Technopolitics of Commercial Supersonic Flight

By

Nathan Todd

A Dissertation submitted to the

Graduate School-Newark

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of

Master of Arts

Graduate Program in

Written under the direction of

Elizabeth Petrick

And approved by

January, 2020

ABSTRACT OF THE THESIS

Technopolitics of Commercial Supersonic Flight

NATHAN TODD

Thesis Director:
Dr. Elizabeth Petrick

The study of technological development and technopolitics is complex. The history of the three supersonic commercial transports, or SST, developed and built in the 1960s exemplifies this complexity. The history of the SST shows a degree of complexity in terms of interaction with involved societies, and is quite unlike other contemporary developments in technology. It impacted societies around the world, created new sectors of industry, damaged economies of major nations, and helped the science of environmentalism gain traction. A study of this history was completed by analyzing various authors reporting on the events as they occurred, documentation from the companies designing the planes, newspapers and journal articles from the relevant time periods about the planes, as well as government documents about their continued involvement in funding such efforts. A careful study of these sources reveals the unique nature of SST development. Its very presence changed both governments and individuals alike. Three project attempts were made to develop an economical SST. These were in the United States, Russia, and a joint project between England and France. No major work currently exists that compares all three in depth that shows both their similarities and their differences. By utilizing all these sources, it was concluded that the development of the SST had profound impacts on the societies in which it was built.

Furthermore, those very same societies stopped any potential the projects may have had to revolutionize the world of aviation.

Throughout history, technology has been the driving force behind the improvement and advancement of the quality of human life. Technological developments have impacted every aspect of human life: agriculture, warfare, the arts, and also transportation. Technology is any concept or idea that results in a creation or invention that has some impact that will improve or change the lives of people in a society. The definition of what is technology has evolved since its introduction into the English language roughly a century ago. Historian David Nye, in his book on technological history, describes the intellection of technology: "For several hundred years before then, it meant a technical description… By the middle of the twentieth century technology had emerged as a comprehensive term for complex systems of machines and techniques."[1] Here, technology is defined as a specific advancement in human knowledge that had a broad impact on society. Examples of such technological developments throughout history could include the domestication of animals, the development of a simple bow, or more modern and complex machines such as airplanes or automobiles.

Technological developments are driven by specific needs or desires at the time of their inception. Before the industrial era, due to limited communication, a revolutionary theory could develop in one region of the world but would have no impact outside of that region. An example of this would be the development of gunpowder in 7th century China. Gunpowder revolutionized warfare when it was introduced to Europe, but it took several centuries before it came there from China. With the advent of the industrial revolution, enhancements in manufacturing, transportation, and agriculture allowed the rate and impact of technological developments to increase substantially. Inventions including

---

[1] David E. Nye, *Technology Matters*. Cambridge, MA: MIT Press, 2007, 15.

planes, trains, and automobiles were developed and refined over time up to the present day. All three of these had an immense impact on the world and society, including the efficiency and quality of travel around the world.[2] Airplanes, automobiles, and trains were all developed within a few decades of each other. Their impact on the world was immediate and revolutionary.

Technological progress is an element of change that takes place over time. A new technology is not developed overnight, and the rate of technological innovation is impacted by individuals, societies, the current pace of other technological developments, and other forces and trends that might exist outside that specific people group. These advancements in technological capability tend to stem from the needs and wants of the society at the time. Technological development in various fields over the past two centuries tends to follow a predictable pattern. Two driving forces are typically behind new technologies. First, there is the need or the presumed need for a specific technology, such as electrical lights, computers, planes, or steam engines. Second, technological development can also stem from the refinement of existing technologies to make them faster, more efficient, or more cost-effective. Other factors, such as societal development, experimentation, and creation of new markets through the development of a new technology, among other forces, are also crucial elements. Society can drive technological development, but technological developments can also work to steer society.[3] Historian Wolfgang Schivelbusch gives an excellent example of technopolitics

---

[2] Wolfgang Schivelbusch, *The Railway Journey: The Industrialization of Time and Space in the Nineteenth Century* (Oakland: University of California Press, 2014), 1-5.

[3] Ibid, 1-5.

when discussing the advent of railways in England: “The changeover to mechanized motive power was possible because in the mining region, fuel was cheaper than food… Parliament, dominated by agricultural interests, passed a Corn Law… the artificially high level of grain prices helped to replace horse power by mechanical power…”[4] Railroads created upheaval as they were being developed in England, and in turn the society was forced to adapt to using and expanding them as they created new challenges.

Social and technological changes overlap and influence each other. Generally, the impact that society and technology have on each other can be separately identified and studied from a historical perspective. In some circumstances, the differences between to two can be difficult to discern, and supersonic flight falls under this category. During the development of supersonic commercial transports around the world, the populations that fostered its growth were influenced by the potential concerns and benefits supersonic flight could bring. This in turn diverted the development of these programs down different paths in the various regions where the SST projects were present.

Supersonic flight is definitively the fastest currently known way to get from one location to another. No successful efforts have been made to implement supersonic flight on a larger scale or significantly improve upon existing flight technologies since the final flight of the Concorde jet in 2003. Some research is being conducted to design a plane that is more capable of navigating the issues of super and subsonic flight as well as minimize the issues and concerns of the sonic booms, but no actual plane has been

---

[4] Ibid, 4.

conceptualized.[5] According to Erick Conway, the development of new commercial planes in terms of increasing their overall speed, which, by their very nature, is one of the key elements of any new design outside of a capacity increase, has ceased since the mid twentieth century.[6] A modern jet airliner is relatively similar to one from several decades ago, aside from minor upgrades in efficiency, comfort, and digital technology.

Attempting to compare the development of three of the major transportation technologies to other developments in ancient or near modern history would be difficult. Planes, cars, and trains have no real technological development that they can be compared to in prior history. All three of them had significant and long lasting impacts on societies and cultures around the world. Furthermore, they all fundamentally changed certain theories on how people perceived the world in terms of space and time. Railways were the first technology to challenge the societal perception of space, as Schivelbusch explains: "'Annihilation of space and time' was the early nineteenth century characterization of the effect of railroad travel… A given special distance, traditionally covered in a fixed amount of travel time, could suddenly be dealt with in a fraction of that time."[7] Trains could travel faster, more efficiently, and endure more than any animal or human. This resulted in the idea of space as it existed in the minds of individuals shrinking dramatically. Distance is always determined by how long it would take to move from point A to B. For centuries, this had been a constant, limited by the speed of a man or a horse on land. Railways completely obliterated this constant. All of these

---

5 Erik M. Conway, *High-speed Dreams: NASA and the Technopolitics of Supersonic Transportation, 1945-1999* (Baltimore, MD: Johns Hopkins Univ Press, 2008), 301-303.

