

**THE STORY OF THE JOLLY GREEN II: A SOCIOTECHNICAL ANALYSIS OF AIR
FORCE TECHNOLOGY ACQUISITION STRATEGIES**

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By

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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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AN INTRODUCTION TO THE SOCIAL AND TECHNICAL COMPONENTS OF THE UNITED STATES AIR FORCE

The Aeronautical Division of the United States Army Signal Corp was formed in 1907, and this component of the US military would eventually evolve into the United States Air Force (USAF). This branch has been integral to American military actions, with a focus on performing its five core missions of “(1) air and space superiority; (2) intelligence, surveillance, and reconnaissance (ISR); (3) rapid global mobility; (4) global strike; and (5) command and control” (United States Air Force, 2013). Both social and technical capability must be maintained in order to ensure its ability to accomplish these objectives. A particular area in which socio-technical competence is required is in the procurement of Air Force technologies, whether these be specific weapons systems or entire aircrafts. Since the USAF relies on the design and production capacity of private companies to outfit itself, maintaining social connections as well as effective technical communication with other entities is vital to its continued operation.

The technical thesis will address one protective system that is vital for the sustainability of the USAF fleets. It is estimated that 25% of aircraft structure failures occur due to corrosion (Petrović, 2016), so the USAF and the companies that produce aircrafts for the USAF create coatings that can prevent corrosion. The goal of the technical project will be the design and production of user-friendly electrodes that can be used to monitor the health of these corrosion protective coatings in real time. These electrodes will allow for the corrosion coating assessment process to be simpler for both the personnel placing electrodes and the personnel analyzing coating quality in different areas of an aircraft.

The STS thesis investigates the social environment that the USAF has developed and continues to develop in its efforts to procure useful technology. The thesis will analyze this environment by utilizing Actor Network Theory, or ANT, to examine the actors that are involved

in the Air Force technology procurement process. ANT was created by researchers from the Centre de Sociologie de 'Innovation in Paris, France in the 1970s and 1980s as a method of sociotechnical analysis that examines the entities that affect a piece of technology as well as the connections between said entities (Muniesa, 2015). This report will use ANT to generate and examine the sociotechnical network around the design, production, and delivery of the HH-60W Jolly Green II, a combat rescue helicopter that was designed by the Sikorsky Company (United States Air Force, 2020). Creating this model will illuminate the network that connects the USAF with other actors and allows for aircrafts are requested, designed, produced, and put into action. The report will first explore the production history of the Jolly Green II, intermittently discussing the actors involved in each step of production, and then conclude by presenting a completed network and discussing the connections between the actors in it. The STS thesis is coupled to the technical work as the electrodes that will be produced will be designed with the intention of testing the non-chromate corrosion protective coating found on the HH-60W. Additionally, the technical work has been sponsored by a private military company so the social connection between said company and the USAF can be better understood via the model developed in the STS thesis.

THE DESIGN, PRODUCTION, AND DELIVERY TIMELINE OF THE HH-60W JOLLY GREEN II

A REPLACEMENT FOR A DECADES-OLD FLEET

The HH-60G Pave Hawk helicopter fleet first entered service in the USAF in 1982 for the purpose of “personnel recovery in hostile conditions and [in] military operations other than war” (United States Air Force, n.d.). These aircrafts, which were jointly designed by the Sikorsky Aircraft Company, were used to support combat operations in Iraq, Kuwait, and Saudi

Arabia and to provide aid during humanitarian efforts overseas and on American soil. Some of the Pave Hawk fleet is still in use to this day but concerns about the age of the aircrafts were present by the early 2000s. The USAF created their first program with the purpose of replacing the HH-60G fleet in 2005, dubbed the CSAR-X program (Matishak, 2005). This program was intended to follow the methodology shown in Figure 1, where the USAF would hand off specifications to companies in the defense industry, companies send designs back to the USAF, and then, after review of the designs, the USAF offers one of the companies a contract to produce their design.

