The Interaction of Private and Public Space Agencies

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By

Eva Femia

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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.

Signed: _____

Approved: _____ Date _____
Benjamin J. Laugelli, Assistant Professor, Department of Engineering and Society

Introduction

The SpaceX Dragon Capsule, developed as a part of NASA's Commercial Orbital Transportation Services (COTS) program, was the first commercial spacecraft to attach to the International Space Station (ISS) and is currently used to transfer supplies to and off of the ISS. Currently, NASA has no way to access the ISS without assistance from a private company (Anderson, 2013). Some claim that NASA and SpaceX are in direct competition and that this level of success from a private organization indicates a failure on NASA's part. However, this argument fails to consider NASA's efforts to collaborate with private companies. Through programs like the COTS, NASA is actively enlisting, not competing against, companies like SpaceX to work towards a common goal. By considering the public and private space sectors as independent, we fail to acknowledge the link between the groups and the role that this link played in the success of the Dragon Capsule. Using Actor-Network theory as a framework, I will examine how NASA acted as a network builder with SpaceX as an essential actor in completing the goal of supplying the ISS. To do this, I will explore NASA's role as a network builder, follow the process of translation, and discuss how the engineers involved also considered the society that the technology was going to enter.

Background

In 2005, one year after the legalization of private space-travel, NASA launched the Commercial Orbital Transportation Services (COTS) program to facilitate the movement of crew and supplies to and from the International Space Station (ISS) through private space companies. The Dragon Capsule spacecraft was one design included in SpaceX's proposal submitted to NASA for consideration under this program. In 2006, NASA announced SpaceX as one of two

companies selected to receive funding under the COTS program, with this funding starting at $278 million. In 2008, SpaceX received a $1.6 billion Commercial Resupply Services (CRS) contract with NASA, minimally involving 12 flights to the ISS and the movement of 44,000 lbs of cargo (Lindenmoyer & Stone, 2010). On May 25th, 2012, the Dragon Capsule became the first commercial spacecraft to attach to the ISS and it soon began regular trips. The SpaceX Dragon Capsule is particularly interesting because it can take two-way trips between the ISS and the Earth and it is designed with the intention of eventually carrying a crew.

Literature Review

There are many articles detailing the success of SpaceX and citing its Dragon Capsule as a prime example of this success, with most agreeing that this is an impressive feat. Additionally, much research exists attempting to explain SpaceX's relatively quick rise into the space sector and its relationship to NASA. However, in doing this, many papers pose SpaceX and NASA in direct competition, indicating that SpaceX's success implies NASA's failure and vice-versa, failing to address that the private and public space sectors may be involved in a mutually-beneficial network. In this section, two papers of this sort are discussed in detail.

In his article *Private Firm SpaceX Poised to Spark Next Space Era*, Marks (2012) discusses SpaceX's Dragon Capsule and what its success means for the future of space-exploration. After addressing that in the short term, this success means that NASA has a way to transfer supplies to and from the International Space Station (ISS), Marks claims that long term "the feat contains the germ of a much bigger idea: a new era in our relationship with space, driven by the goals of nimble companies not sluggish, state-funded agencies." He continues by identifying some potential causes of SpaceX's success, including making "its own

engines, rocket bodies, and electronic systems from scratch" instead of outsourcing, its independence, and its creative, ambitious goals only possible from a private company (Marks, 2012). Throughout the discussion, Marks praises SpaceX at the expense of NASA and the government, only briefly including that "NASA is funding SpaceX to develop this capability." By not mentioning NASA's $1.6 billion Commercial Resupply Services contract with SpaceX as a part of its Commercial Orbital Transportation Services development program, Marks is missing NASA's huge role in the success of the Dragon Capsule. Failing to acknowledge that NASA was essential in creating and facilitating this mission for SpaceX paints an incomplete picture of the process through which the Dragon Capsule was conceived, designed, and implemented.

With an interpretation even more disparaging to NASA, Spencer (2010), in his article *Commercial Capsule Succeeds Where NASA Failed*, compares the Dragon Capsule to NASA's Mercury Capsule from the 1960s. He enumerates the three attempts required for a successful launch of the Mercury Capsule and states that "compared to this, the success of the Dragon Capsule's first flight is nothing to stiff at." In addition to praising SpaceX's technical skills at NASA's expense, Spencer also addresses the two organization's respective ambitions. He claims that the Dragon Capsule, which is currently being tested to carry a crew, "is exciting because of its implicit promise that, someday, it won't just be test pilots and rich space tourists that get to blast into orbit. Maybe the rest of us will be able to go too," alluding to SpaceX's drive towards space tourism. He follows this by saying that "it has become clear that government space agencies have no interest in making that happen" (Spencer, 2010). Similar to Marks, Spencer fails to mention that the development of the Dragon Capsule was facilitated and funded by

NASA programs. These are essential details in understanding the relatively quick rise of SpaceX and other private space-exploration oriented companies.