6 Ibid, 305-306.

7 Schivelbusch, *The Railway Journey,* 33.

technologies had similar effects on this and other areas of life. Railroads, automobiles and aircraft followed similar patterns in their development and introduction into society. In addition, they also came about in an era of remarkable technological and societal transformation. There is no comparable technology that developed so rapidly over such a short period of time and also had an immense impact on global society.[8] All three revolutionized the world, changing how people and societies viewed and interacted with time, leisure, distance, and globalization. They altered economies, transformed warfare, and changed the view people had of the world. Nothing before them could directly compare to how they were developed, the interplay between the three, and the refinement of them into their current forms as they exist today. Commercial supersonic developments in flight are unique in their historical context.[9] They do not follow the patterns that could be seen in the development of railroads, cars, subsonic planes.

The complex forces behind the rise and fall of the SST, or Supersonic Transport, created a historical narrative that had never occurred in history. There were no direct parallels as a precedent. No similar situation had arisen that incorporated such a multitude of diverse factors in relationship with technological progress and changes in a society.[10] The development of the SST was influenced by more factors than perhaps any other technological project. Social, ideological, economic, political, technological, and environmental issues were just a few of the elements that helped start, develop, and

---

[8] Alan Stratford, *Air Transport Economics in the Supersonic Era* (London: Macmillan, 1973), 112-14.

[9] Conway*, High-speed Dreams,* 1-2.

[10] Mel Horwitch*, Clipped Wings: The American SST Conflict* (Cambridge, MA: MIT Press, 1982), 1-2.

dismantle the SST projects around the world.[11] Other technologies may have influenced and been influenced by some of these issues, but the SST project was impacted by and impacted all of them to perhaps a larger degree than anything contemporary. Mel Horwitch, in his book *Clipped Wings*, summarizes a fraction of the impact the SST had on America: "But in less than a decade the SST was totally transformed as an issue… it had changed from an internal and rather technical debate into an all-out societal war."[12] The SST, which had started as a pet project by some aerospace engineers, developed into an initiative that would impact four major nations and result in extensive changes throughout global society. These projects were also a by-product of the time period. The way the events unfolded could not have occurred outside the unique environment that was created by the post World War Two and Cold War era. The war of ideology and the rise of the idea of technological supremacy were crucial concepts that helped push the SST projects from being just a futuristic fantasy envisioned by some to becoming reality a few years later. Without the forces that were crucial to the ideological and technological struggles of the Cold War era, the groundwork for the SST technology would have never gotten the funding or the support it needed to move past that stage.

Multiple elements came to the forefront of global politics, commercial aviation, and aeronautical engineering to help create an environment that worked to develop the supposed need for a commercial supersonic plane. These same factors would be detrimental to it a few years later. The SST project was one of the first large scale

---

[11] Conway*, High-speed Dreams,* 1-4.

[12] Horwitch, *Clipped Wings*. 1-2.

government projects designed for commercial use.[13] As a project that had a potential for significant impacts in various areas of individual lives, its development was closely followed by governments and individuals alike around the world. The long term ramifications of the project were mixed in their interpretation. Different people saw potentially positive as well as possibly negative outcomes from pursing and funding the SST. These opinions often were derived from the knowledge of people within the fields that would be impacted by such a project. Aerospace engineers saw the SST as a challenge to overcome and a way to achieve a technological masterpiece. Economists saw it as a potential financial disaster with minimal potential for profitability. Positive impacts included extremely short travel times, a new era for technological development spurred by working on the cutting edge, and new developments for the military and warfare. Negative impacts ranged from concerns about financial viability, to excessive noise from sonic booms, to fears over potential environmental damage such planes could cause.

This public support or opposition to the SST projects became realized under multiple strikes from union workers whose jobs depended on these planes and in the protests of environmentalist groups who dreaded the potential damage the plane could have on the atmosphere. Organized civil protest over environmental or political concerns had become a radical form of civilian action during the 1960s, especially during the Vietnam War.[14] These developments also spread into protests and arguments against the SST programs. Horwitch explains the impact mass protest had on SST projects: “Mass

---

13 Ibid, 3-4.

14 Ibid, 2-3.

protest and mass political action also became part of the 1960s, beginning with the civil rights movement in the early part of the decade and continuing with protest over the Vietnam War… Grassroots political activism became common, and this style of political opposition soon characterized the environmental movement as well."[15] As the SST became an environmental issue in America, public opinion and protest against its continued development helped shape the policy surrounding the aircraft.

With other forms of transportation, social and economic forces were always in place to control the path of their development. The automobile was initially considered to be a toy of the rich, as building one was elaborate and expensive, and the facilities did not exist to maintain and fuel them. There were few good roads outside most cities, thus making long distance travel with a car difficult at best.[16] Historian Stephen Goddard vividly describes the early days of automobile travel: "But if this alternative to the railroad appealed to the monied elite, the automobile underwhelmed the average citizen. Its relative speed scared animals, stirred up clouds of dust, and damaged primitive roads.[17] This sentiment would change in a few decades as both cars and roads improved. Henry Ford's efforts to mass produce the car, as well as two world wars showing the power of a mechanized army, moved the car into an economically viable framework. They became more affordable to the general public due to his efforts. Thus, over time the public began to accept the car as the standard form of transport and they became commonplace. Eventually the economy of speed and scale came to the forefront of

---

15 Ibid, 5.

16 Stephen B. Goddard, *Getting There: The Epic Struggle between Road and Rail in the American Century* (Chicago: University of Chicago Press, 1996), 49-50.

17 Ibid, 50.

automotive development.[18] Cars had become increasingly inexpensive and thus the road systems had to expand. The interstate highway system in America, initially developed out of the New Deal as well as the need for better infrastructure for wartime transportation, helped to foster the growing automobile industry.[19] Now people could use these new highways to get to new areas faster than ever before and at less cost. These wars and the new improved road systems also helped to foster expansion of existing railways as more goods than ever before needed to be transported. Although this shows the influence on infrastructure expansion in transportation by governments, the impact was a result of wartime needs, not out of a desire for technological preeminence.

