# Prospectus

**Establishing a Benefit Case for New Airport Traffic Control Towers**
(Technical Topic)

**Actor Network Theory and the Successful Construction of Remote Control Towers**
(STS Topic)

By

Katherine Taylor

21 November 2019

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 _____________________
Ben Laugelli, Department of Engineering and Society

Approved: _________________________________ Date _____________________
Cody Fleming, Department of Engineering Systems and the Environment

## Introduction

Smaller communities in the United States rely on air travel to stay connected. Communities that have modern air traffic control processes, including air traffic control towers (ATCTs), are more likely to see increased business traffic, which in turn brings in a significant source of income and jobs (Van Beek, 2017). The FAA (Federal Aviation Administration), limits which airports can build new towers according to a cost-benefit analysis outlined in report APO-90-7, written in 1990 (FAA, 1990). These smaller airports generally do not meet the criteria for a federally funded tower but could still qualify for a federal contract tower, which involves cost-sharing between the FAA and the airport. But the FAA put a moratorium on new contract towers in 2014 due to budgetary constraints. In recent years, however, a new technology, remote towers has been introduced in Europe and looks to be a promising alternative for these smaller airports to traditional air traffic control towers (Van Beek, 2017). To allow for the eventual inclusion of remote towers as an alternative and incorporate the economic benefits they bring to an airport, I will propose a new quantitative model that produces a cost-benefit analysis tailored towards these smaller airports.

However, it has become clear that for these airports to potentially build remote towers, there are several qualitative factors to be understood. In the United States, remote towers only exist in the research phase, so there is little precedent for the successful implementation of a remote tower at a commercial airport (Rosenberg, 2017). In the United Kingdom (UK), there exists a remote tower at Cranfield Airport in Bedfordshire, which started operating in December of 2018 (Baker, 2018). Understanding how this remote tower was successfully implemented will save smaller airports in the United States time and money as remote towers require less planning and costs a fraction of a traditional ATCT (Van Beek, 2017).

To effectively produce a new cost-benefit model for the FAA to determine where to build air traffic control towers, both the technical and social aspects of the problem need to be addressed. Below I outline the process of building a new cost-benefit analysis model for these smaller airports. Additionally, I will use Actor-Network Theory to analyze how Cranfield Airport was able to successfully implement a remote tower by forming a complex network of human and non-human actors.

## Technical Problem

Air Traffic Control Towers (ATCTs) have the primary responsibility for preventing collisions between aircraft and other hazards (FAA, 2019, p.37). These towers are highly visible at airports, standing up to several hundred feet above the concourse. In the United States, there are approximately 500 towered airports, and 20,000 non-towered airports (Van Beek, 2017). Of these approximately 500 airports, only 264 are directly run by the FAA, the rest are contracted out, at the cost of 26% of an FAA tower.  At airports with high levels of commercial activity, there are clear benefits to having a tower, including reduced flying time, and fewer accidents (FAA, 1990). These airports generally deal with air traffic that flies in class B and C airspace. The rest of air traffic in the United States falls into class D, E, or G, which includes charter, recreational and private flights. Airports with traffic that fall into class D airspace are required to have a tower, and with class E and G airports pilots communicate with each other on a single frequency to coordinate takeoff and landings (Sawyer, 2019). In addition to reducing safety risk, ATCTs bring in more chartered business flights, resulting in economic benefits for the town the airport is located in (Berry et al, 2015).

To establish a new tower, the FAA has several criteria, the most important being a cost-benefit analysis of the tower establishment. This process is outlined in detail in FAA report

APO-90-7, updated last in 1990 (FAA, 1990). If an airport receives a score greater than one using the FAA model, that airport should have a tower. If an airport receives a score less than one, then no tower should be built or if one is present it should be decommissioned. Airports with a score of less than one can still petition for a tower and may be required to pay up to 20% of the costs associated with the tower (Van Beek, 2017). Additionally, communities can choose to build and maintain a tower on their own, and these towers are classified as non-federal towers.

In 2014, due to budgetary constraints, the FAA put a moratorium on the establishment of new contract towers, which are the most viable option for an airport wanting a tower and unable to pay for it completely (Van Beek, 2017). The FAA also has not rerun the cost-benefit ratios for existing towers since 2006, and its methodology is not robust to airports fudging their numbers (M. Feeley, personal communication, October 10, 2019). Additionally, remote towers have entered the air traffic control conversation. A remote tower uses cameras to recreate the same viewpoint a physical tower would have without building the actual tower. Currently, the only remote tower tests in the United States are run by private companies. In Europe however, several countries have been testing remote towers for years, and in 2018 the Cranfield airport switched to using a remote tower for all of its air traffic control (Baker, 2018).

