Cubetrix
(Technical Paper)

The Relationship Between Society and Technology in the Airline Industry with an Economic Perspective
(STS Paper)

A Thesis Prospectus Submitted to the
Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia
In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

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Fall, 2019

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

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Introduction

Although humans are the creative geniuses behind technological innovations and engineering marvels, humans are also an obstacle for those advancements. A driving factor that makes a commercial technology successful is primarily economics. Consequently, a driving factor that leads to technological innovation is the consumer confidence and the societal landscape. The aviation industry has seen an exponential growth in consumer passengers which is projected to increase from to 1.28 billion passengers in 2038, a growth of more than 50% (Zazulia, 2018). Despite a significant growth in consumers willing to fly, more people would much rather take cheaper and less luxurious flights. This ultimately shapes the entire economics of the airline industry and affects both the way airlines price their tickets and the demand for more fuel-efficient aircraft technologies. There is a significant trend of airlines going bankrupt from factors ranging from competition with low-budget carriers and labor relations to fuel cost (Kenney, 2011). This poses a threat to the future of commercial air travel and its accessibility and addresses the effects of economics on technological innovation. Why do people target economics over engineering marvels and how does it shape technological innovation?

Consumer preference towards economics shapes technological innovation, including the way airlines pave the path for more efficient aircraft technologies. Although airplanes have been primarily using turbofan engines since the 1960s as they are still the most efficient engines today, there have been significant innovations and modifications to achieve better efficiency with the same type of engine (Ferro, 2017). Technologies will be made given the current restraints and the potential outcomes from those factors can shed light on future projects and innovations. The STS research topic will discuss the relationship between society and the airline industry and its subsequent technologies and why people target economics instead of engineering marvels.

The Technical Topic will explore the use of various technologies to create a novelty that is an interactive object that outputs LED lights and music and will discuss why a team chose to create a novelty instead of attempting an engineering marvel.

Technical Topic

Many people categorize technology with solely innovation and solving problems and forget what makes it unique to humans, creativity. Technology can be used to create nifty toys and devices and enhance peoples' lives but do not necessarily serve to purpose. Airplane technology mainly serves to connect the world and take people to further places faster. Engineers must look at developing airplane technologies from an economic standpoint, a perspective that most people adopt. Our goal, rather than tackling a humanitarian issue, is to create an interactive LED object that produces various lights and music from an economic point of view.

Our project, Cubetrix, is a device in the shape of a cube that plays musical sounds based on human input. The cube will be a portable size as it is meant to be touched and moved and change orientation. Similar to a die, each face of the cube that is up will indicate a different meaning - a different instrument, consisting of a unique tone and scale, is used. Assuming that the cube is placed on a table, the remaining five sides can be played as a different note on that instrument. A side is played when a user touches or presses that side and is further indicated by colored LEDs lighting up. Each side or note should be represented by a different color. Overall, Cubetrix will be able to play six different instruments, with five notes each. The specifics of which instruments and which notes will be further specified in the future.

This device will mainly be controlled by an MSP430, a mixed-signal microcontroller for low-cost and low-power embedded applications, which will process the inputs and control the outputs through its several serial pins (Texas Instrument). We intend to use one accelerometer to determine the orientation of the cube, which determines the instrument being played. Each side will be equipped with a force sensitive resistor (FSR or force sensor) which will detect whether the side is being "pressed" or not (Ada, 2018). Each side will also be equipped with a number of RGB LEDs which will light up a certain color when pressed (Townsend, 2019). The device will have a speaker that will output the analog signal of a note being played on a specific instrument depending on which instrument and which side is pressed. Multiple sides can be pressed at one time, in which case multiple sounds will play at once. This algorithm will be programmed on the MSP430 based on the inputs of the accelerometer and FSR. Significant testing will need to be performed in order to understand the exact values of these sensors.