Similarly, the steam engine locomotive and the railroad were also initially considered to be toys for the rich to entertain themselves. The steam engine itself had been in use for sometime in mining and factories.[20] But as the designs slowly improved, the potential use of the railway for moving mass amounts of goods quickly over long distance became apparent. Schivelbusch develops a general format for transportation technology that is readily applied to the railroad: "In general both goods and people are more desirable or useful in certain locations than in others. This is the origin of the need for transport although the value may not always be definable in strictly economic terms."[21] This coupled with the rapid rise of industrialization brought railroads to the forefront in terms of transportation development. One could argue that the industrial

---

18 Ibid, 54-55.

19 Ibid, 2-3.

20 Schivelbusch, *The Railway Journey,* 1-4.

21 Stratford, *Air Transport Economics,* 2.

revolution would have never achieved its significant impact on the world without the advent of the railroad at the same time. Alan Stratford, in his book *Air Transport Economics in the Supersonic Era*, further builds upon the idea of transportation being central to both governments and societies: "The part played by transportation in the creation of wealth has become of great concern to modern governments, and most studies of industrial growth and productivity have paid careful attention to its contribution."[22] The raw materials and finished products simply could not have been moved fast enough, and the industrial revolution would have plateaued. Instead, railways allowed factories to sell their goods further away, opening up new markets while being rather inexpensive to move the goods to those new markets. It also helped expand the agriculture economy. Perishable goods and animals could now be quickly moved from the farmland to the city or other areas where they were more needed.[23] Refinements in railroads thereafter always centered on decreasing the cost of moving something, whether that was people or goods. Railroads eventually became more economically viable than shipping over water, as they could reach many more areas than ships. Prior to railroads, shipping over a waterway was the preferred method to move cargo over long distances. But ships were limited to rivers, ports, and canals. A railroad could be built practically anywhere, and increasing the payload of a train could be done with only a minor impact on efficiency.[24] This included increased safety measures, creating more powerful locomotives that could haul more of cargo, or increasing the speed of the train without a major increase in operating costs.

---

22 Ibid, 2.

23 Goddard, *Getting There,* 11-13.

24 Ibid, 13-14.

Refinements or changes in railways were primarily concerned with their economic viability. But most major technological advancements throughout history incorporated some type of domestic, international, social, political, or ideological concern.

Developments of any kind are always bolstered or opposed by the push and pull of societal influences. In turn, those same developments also can have an impact on the society that developed them. A force is any element of an attribute of a society that can be used to either support or oppose a change of any sort. A positive force for change would be the realization that industrialization resulted in greater profits.[25] Various businessmen then sought to create industrial empires to make themselves more wealth. By doing so they helped to spur the industrial revolution by financing various developments in industry. Without the industrial revolution, the world would be quite different.[26] With the support of business, financial markets, rising capitalism, and other relevant forces, industrialism revolutionized the world in a plethora of ways from economics to politics, and from philosophy to sociology.[27] Every event in history has some elements behind it either pushing it forward or seeking to hold it back. If these elements can be identified while the event is actually occurring, the outcome of the event can be changed or turned. Various individuals saw the merits in expanding the ideas and applications behind industrialism, and thus they were able to push the revolution forward.

---

[25] Ibid, 10-11.

[26] DAVID EDGERTON, SHOCK OF THE OLD: Technology and Global History since 1900 (London: PROFILE Books, 2019), 3-5.

[27] Stratford, *Air Transport Economics,* 1-2.

Generally, the momentum behind any historical event or change has a fairly consistent pace. Its momentum might increase or decrease depending on surrounding events, but generally its path is relatively predictable. Some events, however, have a rather chaotic path throughout history. The development of supersonic commercial flight could be considered to have just such a chaotic path. Initially, the idea of commercial supersonic planes had inordinate amounts of momentum. Kenneth Owen, in his book *Concorde and the Americans*, summarizes this as: "All three were seeking speed. Supersonic flight was believed to be the next logical advance in air transport, but more basically it represented a dream."[28] This quote not only summarizes part of the driving force behind the SST programs of the 1960s and beyond, but also to a similar extent the entire commercial airline industry.

As a unique event in technological history, the three major SST projects from Russia, England and France, and the United States all have been dealt with individually by various authors. Some authors compared various elements of the three programs, but no major work has been done that compares all elements that complete the history of all three SST projects. In available literature about SST projects, small comparisons are made, but little substantial contrast is done. Kenneth Owen, in his work, does an evaluation of both the Concorde project and the American attempts at developing an SST.[29] He primarily focuses on American politics, and does not go into depth with the economic and political situations in Western Europe. *The Concorde Conspiracy*, by

---

[28] Kenneth Owen, *Concorde and the Americans: International Politics of the Supersonic Transport.* Washington, D.C: Smithsonian Institution Press, 1997, 1.

[29] Owen, *Concorde and the Americans*, 1-8.

military historian John Costello, presents an in-depth look into the politics behind the Concorde project.[30] However, it only briefly mentions the American and Russian projects, and instead focuses more on attempts by the Europeans to sell their plane to America.

Other works do mention the other projects, but overall the majority of the studies done on the SST projects focus on just one of the programs without drawing any strong parallels between the three programs that existed. Horwitch in *Clipped Wings* exclusively focuses on the failure of the American SST programs. Conway does the same in *High Speed Dreams*. Howard Moon in his book *Soviet SST: The Technopolitics of the Tupolev-144* discusses the Russian SST project in depth but only draws a few parallels between it and its two sister programs.[31] Each of the three SST projects was unique in its own way, but they have many comparisons that can be drawn between them. Each SST project had similarities and differences in the forces that gave them their initial momentum and the forces that eventually led to their decline and ultimate end. But none of them were created in a vacuum; the same global events laid the foundations for each of these projects. Furthermore, they all impacted one another along their development paths. All three projects started within a few years of each other, and the progress and research completed by each created feedback loops as each project attempt to build the fastest or largest SST before all other contenders. To have a better understanding of the impact these programs had on the world and each other, all three must be considered equally.

---

[30] John Costello and Terry Hughes, *The Concorde Conspiracy* (New York: Scribners Sons, 1976), 1-5.

[31] Howard Moon, Soviet SST: *The Technopolitics of the Tupolev-144*. New York: Orion Books, 1989, 1-5.

This also leads to a better understanding of the overall SST technology and the environment it created. With an extensive comparison of all three programs, it can be shown that SST development is unlike any similar technological development in recent history. Furthermore, SST development is unique as the three separate projects all started around the same time with similar resources but all ended completely differently.