The cost-benefit analysis method the FAA uses to determine whether an airport needs a tower is vastly outdated and inflexible to new technology developments such as remote towers. As the FAA has constrained resources and budget, and the cost to build a physical tower increases, more alternatives, especially for smaller nontowered airports, need to be pursued. The team will propose a new cost-benefit analysis system for the establishment of ATCTs, with a specific focus on the benefit that towers provide in class D airspace. This new benefit case will add the flexibility necessary for the adoption of remote towers in the future as well. The client for this project is the Fort Hill Group, which consults directly with the FAA on air traffic control. The analysis will take the following steps: design and specification of objectives and metrics, design and implementation of quantitative models, model validation and testing, and final recommendation and results.

**STS Problem**

In December of 2018, Cranfield Airport in Bedfordshire, UK opened the UK's first digital air traffic control tower. A live video stream from cameras mounted on a mast-like device creates a 270-degree view of the airport on a large panoramic screen (Baker, 2018). The tower is referred to as digital rather than remote since the building is located only 40 feet from the original tower. The Swedish company Saab built the technology behind the digital tower and has previously built two other remote towers, both in Sweden (Rosenberg, 2017). Cranfield Airport was originally an RAF base during World War II but converted to private ownership after the war and is now owned by Cranfield University. Cranfield University is a leader in aeronautics research and performs research at Cranfield Airport. In addition to supporting Cranfield University's research needs, the airport also supports business travel and general aviation flights (Cranfield College of Aeronautics history, 2006).

The partnership between Cranfield University and Saab is generally credited with the successful implementation of a digital tower. Cranfield University had an interest in replacing its old physical tower as that tower had bad visibility due to construction of taller buildings near the airport (Baker, 2018). The university also had a vested interest in keeping up with the forefront of aviation technology, as it has established itself as the premier aviation research university in the UK. Saab had the technology and expertise required to implement the digital tower (Baker, 2018). Additionally, the company Rode and Schwarz provided state of the art voice equipment to the tower, which was necessary for ensuring the digital tower workers could communicate clearly with the pilots.

This project, however, would not have been possible without the UK's Civil Aviation Authority's (CAA) policies guiding the establishment of remote towers in the UK. In November 2018, the first version of the "Policy for the Approval of Remote Aerodrome Air Traffic Services" was implemented (CAA, 2019). This document is what ultimately allowed the digital tower at Cranfield Airport to begin operations. This policy was created because remote towers are a listed priority in the CAA's airspace modernization strategy (CAA, 2018). If the partnership between SAAB and Cranfield University is still considered to be the only reason the digital tower construction was successful, then the role of the policy in the success of establishing the digital tower is not understood.

To analyze how Cranfield Airport successfully created the UK's first digital tower, I will use Actor-Network Theory, specifically Michael Callon's process of translation. Actor-Network Theory is an approach to understanding the technology-society relationship that examines power dynamics in heterogeneous networks. Heterogeneous networks are comprised of both human and non-human actors with both playing important roles in the success of the network. At the core of the heterogenous network there is a network builder with a specific goal to be accomplished. Translation is the process of forming and maintaining an Actor-Network and consists of the steps of problematization, interessement, enrolment, mobilization, and black-box (Callon, 1986). I will argue that Cranfield University's enrolment of the CAA's air traffic control policy in the digital tower network was ultimately responsible for the successful implementation of the digital tower.

## Conclusion

The technical report will deliver a new cost-benefit model to determine whether class D, E, and G airports should receive or continue to have an ATCT and be flexible enough to include remote towers as an alternative when the technology becomes more widespread. The model will take into account the benefits seen through decreases in accidents or safety events as well as the economic benefits of increased business presence at the airport. The STS research paper will use the concepts of Actor-Network Theory and translation to examine the successful construction of the Cranfield University digital tower and how the enrolment of the CAA's air traffic control policy ultimately allowed for the opening of the tower.

The results of the technical report will help resolve the broader socio-technical issue of maintaining the economies of smaller communities in the United States by creating a benefits case more tailored to airports that do not see the same volume of traffic as major airline hubs. The findings from the STS research paper will help smaller communities that want to pursue building a remote tower understand how to successfully form the correct network to open a remote tower, and thus bring in more economic opportunity.

Word Count: 1,767

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