural industry. By showing the potential capabilities of the drones, the UAV firm attempts to expand their consumer base to multiple industries; hence, increasing their UAV market.

4.2 Removal of Technical Barriers

Rationalization Strategies to remove Technical Barriers

Our analysis results show that rationalization strategies used to remove technical barriers focus on providing exhaustive proof of the technological capabilities to accomplish tasks that would be dangerous for human execution; for example, some mining companies utilize drones to map dangerous areas that would be impossible for an individual to do. These discursive strategies also enforce the goal of removing technical barriers associated with the high complexity of the UAV technology or the possible unreliable results obtained from using UAVs for critical tasks. The prevalent rationalization strategies emphasized efficiency, synergy, time saving, lifesaving and overall utilitarian benefits gained by the usage of UAVs to perform the needed jobs.
A representative example of the humanitarian industry focuses on providing rationales and showcasing efficiencies gained by using the UAVs to map disaster areas to discover access routes for delivery of humanitarian aid. Data from *Can Drones Save Lives? Discovering the Future of UAVs in Humanitarian Response* emphasize the technological capabilities of the drone when used for humanitarian relief activities; “They can reach areas that are inaccessible and they also have the technology that can allow them to fly at night through smoke, pick up heat signatures of bodies and survivors and pinpoint their locations, deliver supplies, the opportunities really are endless in terms of what drones can do in responding to disasters”.

In the business industry, the observed strategies provide a problem/solution approach to convince the business that their requirements will be met or that their technical problems can be solved by using UAVs. Data collected from *Map the invisible – Parrot Sequoia for eBee Ag* targets the precision agriculture industry. The material analyzed shows the use of multispectral cameras to collect large amounts of data with only one flight of the UAV, instead of with multiple flights. The UAV’s data collection is optimized with only one flight. As further described; “inside sequoia, there are four multispectral sensors, these capture data across different spectral bands”. These spectral range cameras allow the drone “to capture analytical non-visible data and visible imagery in the same flight”. Furthermore, with data from different spectrums the post processing can be done simultaneously to obtain multiple results utilized for different purposes. “Using photogrammetry software, Sequoia’s imagery can then be transformed into application maps and even exportable prescriptions”. The post processing of data allows for quick turnaround application solutions and support the decision-making process regarding grape crop maintenance “helping the farmer to optimize their use of water or chemicals to boost yield and increase their net profit”.

**Narrativization Strategies to remove Technical Barriers**

In the Humanitarian industry, the analyzed data showed a limited number of narrativization strategies utilized in support of the removal of perceived technical barriers. The narrativization strategies legitimate the use of UAVs by providing stories that create an appeal to potential users. A specific example of the narrativization was collected from analyzing data from *drones as humanitarian tools* where a team from ‘doctors without borders’ recently used a small drone to conduct an aerial mapping exercise of remote Makhanga island in order to prepare for anticipated seasonal floods that cut off the area from humanitarian aid. The data emphasizes the technical ease of utilizing the drone by non-pilots to obtain “really precise pictures” to “identify the access roads for their missions”; hence, conveying the message that drones are not only highly technological tools but they are also extremely easy to use.

4.3 Removal of Sociocultural Barriers

**Moralization Strategies to remove Sociocultural Barriers**

Moralization strategies were identified as supporting the removal of sociocultural barriers that hinder the transfer and diffusion of the UAV technology by trying to modify specific socio-cultural values.

In the humanitarian industry a significant data point from *I'm a Drone, I'm Here to Help* emphasizes that mapping is an evolutionary process that has reached the new technological milestone by performing mapping with the help of UAVs; “it is interesting because they don't have internet, laptops... but they
understand maps, they have hand drawn maps, they know what power this could give them”. This type of description depicts a change in the way people has traditionally generated and utilized maps; it provides a new and advanced way of obtaining maps in a more accurate and efficient manner. The data reflects an attempt to change way in which people utilize technology to solve time critical problems; also, it attempts to change old traditions that no longer support time-critical solutions to problems.