A historical study of the societal changes that occur during the course of the lifespan of a technology's development and refinement will show the forces behind its development. It will also show the overall impact that technologies development and deployment had during its initial introduction to that society. Planes, cars, and trains all began as innovations by individuals.[32] The initial amount of force for further development and refinement was limited. Aircraft were seen as toys and lacking in practical use. Cars were considered as a gadget of the idle rich. Trains were thought to be a novelty. But as different individuals sought to apply the new technologies to other areas, greater forces, such as governments, larger groups of individuals, or companies, sought to further refine such technologies for their own use or personal gain.[33] Trains were quickly seen as a cheap and efficient way to move large amounts of goods and people across long distances. Henry Ford sought to bring automobiles to the general populace by designing the assembly line. And during World War One, various governments found the application of flight to be extremely useful for war. Airplanes

---

32 Goddard, *Getting There,* 1, 22.

33 EDGERTON, *SHOCK OF THE OLD,* 5-8.

opened up a new realm for combat, including reconnaissance, bombing of industrial bases and entrenched positions, and air to ground attacks on enemy lines.[34]

Throughout the history of technological development, under most normal circumstances, if a technology is developed that is better than a previous one, that new technology will generally take precedence over the other. This is especially prevalent in the fields of warfare and transportation.[35] For example, the wheel revolutionized transportation as it allowed for movement from one place to another while carrying some sort of load. Domestication of animals allowed the development of chariots and wagons and the like. And eventually, cars replaced animals, and cars have improved in every possible way as technological development created superior cars. Cars have become safer, more efficient, faster, and cheaper to build and maintain. A car can be developed to fill almost any conceivable role on land. This can include transportation of people or goods, to racing, to test vehicles. Railways also filed a similar role, but generally over longer distances with larger amounts of cargo.[36] The one glaring exception to this historical trend is air travel. Specifically, supersonic flight and its commercial applications have been all but abandoned today. The military use is still quite present, but any attempts to develop a sustainable airliner for commercial use that is capable of breaking the sound barrier have vanished. When compared to historical trends that are present in the development and refinement of other similar technologies, such as railways

---

[34] Charlie Keitch and Josh Blair, "What Impact Did the First World War Have on Aircraft and Aerial Warfare?" Imperial War Museums, December 7, 2017, , accessed April 07, 2019, https://www.iwm.org.uk/learning/resources/what-impact-did-the-first-world-war-have-on-aircraft-and-aerial-warfare.

[35] Conway*, High-speed Dreams*, 5-6.

[36] Stephen B. Goddard, *Getting,* 8-9.

and automobiles, one would expect that eventually there would be a development that would allow for a viable commercial model to be developed, as a plane flying at supersonic speeds can get from point A to point B considerably faster than more conventional aircraft.[37]

Therefore, the question that must be asked is why this technological development failed. In this particular case, multiple obstacles were present that prevented supersonic aircraft for furthering their development. Any change in technology has the potential to impact society and create social change.[38] Sometimes technological development can proceed despite societal pressure to the contrary. Automobiles were initially considered useless and frivolous, but slow change and pressure over time resulted in them being virtually irreplaceable in the present day. Supersonic flight was so entangled in national and international politics, social changes during the cold war, and new fields of study that the opposition against its further development proved to be too great to sustain its momentum. As with any force for change, momentum is critical.[39] If any attempt for change loses the forward motion it has obtained from these outside elements by either lack of force behind it or an equal or greater force stopping it, than that force will begin to degrade. Supersonic commercial flight had a vast amount of forward momentum behind it. The various forces, including the three separate programs all supported by various combinations of government and private enterprise, the prestige of technological achievements during the Cold War, the support of the military, and the initial public

---

37 Horwitch, *Clipped Wings*, 12-13.

38 Costello, *The Concorde Conspiracy,* 19-21.

39 Horwitch, *Clipped Wings*, 9-10.

support for the project, all resulted in generating considerable momentum for an SST program. Alan Stratford states: "No project has ever come before the world's airlines with more of a fanfare. Never before have so many arguments, technical, commercial and political, been used to support or to decry and new development in aviation."[40] The impact on society and similar technological developments these SST projects had from their inception was considerable. However, only a few decades later, that momentum to develop this new technology into something sustainable had failed. Therefore, the social, economic, political and scientific forces that opposed this development were stronger than the momentum. An example of a negative or counter force that moved against the industrialization era could be the noble classes of the day, who resented the new wealth the industrialists were gaining, as well as their general desire to keep things at the status quo.[41] Such individuals sought to oppose the industrial movement but were unsuccessful. Throughout any development of technology, forces such as these among others play into the history of the technology.[42] These forces decide whether or not the path is seen to its end or if it gets cut short and abandoned.

Trends in the history of technological developments can be easily seen in the field of transportation. Before aircraft, trains and cars were the two revolutionary developments in the realm of transportation.[43] Ahead of their development, the only methods of travel were either by foot, horse, or boat if over water. A brief look at the

---

40 Stratford, *Air Transport*, 284.

41 Schivelbusch, *The Railway Journey*, 26-28.

42 Edgerton, *SHOCK OF THE OLD*, 8-13.

43 Goddard, *Getting There*, 82-85.

development of these two technologies, and their eventual conflict with each other, helps to provide a context for the later conflict between subsonic and supersonic aircraft development. The advent of the railroad challenged and altered many constructs, from concepts of time and space to economics and politics. Being able to move several times faster than anything before it, railways facilitated the rapid expansion of industrialism in the nineteenth century. However, even though railways had a large impact on society, their development followed a pattern that can be observed in other technological developments, especially those related to transportation. Early trains were a refinement of steam engines used in factories and mines, which had been developed in the early eighteenth century. As refinements were made to existing steam engines, various individuals sought to put the engine to use in moving a vehicle.[44] Eventually, this resulted in the development of early trains in the early 1800s. Railway development rapidly expanded, to the point that by the 1860s, railways were common place in both Europe and the United States. Development on the engines themselves also advanced at a predictable pace with marked improvements both in design and reliability as well as speed and efficiency.[45] In Europe, many well defined roads had existed for centuries due to Roman expansion, but railroad development was spurred by individuals with capitalistic intentions. Aircraft development, due to extreme development costs and public safety concerns, could only be completed by large corporations. But even large

---

44 Schivelbusch, *The Railway Journey*, 2-4.

45 Ibid, 3-6.

multi-million dollar corporations balked at the potentially enormous costs of developing an SST.[46]

Supersonic commercial aviation was from the beginning dominated by governmental influence.[47] Some companies, individuals, and smaller government agencies, such as NASA, all worked on preliminary models for a potential SST design. But no single company or agency was capable of building a supersonic aircraft without more widespread government support due to the massive financial costs. The potential for loss on investment was too high for any company to consider making such a plane. Without the government investment into the development and industry needed for an SST, the idea of a supersonic commercial airplane would have never made it past a basic design phase.