We anticipate facing a few challenges as we navigate through project. The device may pose a challenge since we value the aesthetics of our Cubetrix device, and we hope to keep all computing parts - sensors, MSP430, outputs, battery - inside the cube. If the cube is to be portable and interactive, each of these computing parts must be secure within the cube. Our challenge would be to physically organize it in a way that secures the connections between these parts and efficiently stores them within the given space. Especially with the LEDs, we need them on the surface of the cube in order to be visible, and to be covered with an additional layer of translucent material so we get a glowing effect. The force sensors must also be on the surface in order to detect a "press" inside. These details will need to be carefully planned out and taken into account when designing our device. Finally, a challenge that we may face is the battery needed to power the device. We intend to use a standard battery, and the enclosure will be opened for their replacement. This purpose of this project is to explore various technologies and produce a device with self-given constraints for low-cost materials.

STS Topic

Economics is a major driver in technology and the airline industry is at the mercy of it. Consumers today would rather choose to fly slower and cheaper, reducing the demand for the innovation of faster and more efficient airplanes. The following research will discuss the societal implications on specifically the airline industry and how its technologies are shaped. This topic will be analyzed using the STS theory Social Construction of Technology (SCOT). SCOT examines the theory that technology does not influence human action, but that rather, human action shapes technology (Klein and Kleinman, 2002). Klein and Kleinman push for the structural concepts towards the understanding of technological development. To understand how human actions shaped certain technologies, it is worth taking a closer look at the failure of Britain's own De Havilland Comet, the world's first commercial jet airliner (Hollingham, 2017).

The Comet was an example of a technology that was too advanced for its time. The end of World War II resulted in a surplus of aircraft which became the catalyst for the rising popularity of general aviation (Bilstein, 2006). When the Comet took flight in 1952, it shocked the world and created a new level of travel for the elite (Hollingham, 2017). The Comet was introduced in response to the inefficiency of propeller-driven aircraft encountering supersonic speed and to quench society's thirst for faster air travel (Pushkar, 2002). However, the Comet was plagued with flaws and despite being able to fly 100 miles faster than propeller-driven aircrafts, it was limited by its range and crashes that led to its downfall and commercial failure (Whitey, 1997). However, an important discovery to note was that the entrance of jet-engines into the commercial market was only viable because jet innovations proved to be more efficient, faster, and have greater range (Bilstein, 2006). The general public's motivation and need for improved air travel pushed for the development of the Comet, and despite its failure, paved the way for jet-engines to take over the commercial aviation industry.

Once jet-engine airliners became the new standard, the idea of supersonic transport on a commercial scale was brewing as small fighter jets already began breaking the sound barrier. Conveniently, the world was embroiled in the Cold War and was eager to participate in a new race analogous to the Space Race (Bramson, 2015). To explore the SCOT theory deeper in the airline industry, another example is the introduction of the Concorde, a supersonic passenger aircraft developed by Britain and France. The political and societal landscape amidst the Cold War shaped the development of the Concorde. The primary goal was to produce an extremely fast passenger jet, not fuel efficiency. However, the Concorde was built in the wrong place at the wrong time in a more cost-conscious era (McFadden, 2017). The Concorde was designed well before the oil-price shock of the 1970s, so even though it was a tremendous feat of engineering, it was effectively dumping fuel. Its high energy consumption simply made it unprofitable in an era of high fuel prices (Overly, 2017). Society influenced the development of the Concorde but also betrayed it. Its development was highly subsidized by the British and French governments which was why it lasted as long as it did.

The De Havilland Comet and the Concorde were both monumental feats of engineering that were too advanced for their respective times. They were both developed when society pushed for faster air travel but were betrayed by society's preference for cheaper and more fuel-efficient air travel. Another look at the SCOT theory in the airline industry is the introduction of the Boeing 747. By the time the Concorde took commercial flight in 1976, the Boeing 747 had already established itself as the ruler of the skies as an efficient and high capacity subsonic passenger transport compared to the fuel-guzzling and high operating costs of the Concorde

(Klein, 2016). The Boeing 747 was pushed into development as people wanted to fly cheaper and airlines wanted to carry their passengers in greater capacity with fuel efficiency in mind, despite using the turbofan engine.