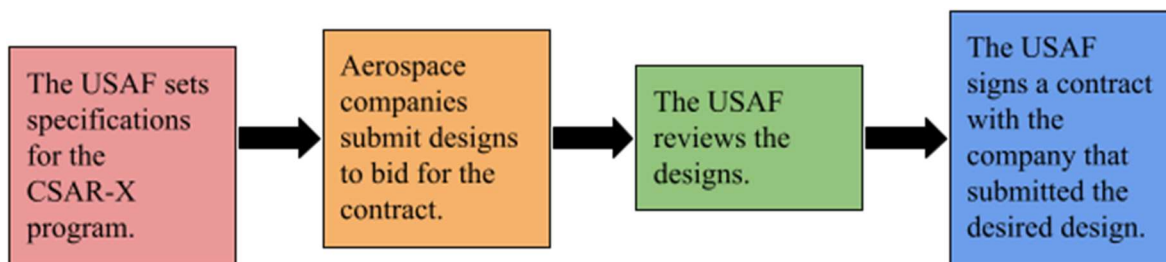


Figure 1: USAF Aircraft Design Process: A model of the USAF methodology for the awarding of the CSAR-X contract (Askew, 2023).

Initially the Boeing HH-47 Chinook won the competition for the project, but an official contract was not signed due to protests from other companies (Munoz, 2007). The Sikorsky Aircraft Company and Lockheed Martin Sys. Integration Owego formally complained that the evaluation criteria that the USAF was using differed from the criteria that had been included in the request for proposals and that the Air Force had unfairly favored the Boeing company. The Government Accountability Office, or GAO, sided with the two protesting companies, forcing the USAF and Boeing Company to pause any further progress (Government Accountability Office, 2007). With these complications and continued pressure from Sikorsky and Lockheed Martin, Secretary of Defense Robert Gates ended the CSAR-X program and terminated the USAF's contract with Boeing in 2009 (DiVittorio, 2010).

The USAF, still facing the problem of an aging fleet of Pave Hawks, began their next attempt to replace the aircrafts soon after CSAR-X ended. In March of 2012 the Combat Rescue Helicopter program, or CRH program, was initiated with the same overall goal of the previous project (United States Department of Defense, 2019). To produce a vehicle that would be suitable for personnel recovery while in potentially hostile environments, the USAF set several specifications. The CRH had to be capable of taking off and landing vertically as well as hovering at high altitudes while carrying weight mid-mission. Durability and survivability in various situations were also paramount, as the aircraft would be used in day, night, hostile and non-hostile environments. All of the systems required to provide these capabilities had to be operable by one pilot so a second pilot could focus on navigation and communication.

As the USAF's attempt to replace the Pave Hawk began, relevant sociotechnical actors in the military aircraft production process became apparent. Regarding the network around the Jolly Green II, the HH-60G helicopter itself serves as an actor since the CRH program was specifically made with the intention of meeting and exceeding its capabilities. The USAF also serves as a major entity as it set the initial technical specifications for the HH-60G, used HH-60G helicopters extensively, and commissioned both the CSAR-X and CRH programs when the time came to replace the fleet. Due to these interactions between the USAF and the Pave Hawk, they can be connected in the ANT model for the Jolly Green II. International politics and the environmental events that occurred around also served as actors. Since combat rescue aircrafts were used in peaceful, politically hostile, and environmentally hostile settings, the design and specifications for both the Pave Hawk and the eventual choice for the CRH program were molded for use in these scenarios. The geopolitical state of the world also affected the USAF and its decisions of what missions to take on and with what aircrafts. While not directly related to the

creation of the HH-60W, the initial failure of the CSAR-X program illustrates the relevance of the relationship between the private sector and public sector. A disagreement between the companies and USAF over the methodology used to choose the contract winner required the involvement of a separate organization in the U.S. federal government, and eventually ended the program in its entirety.