However, several important factors diverge when comparing developments in supersonic commercial aircraft to subsonic aircraft, or even the automobile or railroad industries. Automobiles and railroads became what they were out of capitalistic and societal needs. Individuals saw the potential of decreasing transportation times for goods and people, and sought to market that. In doing so, they created a system of roads and rails as well as the cars and engines to ride on them. This in turn helped to increase economic activity and boost their profits. It was only after these innovations had proven successful that the impact on society and economics was deemed to be high enough that the various governments felt that they needed to step in and regulate the industry.[48] The

---

46 Horwitch, *Clipped Wings*, 8-11.

47 Horwitch, *Clipped Wings*, 7.

48 Goddard, *Getting There*, 22-24.

governments did utilize these systems that were developed and sought to control them, but were often not the original driving force for their existence. However, before developing the impact and control that governments had over the industries and organizations that governed flight, it is crucial to understand the foundations of the jet aircraft age.

To distinguish between other aircraft, supersonic commercial flight includes any plane that was specifically designed to carry passengers and achieve speeds above the speed of sound. Such a plane would be able to travel much faster than an average commercial airliner, and would also be quite different from any military aircraft that could break the sound barrier. All forms of transportation are similar in certain respects.[49] They are all designed to move some form of cargo, be it raw materials, food, oil, or people from one location to the other. Various elements are taken into consideration, such as speed, efficiency, volume, as well as the specific method of travel. There are three specific methods for travel, and these are by air, land or sea. Travel over land and sea has been common place for centuries. Air travel only developed in the past century to complement the other two forms.[50] Prior to the development of the steam engine, travel was done either by power of man, beast, or wind. Engines revolutionized travel, and an engine of some sort is essential to all forms of transportation in the modern era. Cars, planes, trains, and ships all use some form of engine to move their cargo from one point to another. With all these similarities, these various modes of transportation all share similar historical developmental properties. These trends can be compared and contrasted

---

[49] Stratford, *Air Transport*, 284-287.

[50] Ibid, 4-6.

across the time periods of their development. Supersonic commercial aircraft, however, differed from these trends. Their development involved a high degree of both government and commercial influence that had not been seen before in transportation development.[51] Nor had the development of forms of transportation had such an impact in other realms that it helped to develop an entirely new branch of science, environmentalism.

Supersonic flight is directly linked to subsonic flight. Planes that cannot break the sound barrier are much more common than planes that can. But, without the initial theories and knowledge of flight, supersonic flight would be impossible. One directly stems from developments in the other. However, they can still be viewed as two different aspects of flight as they are quite different and require different sets of rules and variables both in fluid dynamics and construction design.[52] Even though both supersonic and subsonic aircraft operate within the same parameters required to remain aloft in Earth's atmosphere, these differences in aerodynamics, structural demands, variations in air temperature at extreme speeds, and other factors created two different realities for aircraft construction and design. These realities were based on the specific needs of the aircraft, determined by if it was subsonic or supersonic. However, a supersonic aircraft must be able to operate within the realm of subsonic flight, as it cannot land at supersonic speeds. Thus, both in a societal context and a technological context supersonic flight can be thought of as an extension of subsonic flight. Additional mechanics and characteristics of the aircraft are required to sustain supersonic speeds, but it must first be capable of flying

---

51 Ibid, 288-289.

52 Ibid, 287, 292.

at subsonic speeds to reach supersonic velocity.[53] It could also be considered a refinement of subsonic flight. A supersonic aircraft takes the basic principles of flight, improves them, changes them, and utilizes them to achieve its higher speeds.[54] At the same time, it is also dealing with different principles of flight that are only common to an aircraft flying faster than the speed of sound. Thus, refinements to the basic and advanced principles of flight are required to utilize supersonicspeeds in an aircraft.

From a purely societal context, supersonic aircraft were thought to have potentially been a replacement for any other form of aircraft. Developers, engineers, politicians, generals, and scientists thought that planes traveling faster than the speed of sound would replace all other forms of commercial flight.[55] Costello conveys the beginnings of the Concorde project with the Royal Aircraft Establishment and the aeronautical research labs in Farnborough, England: "Shortly after the war, Farnborough had seriously begun to consider the methods of achieving high-speed commercial fight… Britain's most powerful aircraft establishment had concluded that supersonic flight was inevitable."[56] Technology across the board had developed at rapid speeds over the course of the early twentieth century. Many of these new ideas were forged in war, and once the war ended, developments continued. Technologies such as atomic weapons, supersonic aircraft, computers, radar and many others developed over the course of a few years. Prior to this, many developments took decades or longer to come to fruition. Such was

---

53 Costello, *Concorde Conspiracy*, 25-57.

54 Conway, *High-Speed Dreams*, 15-17.

55 Owen, *Concorde and the Americans*, 41-43.

56 Costello, *Concorde Conspiracy*, 20.

the speed of new developments that many considered that technological accomplishments would continue at their current breakneck pace with new ideas quickly replacing old ones.[57] In just a few decades, cars had been developed to the point that the common person could afford one, and they quickly replaced the horse as the common mode of transportation. Horses and other draft animals had been the norm for almost any type of transportation for over a millennium. And in a few short years they had become irrelevant. This hectic pace of technological development over the past several decades was one of the core elements behind the initial thought that supersonic flight would become the sole method of air travel.[58] Supersonic aircraft could travel much faster, thus creating efficiency and becoming that pinnacle of technological innovation that had seemed to become the norm.

This environment of massive technological gains over short periods of time created issues within society. It also created problems within the various industries that developed or worked on new technologies. Industries and workers became dependant on specific projects for their very survival, especially in aerospace.[59] Many of these industries were specialized in fabricating the materials that enabled a plane to deal with the extreme demands of flight. Such specialized industry could not be readily used elsewhere. This resulted in the various aeronautical industries of the world having an inflated amount of importance. They required lucrative military and civilian contracts to stay in business. The amount of jobs and technical expertise they supplied was often

---

57 Conway, *High-Speed Dreams*, 118-120.

58 Owen, *Concorde and the Americans*, 23-24.

59 Edgerton, *The Shock of the Old*, 4-7.

significant enough to impact political policy. Without the development of the various fighter and bomber planes of the Cold War, the entire military aviation sector of the American or English economy could have been shut down. New technologies developed so rapidly that sometimes no market could be found for them or they were eventually discovered to be dangerous or problematic. An example would be the development of the V2 rocket by Germany during World War Two. This weapon was costly to develop and produce, and had very little impact on the war effort. The resources could have been more wisely distributed to other areas, but certain individuals and forces in the German government forced development down this path.[60] But these are just couple of small examples of how the rapid development of technology was potentially conflicting with the society or situation that fueled it.[61] Technological development had to keep up with society and current needs, and vice versa.