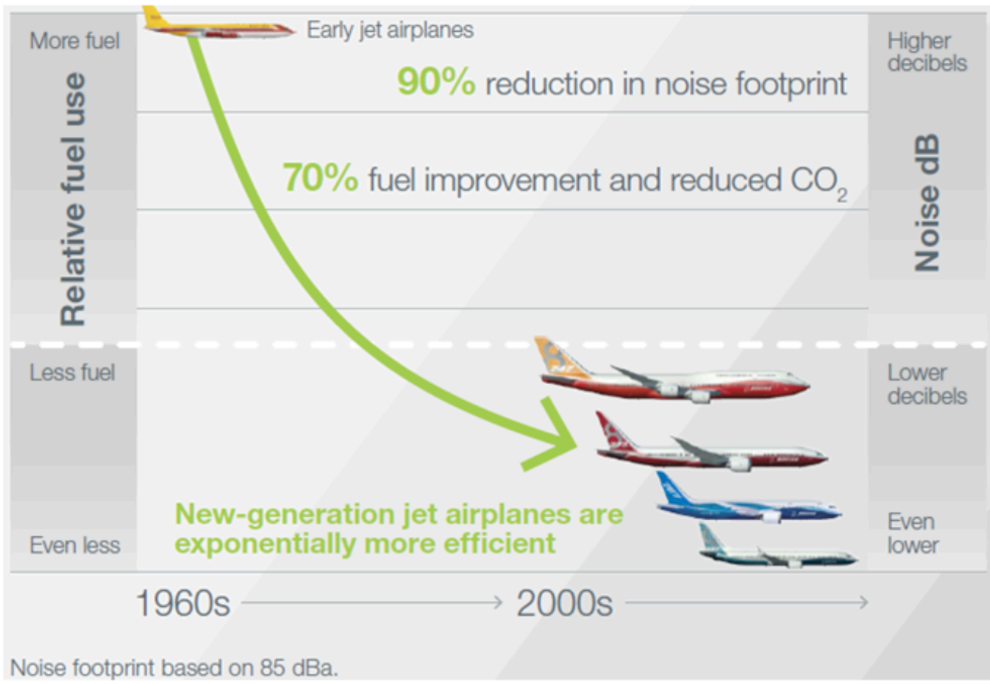

Figure 1. Improved efficiency of new generation aircrafts (Cederholm, 2014)

The Boeing 747 saw tremendous success compared to Comet and Concorde despite them all being milestone technologies of human influence. As society realized its favor towards economics, airplane technology was shaped to meet efficiency standards. These engineering marvels reveal the value of an economic perspective on technological advancement. Even though we are not flying any faster than planes did in the 1960s, technology has advanced in the path of efficiency like none other (Ferro, 2017). The industry was greatly affected by the shifts in societal influence but in different perspective, the airline industry has opened up a new avenue for transportation and with more people becoming reliant on it, the industry may determine the development of social structure. The sudden shift in power may shed light a potential technological determinism of the airline industry on society. With fuel prices ever increasing, air travel may be limited to a select elite.

Figure 2. Jet Fuel Monthly Prices – US dollars per gallon (IndexMundi)

Research Question and Methods

Why do people target economics instead of favoring engineering marvels and how does it shape technological innovation? This also poses the question of why would a group of engineering students would choose to make a light up toy lamp instead of attempting an engineering marvel. To understand the implications of these questions, I will use historical case studies and examples and documentary research methods to pursue and answer to the research question. Historical case studies will serve to provide greater context and information surrounding the event of a technology. These case studies may provide a deeper understanding and potentially reveal any trends in the root of the issue at hand. Documentary research will include detailed public opinion, factual documents, and evidence to be used for the interpretation of the question. These methods will serve to explore the technological shifts in the airline industry and the root cause of what pushed for them. They will not only explore the social and economic impacts on the airline industry and its technologies, but also the impact of such technologies on society and economics (Whitelegg).

Conclusion

The technical deliverable will be a musical LED device that responds to physical inputs. The cube shaped device will produce music and LED lights based on which side of the cube is pressed. This project will be delivered with an economic point of view. The STS topic will serve to explore the relationship between society and technological innovation and how society shapes those technologies. This deliverable explores that relationship with the airline industry and its technologies. We hope to expose the possibilities of creating various technologies for the purpose of enjoyment rather than solving a humanitarian need or attempting an engineering marvel. We also hope that this project will shed light as to why scientists target economics over technological marvels in regards to innovation.

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