Narrativization Strategies to remove Sociocultural Barriers

The identified narrativization strategies used to remove UAV technology transfers include the utilization of storytelling to convey a sense of acceptable, appropriate or preferential behavior towards the UAV adoption in multiple settings; in this case the entertainment industry. The target user is an individual and not an entity; hence the stories and messages appeared to be personalized. These strategies were manifested as stories associated with personal choices to capture memories from a different perspective. Other stories focused on appealing to the users’ creative and artistic sides.

In the entertainment industry, a representative example comes from DJI – Phantom 4: One Step at a Time; this story targets the creative side of individual users. This narrative content conveys the idea of finding new ways to use the drone as a conduit for human emotions. Creating a story of how emotions can be better seen and understood via images of difficult to reach locations is the strategy of this narration. The narrator provides the following comment: “You can write a story, you can tell people how scary it was and how much effort it took, but unless you get a visual that people can connect with; it's really hard to describe”. The narrative along with the UAV generated aerial images that create emotions or astonishment effect on viewers is a new way to experience the results of new technological products for personal use; the narrative attempts to create an emotional bond with the story receiver.

5 Discussion

From a general perspective, in our findings the most predominant legitimating strategy was the use of narrativization to remove technology transfer barriers across all our categorized industries. Common sense may dictate that firms execute marketing campaigns to create or grow their market share; however, our results provide a lesser obvious and more profound understanding associated with utilizing legitimating strategies to remove barriers for UAV technology transfer.

Although some of the initial discourses has been created through the firms’ marketing departments, the legitimacy of the technology in a different context requires of a long-term and strategic positioning of the firm to reinforce the perspective that the technology firm is trying to sell and to dissipate any possible doubts, fears or counter-argumentation in the new segment where the technology is to be positioned.

Our analysis conclusions corroborate and complement other research results on the existence of barriers of technology transfer and diffusion. Antioco and Kleijnen’s (2010) conclusions on barriers resulted from researching the consumers’ perspective; our research addresses the question from the UAV firms’ perspective. We can further assert that our discoveries complement theirs by providing a different perspective on strategic legitimation discourse used to remove those barriers.

Antioco and Kleijnen (2010) suggest that change in tradition can appeal to the consumers need for uniqueness. Our results, viewed from the firm’s perspective, align with the idea that consumers may
experience the need to feel good about themselves by breaking tradition and changing the cultural norms; hence, removing some sociocultural barriers that impede the transfer of UAV technology. Our discoveries complement Berge and Heath’s (2007) results based on identity-relevant products that consumers use in their efforts to feel a certain way about themselves. Our analysis outcomes show the multiple narrative strategies used by UAV firms to emphasize how the adoption of the new technology will benefit the consumers’ self-image. The implementation is achieved with emphatic narratives of the positive self-image acquired when using UAVs with cameras to record photographic memories of events from perspectives and heights that had never been done before; hence, rendering these photographs ‘unique’ and consequently enhancing the user’s feelings of uniqueness.

Moreover, the results presented support the claim of market shaping. This is substantiated by the UAV firms’ use of narratives that appeal to potential new users by promoting unique ways of collecting photographic memories in different settings. These narratives take place in different settings and provide new ideas to users on how to be creative and unique. They also shape the entertainment UAV market to capture additional users, including; artists, average users, young professionals, older active individuals; etc. The purpose is to legitimate the transfer of the UAV technology and use it as a unique and innovative way of capturing memories in order to create or grow the market.

Additionally; Antioco and Kleijnen (2010) identify a type of ‘performance risk barrier’ which in our barrier categorization we identify as a technical barrier. This barrier is associated with the consumers’ need to fully understand the overall functionality and performance of the product; our results show substantial evidence that UAV firms emphasize and showcase the UAV’s functional capabilities. Deliberate attempts to explain all the UAV technical capabilities substantiate the need to provide enough information for the user to feel comfortable when adopting the technology; hence, contributing to the creating, shaping and growth of the market.

6 Contributions, Limitations and Conclusion

In this paper, we focused on studying a model of discursive strategies used in legitimating the transfer and diffusion of UAV technology from military settings to other settings. Our findings provide evidence of the strategies the UAV firms use in different industries to enable the UAV technology transfer and consequently, aid the legitimation of the UAV market in different contexts. More specifically, our contribution and findings can be seen in three ways.