Supersonic commercial flight is an excellent example of this trend that existed in the mid twentieth century. It was a new and exciting technology that captivated both governments and individuals with its potential applications, not to mention the allure of a cutting edge technological idea. Development for SSTs incorporated huge amounts of assets from both private and public sectors in multiple countries. All of this effort was put into the development of a tool that some deemed to have no practical or needed purpose.[62] These people saw that the economics of the plane were limited at best and were concerned about the limited information about total costs of development and

---

60 Ibid,, 14-17

61 Ibid, 28-31.

62 Conway, *High Speed Dreams*, 64-71.

construction. But driving forces of national pride, desire for consistent technological progress, as well as socio-political factors all kept the various SST projects moving for decades. All three of the major SST programs dealt with these development issues.

Furthermore, these three separate programs were developed for the sole purpose of building a supersonic commercial aircraft. All of these projects had similar reasons behind them, including all the driving forces previously mentioned. All of the nations involved had relatively similar levels of technical capability. One could assume that with a similar starting point in terms of societal inertia, resources, and technical knowledge all three programs would be relatively similar. But all of these projects were different and diverged from one another even with all these similarities and similar timeframes. The end result of each program was radically different than the others.

Technological development never happens in a pure vacuum. It always occurs in a set social-political environment that can influence the reasoning behind development. Both sides can influence the other. Society can have a need for a new concept or idea to fulfill a gap in the current system, and the pace of technology can sometimes rise to fill that need. A prime example of this would be the development of vaccinations for dangerous infections. Society needed a way to prevent various diseases that were causing consistent medical issues. Medical science eventually was able to develop working vaccines to fulfill this need. Polio is an excellent example of this. The virus caused death and serious health complications around the world. This spurred doctors and scientists, armed with new medical knowledge, to develop and deploy an effective vaccination that

dramatically decreased rates of infection.[63] On the other hand, technological developments can also have impacts that were not intended. The internet, which started as a military project, rose to become one of the most important and influential developments of the twentieth century.[64] On a more refined scale, politics and society can have a direct effect on the development of a specific technology, such as supersonic flight. And that developmental process can in turn have an impact on society and politics. Historian Horwitch explains this idea: "Other factors also worked to make the SST in the end a matter of widespread societal concert. The aircraft, if built, would have directly affected a large number of people-many more than, say, a space program or weapons system."[65] What began as a project to maintain technological supremacy ended up having unintended influences on society. As the impact an SST could have on a society became more understood, politics and the development of the plane were forced to change.

The Cold War has always been known as a battle of ideology instead of a battle through outright warfare. Of course, there were many proxies to this over arching ideological warfare that often resulted in actual war, such as the Vietnam War or the conflicts in Afghanistan. Other proxies to the ideological struggle were the attempts to overthrow a government and install one more favorable to one of the two parties, democracy or communism. Or, if a friendly government was already in place, one worked towards preventing the other ideology from doing just that. But the Cold War conflict was not limited to just military technology. Overall technological superiority was

---

63 Anda Baicus, "History of Polio Vaccination," World Journal of Virology, August 12, 2012, Accessed April 12, 2019, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3782271/.

64 Edgerton, *The Shock of the Old*, 103-105.

65 Horwitch, *Clipped Wings*, 3.

a weapon used by all sides involved and was more influential than any military program.[66] The space race was a core element of this. Space technology and travel became a centerpiece for ideological and political capital. Similar developments in rocket technology led to the development of intercontinental ballistic missiles, or ICBMs, which were crucial to the late stages of the Cold War.[67]

Aircraft, both civilian and military, were a centerpiece in this specific element of the greater struggle between the NATO alliance and the USSR. The advent of the space race created yet another realm for the two power blocks to fight over as it symbolized both literally and figuratively technological abilities, ideology, and power.[68] And power, in any form, was an essential form of capital for this conflict. In the USSR, the communist government sought to prove its superiority both as an ideology and as a way of life. The leaders within the USSR sought to do this by any means necessary.[69] The SST programs that sprung up in the USSR, America, and Europe were a prime example of this. The USSR wanted to use their own supersonic commercial plane as a show of force and dominance. This would not be in a military fashion but to show that they could dominate in the realm of peaceful enterprise. The USSR thought that if they could develop these cutting-edge tools, it would show and prove their dominance and resilience to the rest of the world. Furthermore, it would show that their ideology was, in theory, the

---

66 Conway, *High-Speed Dreams*, 49-51

67 Ibid, 48-49.

68 Hackney, Donald I. "The Supersonic Transport as an Instrument of National Power." OAI. 1-4. Accessed June 17, 2017. http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA510143.

69 Moon, *Soviet SST*, 4-6.

superior one. This war of ideologies was a crucial element of the Cold War but it was also a crucial drive behind the desire to develop an SST.

Before dealing with the developments of SST programs around the world, the early stages of jet aircraft and some basic principles of flight and its economics must be explained. Without the advent of the jet era, there would have been no supersonic aircraft. After the development of jet engines in World War II, the idea of a plane that could travel faster than the speed of sound became an important topic. Such a technology could have broad uses in both military and commercial applications. Jet powered planes were developed and deployed at the tail end of World War II by Germany to little effect.[70] Soon after, jet engines became the norm for powering aircraft from fighters and bombers to commercial planes. Developments soon began to push the limits of these aircraft to greater speed and maneuverability.[71] Eventually the militaries of the world developed various types of aircraft that could surpass the speed of sound, and would continue to produce such aircraft and refine them. America and Russia, the two major powers left after the war's end, were able to obtain some of the designs used by Germany to enhance their own jet engine projects. They used these to develop more sophisticated jet powered aircraft, eventually creating bombers and fighters that could reliably break the sound barrier. However, the commercial sector was not as quick to develop a sustainable or feasible aircraft that could both break the sound barrier and economically transport passengers from one location to another.

---

70 Conway, *High Speed Dreams*, 14-15.

71 Ibid, 15-17.

Flight is one of the most influential technological advancements of the past century in terms of its impact on society, globalism, economics, warfare, and other technological developments. It revolutionized the world in many different ways, but primarily it created a cheap yet expeditious mode of travel to any part of the world.[72] Distances that would normally take days to cover could now be traveled in a matter of hours. As such, developments and improvements in flight technology proceeded upon a fairly linear path.[73] As the usefulness of flight became apparent in both commercial and military sectors, rapid advances took place in a relatively short period of time. Conway exemplifies this by explaining that: "The rapid progress in supersonics led to tremendous enthusiasm for the technology. Aircraft engineers who had entered the 1950s highly skeptical of the commercial potential of supersonic aircraft met the next decade believing that commercial supersonic flight was just around the corner."[74] Improvements made flying faster, safer, and more efficient through improvements in engine design, materials, aeronautics, and other related fields.[75] Flight, by its very nature, is the effort to defeat gravity and move from point A to point B as quickly as possible. Supersonic aircraft embodied this pinnacle of flight technology in the fact that they were able to move from one point to another faster than anything prior.[76] However, since the middle of the twentieth century, technological developments in flight have stalled. Minor innovations in design and safety have been developed, but there have been no major breakthroughs in

---

72 Stratford, *Air Transport*, 1-4.

73 Ibid, 4-9.

74 Conway, *High-Speed Dreams*, 14.

75 Stratford, *Air Transport*, 13-20.

76 Horwitch, *Clipped Wings*, 2-6.

increasing the speed or efficiency of aircraft, primarily in the commercial sphere.[77] The implementation of supersonic aircraft in the commercial realm has gone dormant since the Concorde program was shut down in 2003.[78] Since then, when the Concorde jet flew its last flight, no new commercial supersonic aircraft have been developed outside of conceptualizations or research projects. The Russian Tupolev Tu-144 and the French/British Concorde are the only two commercial supersonic aircraft to ever have been developed and flown.