CONTRACT COMPETITION YIELDS INDUSTRIAL INSIGHT

The official request for proposals, or RFP, for the CRH program was released in October of 2012 (United States Department of Defense, 2019). Several companies indicated interest in submitting designs to the USAF, including the Northrop Grumman Corporation in collaboration with AgustaWestland, the Boeing Company, Textron, the European Aeronautic Defence and Space Company, and the Sikorsky Aircraft Company in collaboration with Lockheed Martin. However, by the end of the year almost all of these companies would decide not to compete for the contract (Shalal-Esa, 2012). While the USAF had released an RFP that was open for any defense company to bid for, industry executives claimed that the USAF favored the Sikorsky Company's design. Sikorsky and Lockheed Martin had developed an aircraft design based on the U.S. Army's UH-60M Black Hawk, a multi-purpose helicopter that could assist in assault and evacuation missions (PEO Aviation, 2020). Officials from the other five companies claimed that the terms of the RFP were so specific that the Sikorsky-Lockheed Martin aircraft could meet specifications perfectly. Additionally, the companies claimed that the RFP failed to reward companies for exceeding expectations in areas such as aircraft size and carrying capacity. The Pentagon supported the USAF's choice to be specific in the terms of the competition (Shalal-Esa, 2012), and after a formal investigation the GAO determined that the Air Force was within its rights to award a contract without testing prototypes from multiple companies (Government

Accountability Office, 2013). In June of 2014, with no other competitors left, the USAF was able to officially award Sikorsky with the contract and designated their design the HH-60W Jolly Green II (Mayer, 2014).

At this point in the creation of the HH-60W, the private sector becomes especially socially and technically relevant. The industrial team that designed the HH-60W, made up of Lockheed Martin and the Sikorsky Aircraft Company, must be an actor in its network since it put in large amounts of technical work to create the aircraft. The other private companies that submitted designs to the USAF must also become actors, due to their roles as competitors in the industry. The presence of other defense companies can influence a company to change factors in a design in order to make their product more favorable than their competitors'. For example, the Institute for Defense Analyses estimated that competition between the companies that created designs for the Joint Strike Fighter program resulted in between 11 and 18 percent of savings for the Department of Defense as the companies lowered their prices as much as possible in order to win the contract (Woolsey et al., 2012). The private companies also did affect and were affected by the U.S. Federal Government through the Pentagon and the GAO, which both had the ability to force the USAF to change the RFP to be less specific. By not choosing not to act, both government agencies ensured that the CRH would be designed using Sikorsky's design philosophy and would be similar to an already existing aircraft in the UH-60M Black Hawk. This helicopter also serves as an actor in this network as its existence and reliability in the U.S. Army resulted in its use as an inspiration for the Jolly Green II.

SIKORSKY AND THE UNITED STATES AIR FORCE COLLABORATE

As the Sikorsky Company began working on producing fully functioning HH-60W helicopters, it was purchased by Lockheed-Martin on July 20, 2015 (Petrescu et al., 2017).

Steady progress on the vehicles was made, with multiple design reviews conducted for the systems that were necessary to create a functioning aircraft. By December of 2016, Sikorsky had proven that their helicopters would be able to perform USAF standards and that they would be able to produce the crafts on time. The Air Force Review Board then authorized the purchase of the first five HH-60W helicopters. Production continued with little delay, and in early 2019 the first two functioning helicopters were delivered to the USAF for testing and achieved first flight. With a completed and fully capable aircraft now in the flight stage of testing, the USAF authorized the next phase of production for the future delivery of 61 helicopters in September of 2019. While the CRH was not yet able to meet all of the initial specifications set by the USAF, the aircraft continued to perform well during testing and improvements in these key areas continued to be made. However, in the midst of these stages of testing and production, delays in progress occurred due to the COVID-19 pandemic beginning in March of 2020. Despite this, the HH-60W, now named the Jolly Green II, was able to continue testing through 2020 and into 2021 until the first fully functional helicopter was finally delivered to the USAF on May 18, 2021 (Lockheed Martin, n.d.). The Jolly Green II continued to be produced and delivered to the USAF, though in 2022 the U.S. Congress elected to reduce the budget allocated to the CRH program. This forced the USAF to reduce the number of helicopters that it would procure to 75, as opposed to the 113 aircrafts that were initially requested in the RFP (U.S. House of Representatives, 2022).