In the analysis section, I will examine NASA's role in the Dragon Capsule's success. This will provide a more complete picture of SpaceX's rise and its relationship with the public space-exploration sector. To do this, I will employ Actor-Network theory as a framework.

Conceptual Framework

In this analysis, I will examine the relationship between NASA, the private space-exploration sector, and the success of the SpaceX Dragon Capsule using Actor-Network theory as a framework. Actor-Network theory identifies a network builder, a person, group, or organization that recruits actors and forms a network to accomplish some goal (Cressman, 2009). The process of building a network involves aligning the interests of the actors involved. This network is heterogeneous, meaning that it consists of both human and non-human actors. All actors are essential to the network and the completion of its goal, but also have agency and the ability to act independently (Callon, 1987). As a result, strong associations and interconnections contribute to a powerful, stable network while rogue actors that refuse to behave as desired by the network builder leave a network vulnerable.

Actor-Network theory asserts that engineers function also as sociologists. While developing a technology, they consider not only technical design but also the society that the technology will fit into. The engineers attempt to consider all perspectives of the sociotechnical world, including the economic, political, and social. Then, they take these perspectives into consideration when defining their goal, recruiting actors, and developing their technical design.

In doing this, the engineer-sociologists simultaneously address social and technical problems, creating technologies that interact successfully with society (Cressman, 2009).

The final concept I will address in relation to Actor-Network theory is Michael Callon's concept of translation. Translation is the network builder's process of creating and maintaining a network. It is broken down into four moments, (1) problematization, (2) interessement, (3) enrollment, and (4) mobilization. The creation of a network begins with identifying a problem and the actors necessary to solve that problem. Next, the network builder recruits the identified human and non-human actors, aligns their thinking towards the same problem, and assigns them roles in solving the problem. By doing this, the builder secures itself as the director and representative of the other actors. If these four moments are executed successfully, the resulting network is coherent and stable (Callon, 1987).

In the analysis section of this paper, I will identify NASA as the network builder and an engineer-sociologist. SpaceX, along with many others, is one of the actors recruited into NASA's network to accomplish the goal of transferring supplies to and from the International Space Station. By following Callon's concept of translation through identifying each of the four moments, I will explore how the success of the SpaceX Dragon Capsule is a result of this network.

Analysis

The Dragon Capsule is a result of NASA acting as a network builder and recruiting SpaceX as an actor to accomplish the overarching goal of developing a consistent way to supply the International Space Station (ISS). To show this, I will describe NASA's role as a network

builder, explore the four moments of translation, and discuss how the design required the engineers to also act as sociologists.

NASA as a Network Builder

NASA's position in society allowed it to be a strong network builder and to align smaller, private companies' goals with its own. Since it was founded in 1958, NASA has achieved spaceflight, built artificial satellites, completed missions to the moon, and led a number of other space-exploration efforts. Over the past 60 years, it has remained a source of technological pride and cultural symbol of American innovation and progress. This put NASA in a very strong position financially, technically, and socially, allowing it to create a strong network.

As discussed in the literature review, some think that NASA no longer has a strong drive to explore space. In his article *Commercial Capsule Succeeds where NASA Failed*, Spencer (2010) says that "it has become clear that government space agencies have no interest in making [commercial trips to space] happen." I argue that this is not true, the fact that NASA began and funded the COTS program is an indication that it is interested in commercial trips to the ISS. One of the objectives of the COTS is to "create a market environment in which commercial space transportation services are available to Government and private sector customers," which directly illustrates that this is a goal of the government (Lindenmoyer & Stone, 2010). Through mentioning the free-market and commercial services in the objectives of a NASA program, the government is stating its interest in the future of space-exploration, both public and private.

Four Moments of Translation

In order to fully examine how the SpaceX Dragon Capsule was a result of a network built by NASA, I will identify the four moments of translation as defined by Callon. By moving

through these stages, I will illustrate how the Actor-Network theory framework can be used to more clearly understand the relationship between SpaceX and NASA.

I. Problematization

Problematization is characterized by a network builder, in this case NASA, identifying a problem to solve and the actors needed to solve it. This can be seen in NASA's recognition of their need to consistently supply the ISS and their identification of the private sector as a group that could help make this happen. In 2004, as a response to the Space Shuttle Columbia disaster, the government announced a new plan for space-science, the Vision for Space Exploration (VSE). One of the many objectives of the VSE was to fully complete the ISS by 2010 (NASA, 2004). At this point, NASA did not have enough funding to reach all the goals set forth in the VSE, which led them to turn towards the private sector. In his speech given to the American Astronautical Society, Michael Griffin (2005), the NASA Administrator at this time, expressed that "we believe that when we engage the engine of competition, these services [of the ISS] will be provided in a more cost-effective fashion than when the government has to do it." From this, it is clear that the financial advantage is the main motivation for NASA to begin building a network to fully service the ISS. Additionally, this statement shows that NASA is actively identifying the problem it wants solved, which is servicing the ISS. The "competition" refers to the private market within the United States, since the government is unlikely to look towards other countries for assistance with space-exploration.