From its conception, the SST was considered to be the next logical step in the aviation industry. Multiple companies and governments as well as individual researchers, developers, and businessmen felt that the way of the future would be in supersonic flight.[79] The aviation industry in general shifted away from the idea of the jumbo jet, which had been conceived around the same time as the SST, to put more initiative into the supersonic programs they developed or wanted. The fact that the SST had significant industrial, political, and capital backing from its infancy is astounding. Very few other technological developments, especially related to travel, had such worldwide support and backing, even before a design had even been considered.[80] Cars and trains had their required infrastructure supported by governments but little worldwide government influence impacted the development of cars themselves. This is further compounded by the fact that these efforts to develop an SST, even with significant backing from multiple

---

77 Owen, *Concorde and the Americans*, 149-153.

78 Ibid, 184-187.

79 Ibid, 15-18.

80 Costello, *Concorde Conspiracy*, 59-61.

sectors, not only failed to produce and continue the use of the SST, but also failed to overcome the engineering and environmental issues that plagued and doomed[81] the projects. The overall failure of the SST projects of the mid twentieth century was relatively unheard of in the history of recent technological development. Normally a project with enough political and financial backing will be able to overcome most challenges. The SST projects of the 1960s and 1970s had both of those elements backing them, but also faced considerable challenges that other projects may not have.[82] Horwitch, and other historians, agree that SST projects were unique, partially because they were both a civilian and government project: "Unlike space or defense programs, the SST was one of the first post-World War II examples of large-scale governmental funding of civilian projects with the explicit commercialization of a new technology as their ultimate goal."[83] Governments and civilian industries worked jointly on military projects. Civilian companies included Lockheed Martin, Boeing, BAE, Airbus, Tupolev, and others from various nations. Government agencies included the Federal Aviation Administration, National Aeronautics and Space Administration, and the Royal Air Force Establishment. But the SST is the only civilian technology that involved both of these entities.

In the 1950s, flight was still a fairly new and rapidly developing technology. It had only been common place for a few decades, and major advancements in aviation technology had been made during World War II. The majority of commercial side

---

81 Owen, *Concorde and the Americans*, 171-173.

82 Ibid, 5-6.

83 Horwitch, *Clipped Wings*, 3.

developments in commercial aviation were focused on either making planes that could carry more people or planes that could get from point A to point B faster.[84] Other efforts were focused on building the infrastructure and agreements needed to foster a worldwide environment for mass air travel. Developments in either of these areas would enable to make the owners of the aircraft more money. The United States at this time was often considered to be at the forefront of technological development, due in no small part to their development of the atomic bomb during World War II and other technological developments that stemmed from wartime research.[85] This was considered to be a pinnacle of scientific development at its time. As such, both the major nations of Europe as well as Russia desired to both catch up to America in terms of technology, but also surpass them.[86] The SST projects were a perfect example of this. Having a plane that could fly faster than any other, when other nations had yet to accomplish such a feat, would generate significant scientific and political capital in the already intense era of the Cold War.[87]

World War Two created the first machines that were capable of approaching the sound barrier. The Germans had experimented with and developed several early jets. Prior to the development of a jet engine, the primary engine design for a plane was a prop engine.[88] This was an internal combustion engine where the drive shaft was directly connected to a prop. The engine allowed the prop to be spun up, creating thrust, and

---

84 Stratford, *Air Transport Economics*, 23-26.

85 Horwitch, *Clipped Wings*, 43-45.

86 Costello, *Concorde Conspiracy*, 62-65.

87 Ibid, 65-67.

88 Conway, *High-Speed Dreams*, 14-16.

allowing flight when paired with a suitable airframe. Prop engines were fairly reliable but were limited in both speed and maximum height for flight. There are various designs for jet engines, but they all share similar properties. The main differences between the types of jet engines are usually related to their ability to compress air, increase thrust, and use as much of the energy available for useful work. Overall, a jet engine differs from a prop as it uses the energy created by burning fuel more directly for thrust, by channeling it through an exit path as the fuel was ignited combined with turbines and other elements to increase pressure and efficiency. While this style of engine resulted in the potential for vastly higher speed aircraft, it was not without its own design challenges. Airplane design for a jet engine required different techniques and designs to sustain flight. But refinements in the engine and aircraft design led to the jet engine becoming the dominant power plant for most aircraft due to the higher speeds and higher flight ceiling. A jet engine was essential for developing an aircraft capable of exceeding the speed of sound. A prop driven engine was not capable of approaching anywhere near the speed required to break the sound barrier.

The appeal of a supersonic aircraft was primarily vested in its superior speed.[89] In the modern era, speed was becoming a reigning principle of both military and civilian elements of society. If you could move your bombs or material faster than your rival, you had the edge. However, the trade off with supersonic aircraft is a more expensive design and lower fuel efficiency. Considerable energy is required to reach and surpass the sound barrier. Even with the time saved, often this does not equate to a profitable trade off in terms of fuel consumption over distance traveled. With military applications, cost and

---

[89] Owen, *Concorde and the Americans*, 1-3.

consumption of fuel is generally not a primary issue. However, with the initial advent of the theory and desire for supersonic flight, the potential long term cost issues were not under consideration.[90] The appeal of greater speed was the focus of many airplane developers and researchers as the elusive barrier of sound was slowly broken down.[91] Various schools of thought in the aviation industry existed. Generally, the two predominant ideas were that either supersonic aircraft would compliment or extend from current subsonic aircraft or supersonic aircraft would completely replace subsonic aircraft.[92] Many technological or aviation magazines and publications from the mid 1950s showed a future where supersonic aircraft ruled to skies.[93] This helped to fuel a public conception of socio-political dominance in the air through transportation and military aviation technology. Within aircraft development, various elements were important including aircraft range, flying characteristics, radar cross sections, maneuverability, and fuel economy. But sheer speed was generally the dominant element that was put forth in design stages, especially in the 1950s. A bomber that could fly faster than it could be intercepted by a fighter jet or ground based anti-aircraft weapons would give a technological edge to the developer of that bomber. And having an airline industry where planes could move passengers faster any other commercial aircraft on the market would show another aspect of technological dominance.