Four of the previously discussed actors were important to the manufacturing and testing of the Jolly Green II: the USAF, the team of Lockheed Martin and Sikorsky, the international environment, and the U.S. Federal Government. The social connection between Lockheed Martin and Sikorsky changed as the former gained control of the latter, and this purchase

affected the entire defense industry by functionally removing a competitor from the playing field. The relationship between the USAF and Sikorsky could once again be examined as Sikorsky was repeatedly reviewed by the USAF to ensure that the company remained effective in its production and delivery. COVID-19 greatly affected the international environment, and its presence delayed the testing of the helicopter. The U.S. Federal Government similarly changed the terms that the USAF and Sikorsky had initially agreed to by reducing the amount of air crafts that the USAF would be able to accept. The final actor that has not been discussed is the Jolly Green II itself. After being designed, contested, chosen, produced, tested, and delivered it could be placed in a relatively central part of the network.

FORMING A NETWORK AROUND THE JOLLY GREEN II

After reviewing the timeline that led to the creation of the HH-60W Jolly Green II, a map of the network that allowed for the creation of the Jolly Green II can be created, which is shown in Figure 2. The previously discussed actors, including the Jolly Green II, the USAF, the U.S. Federal Government, the Sikorsky Company, other defense companies, the international environment, and previous personnel recovery aircrafts, are placed in the network connected as was discussed previously. The model also distinguishes between the companies and organizations run by humans, technological elements, and the larger environments that the other actors influence and are influenced by.

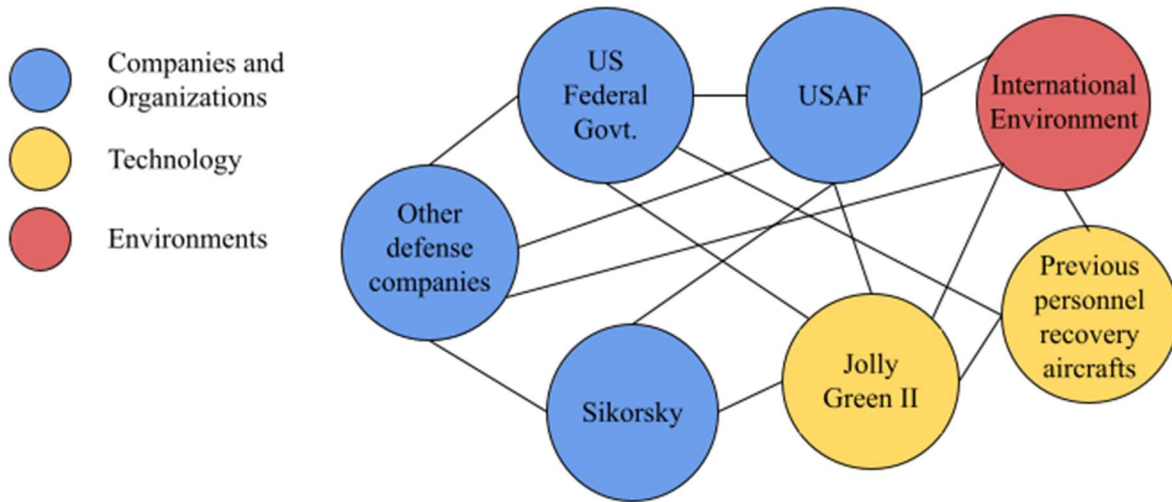


Figure 2: Actor-Network-Theory Map: A model of the sociotechnical relationships involved in the development of the Jolly Green II (Askew, 2023).

While this network is centered around a specific aircraft, its general structure can be applied to other pieces of Air Force technology. In their spending report for the 2022 financial year, the U. S. Air Force reported that they spent approximately \$59 billion on the procurement of new technology. Most of these systems were acquired using a similar process to that used in the CRH project, so while the specific actors involved would change, the overall network would be similar. For example, a network for the HH-60 Pave Hawk would be the same as the network shown in Figure 2, with the Pave Hawk replacing the Jolly Green II. While the specific manner in which the actors operated differs, the overall socio-technical relationships formed by the USAF and around the aircraft and any other procured technologies can be understood with this model.

American citizens should understand the network that is formed around military technology and be able to identify the actors that affect military operation. The \$59 billion that the Air Force spent on procurement came from tax dollars, and tax payers have the right to know how their money is being spent. Beyond financial reasons, citizens also deserve to know what

entities influence their government, especially when said entities are private companies with interests that may not align with those of the American public. By understanding this model which ties these agents together and illustrates their sociotechnical connections to each other, citizens of the United States can educate themselves about this network and support or challenge it as they see fit.

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