In this stage, NASA and the United States government identified the problem they wanted to solve: the ISS needed to be serviced and NASA was no longer capable of doing this.

They then considered the actors needed to solve this problem and turned towards the private space sector.

II. Interessment

Interessement is the stage in which the network builder, NASA, recruits the human and non-human actors identified in Problematization to join its network. To recruit private companies, NASA began the Commercial Orbital Transportation Services (COTS) program. The first phase of this program was stated as the "development and demonstration by the private industry of space transportation capabilities to and from LEO (Low Earth Orbit)" (Lambright, 2015). This directly sets forth the private industry as an actor and NASA as an active network builder. NASA then requested proposals from companies, listing four technical requirements that the submitted designs must meet. Funding was awarded to two companies, SpaceX and Rocketplane Kistler (RpK). The Dragon Capsule was in SpaceX's initial proposal to NASA as part of this program.

It is also important to note that the Dragon Capsule was SpaceX's first significant success. On the company's website, under the *Making History* section, the first paragraph is about the Dragon Capsule spacecraft, stating that the capsule "made history in 2012 when [it] became the first commercial spacecraft to deliver cargo to and from the International Space Station". Since this is posted on its website, it seems that SpaceX is proud of this accomplishment and considers it a huge beginning success for the company. Founded in 2002, SpaceX was relatively new when it submitted a proposal to the COTS program. The COTS program gave SpaceX and its engineers a specific problem to focus on, which is a demonstration of how NASA acted as a network builder in aligning its actors' objectives with its own.

III. Enrollment

During enrollment, the network builder assigns roles to the various actors. Ideally, the actors accept and perform what is assigned to them. Through the COTS program, NASA clearly identifies goals for the selected companies. SpaceX is an example of when an actor meets its goals and RpK is an example of when a company fails to perform as expected by the network builder. After receiving initial funding from NASA, SpaceX and RpK were tasked with raising their own funding to contribute to the development and demonstration program in addition to reaching certain technical milestones. These roles were assigned to the private companies in the network by NASA, the network builder. RpK failed to contribute the necessary funds and was therefore dropped from the COTS program. This is an example of the network builder removing an unnecessary actor when it is no longer essential or aligned with the goals of the network. In contrast, SpaceX completed all the goals assigned to it by NASA (Lindenmoyer & Stone, 2010). This is demonstrated by the successful trip of the Dragon Capsule to the ISS in 2012.

IV. Mobilization

Mobilization is characterized by the network builder, NASA, securing its role of representing and speaking for the other actors. This is demonstrated through SpaceX's praise of and appreciation for NASA. When discussing the success of SpaceX, Elon Musk says "we would not be the company that we are today without the support of NASA" (Lambright, 2015). This acknowledgement of NASA's role in SpaceX's growth is crediting the network builder. SpaceX needed the strength, momentum, and funding that NASA had in order to progress. Through the COTS, NASA ensured that their name was on the successful cargo delivery to the ISS.

Additionally, the Federal Aviation Administration (FAA) currently requires "FAA representatives [to] attend every launch, evaluate every landing, and work alongside the space tourism operators" (Seedhouse, 2019). The presence of a public representative at all private space-exploration events is a demonstration of the government's consistent role in monitoring the private space sector, including SpaceX. As the network builder, founder, and sponsor of this program, NASA acted as a representative for SpaceX and the other actors in the network.

Engineer-Sociologists

Another key aspect of Actor-Network theory is the idea that the engineers also act as sociologists by envisioning the world required for the success of the designed technology. In the case of COTS and the Dragon Capsule, this can be seen through the policy changes that needed to occur to allow for the technical project to move forward.

As of the beginning of the 21st century, private space-exploration was not legal. However, when visualizing the world required for successful, consistent supplying of the ISS, NASA acted as a sociologist. Shortly following NASA's realization that they needed private assistance to supply the ISS, the Commercial Space Launch Amendments Act was passed. This policy legalized private space-exploration. The first goal of the bill was to "open space to the American people and to their private commercial enterprises" with hope that this would "guide Federal space investments, policies, and regulations" (2003-2004). This allowed for the COTS to move forward and for private companies to begin designing spacecraft to be commissioned by NASA. From the language of the bill, it is clear that it was passed purely for the purpose of progressing this specific project. It also notes that the goal of opening space to the private sector is to "guide"

future endeavors by the public sector. This societal change was necessary for the Dragon Capsule's success and is an example of engineers also acting as sociologists.

Conclusion

In this paper, I have used the Actor-Network theory framework to argue that the success of the SpaceX Dragon Capsule is a result of the network built by NASA because NASA acted as a network builder and moved through the steps of translation to align SpaceX's goals with its own. From this, I can conclude that the private and public sectors of space-exploration are not independent agencies in direct competition with each other. Instead, they are in a mutually beneficial network, working together to further our space-exploration capabilities and knowledge of space. It is useful to have a full understanding of the relationship between SpaceX and NASA as these organizations continue to grow and shape the future through their successes.

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