First, the research contributes to the literature of technology transfer by Johnson et al. (1997), Choi (2009) and others, by validating and expanding on the notion that ‘communication is the key element in the transfer process’. Our research considers the original technology transfer models developed by Johnson et al. (1997) and Battistella et al. (2015) and provides substantial evidence that UAV firms strategically use legitimating strategies to communicate with the potential end users to help the UAV technology break through the barriers that impede its transfer and diffusion.

Second, this research contributes to the literature of institutionalization and stabilization of markets; by exploring the use of legitimacy discursive strategies proposed by Vaara et al. (2007), it was possible to confirm that the technology transfer process includes the shaping the market where the new technology will be transferred. Thus; the analysis of the AUV industry in the three industries allow us to observe the use of legitimacy discursive strategies that are adapted to overcome the barriers that each
industry encounters. This process of transferring technology to different settings shows the UAV technology needs to be adapted for each context to obtain a congruence between the technology, the buyer logic and the market (Greenwood and Suddaby, 2005).

Third, this paper further emphasizes the technology transfer as a socio-cultural process of market shaping (Peñaloza, 2006 and Humpreys, 2010) in which the use of a discursive strategy permits to overcome the existent barriers of each setting/environment. Likewise, this study permits to explore the shaping of markets as a dialectic process in which the introduction and posterior stabilization depends on the discourse developed by UAV firms that permit to enter seamlessly into new markets. Following the literature on market shaping (Kjellberg and Helgesson, 2006, 2007 and Araujo 2010) this study permits us to observe the use of the legitimacy strategies to create market representations (Rinallo 2006, Diaz Ruiz 2013) that consequently allows to give sense to the functions and use of the drone in this new setting.

Our research will further enable practitioners to become aware and focus on the most challenging barriers to proactively avert those that may deter the transfer and commercialization of controversial technologies to new settings. By understanding the role of the legitimacy discursive strategies, companies can create tactics that permit the legitimation and institutionalization the technology transfer process. The accurate implementation of those legitimacy strategies will in turn facilitate the technology transfer barrier removal by potentially reducing the time to successfully enter into new markets.

This study had several limitations that offer opportunities for future research. First, it is limited in what it can claim because it is based on a data set of approximately 50 videos and 30 brochures and focuses primarily on our independent interpretation of the messages that UAV firms use to remove technology transfer barriers. We did not corroborate with the firms if our interpretation was aligned with their strategic approach with regards to barrier removal; future studies may add this insight from the firm perspective to cross-reference and corroborate the intended result of the legitimation strategies implemented. Second, it is important to mention that there are two different types of consumers. For the entertainment sector; for example, the consumers are considered individual technology users. For all the sectors; the consumers may be entities that cannot make decisions as individuals. Traditionally, those consumers need agreement from a board that approves the firm’s expenditures. Further research that addresses the different types of consumers may shed additional light into the main differences on how to remove barriers perceived by individual consumers compared to entities that acts as consumers. Finally, comprehensive research based on the chronological evolution of strategic narratives utilized by technology manufacturers to remove barriers may provide valuable insight on trends of technology innovation transfer and adoption.

By exploring the UAV technology transfer barriers and the strategies associated with their removal; this research provides a unique perspective to understanding technology transfer as a socio-cultural and dialectic process that requires the development of market representations and market stabilization processes to overcome barriers at each context.

The results can be extended to other technologies that are transferred from controversial settings to ordinary settings. Technology has transformed and will continue to transform the way we do our jobs and the way we live our lives. With the growing implementation of innovative drone technologies and the digitalization of human tasks; it is essential to comprehend the potential strategies that can be implemented to remove the technology transfer barriers associated with those innovations. Legitimacy strategies facilitate technology transfers by reducing potential counter-arguments through.
discursive tactics established to remove diverse barriers. Studies focused on utilization of legitimation strategies for specific purposes are incipient; our results show that the transfer of controversial technology may benefit from the tactical utilization of legitimation strategies to remove the barriers impeding the transfer and diffusion of such technologies.
References