---

90 Costello, *Concorde Conspiracy*, 72-74

91 Conway, *High-Speed Dreams*, 50-53.

92 Costello, *Concorde Conspiracy*. 22-25.

93 NASA, 1-4, accessed March 03, 2019, https://history.nasa.gov/SP-4219/Chapter3.html.

The commercial SST programs were an offshoot of the Cold War, just like many other technological developments of the era. Supersonic aircraft were developed out of a desire for technological preeminence both in terms of military and overall technology.[94] But they also stemmed out of earlier military efforts related to supersonic plans. Before the advent of the ICBM, the major way to deploy a nuclear weapon was via a strategic bomber.[95] The idea of a bomber that could travel faster than the speed of sound, prior to the development of SAMs, was an appealing one. Many of the theories of aviation that were used to develop a commercial supersonic aircraft stemmed out of Cold War military designs and research.[96] Without the overarching political and military conflict that dominated the era, many technologies may not have been developed or applied to civilian use. Common place tools such as computers, satellites, and many others stemmed directly from new or refined technologies. The development of these was directly spurred by the ongoing global conflict. Supersonic aircraft were no exception. The end of World War Two had seen the introduction of several new and key aircraft technologies, specifically the jet engine. Initially developed and deployed by Germany, this new engine would prove to be revolutionary for the aircraft industry.[97] Nuclear weapons also were a core element of aircraft development. The American military wanted a new bomber that could not only deliver the large nuclear weapons, but also do so faster than any other aircraft that existed. With the advent of jet engines, aircraft were capable of reaching much higher speeds than ever before. The ability to break the sound barrier was feasible, if

---

94 Moon, *Soviet SST*, 40-45.

95 Conway, *High-Speed Dreams*, 44-45.

96 Conway, *High-Speed Dreams*, 14-19.

97 Costello, *Concorde Conspiracy*, 19-21.

poorly understood.[98] Similar in many respects to the space industry, many of the technologies and theories developed around aircraft capable of breaking the sound barrier were created and tested at the same time as the aircraft themselves. Concepts such as drag, air temperature, and aerodynamics in a supersonic environment were unknown, and this information was crucial to developing such a plane. A wind tunnel could only generate so many of these variables.[99] There were no theories in place based on preexisting models that could define the designs needed for such an aircraft to perform safely. Specifically, the most problematic issue was the gap that existed in current aerodynamic theory between speeds of Mach .8 and Mach 1.2. Transonic would become the term to describe the speed of a plane that flew at those Mach variables.[100] Between these speeds, vast changes occur in aerodynamics for aircraft, and there was no data available to determine what kind of craft could remain stable through those changes.[101] All that was known in the aftermath of World War Two when these aircraft were initially conceptualized was that conditions for aircraft operating past the speed of sound would be quite different than those normally encountered.

In the early 1950s, with the beginning of supersonic tests, the majority of the tests were done on smaller aircraft. These aircraft, such as fighters or interceptors, would only have to fly at supersonic speeds for short periods of time. They could use afterburners to

---

98 Horwitch, *Clipped Wings*, 7-9.

99 Conway, *High-Speed Dreams*, 34-36.

100 Ibid, 20-22.

101 "SKYbrary Wiki." Hypoxia - SKYbrary Aviation Safety. Accessed March 03, 2019. https://www.skybrary.aero/index.php/Supercritical_Aerofoils.

increase their thrust to needed levels for small contained bursts.[102] While these planes still encountered the same flight stability issues that SSTs would later deal with, they did not have to deal with them consistently as they were not always flying at supersonic speeds. These planes did help to lay the groundwork for super-sonic aerodynamic theory however, which aided later developments on SST projects.[103]

These new developments in the military aircraft industry had the majority support of the military and political systems of the time. World War Two had proved the dominance of aircraft, and newer faster craft were necessary to hold the edge during the Cold War era according to the armed forces.[104] Lacking a need for a profitable return on investment, development was able to continue at a frantic pace due to lucrative funding and allocation of resources. On both sides of the political spectrum, dominance in technology was seen as necessary for survival in both the realm of military strength and ideology.[105] The realm of the air was the new field for a show of strength.

Concurrent to rapid military developments in aviation, individuals at the National Advisory Committee for Aeronautics, the forerunner to NASA, were considering potential commercial applications for supersonic capable aircraft.[106] Initial designs of supersonic aircraft were based around converted bombers that would transport civilians instead of explosives. These drafts were nowhere near capable of making actual flights

---

102 Costello, *Concorde Conspiracy*, 22-23.

103 Stratford, *Air Transport Economics*, 84-85.

104 Conway, *High-Speed Dreams*, 21-23.

105 Horwitch, *Clipped Wings*, 21-23.

106 Conway, *High-Speed Dreams*, 16-17.

even if they were built, but they did represent the groundwork for what would come. Without these military developments, supersonic aircraft would have never made it to the commercial realm. The military saw the use of supersonic aircraft as furthering the abilities of the new realm of the air. With the advent of the Cold War as well as the development of atomic bombs by both sides in the conflict, new ways were needed to deliver these atomic weapons.[107] A plane that could fly higher and faster than anything else and still reliably deliver a payload to its target was ideal. Various other government organizations also sought to move this technology of supersonic flight to the commercial realm.[108] However, militaries had several advantages to developing supersonic planes that the commercial sector did not have. The military did not have to worry about selling their developments, nor did it have to concern itself with fuel costs or any other elements that were pressing concerns of the aviation industry. Utility and reliability were the two major concerns. If a plane could perform its task quickly and effectively, it met its purpose. Commercial planes had many more variables to concern themselves with as they sought to develop new airplanes. Transportation capacity, fuel consumption, safety, price of construction, maintenance costs and many other concerns all plagued the development of any aircraft.[109] And commercial supersonic aircraft had to deal with these issues to a much larger degree. Supersonic aircraft dealt with a wider scale of physical variables in terms of flight, consumed more fuel, and were generally costlier to operate and build than a traditional aircraft. Still, engineers and aircraft companies sought to overcome these challenges and design a plane for the future.

---

107 Ibid, 37-39.

108 Costello, *Concorde Conspiracy*, 30-31.

109 Stratford, *Air Transport Economics*, 285-290.

The interplay between military developments in aircraft and their civilian applications were crucial to the historical path of the development of the commercial SST. Without the breakthroughs that were made in aviation by military engineers in the realms of aerodynamics, physics, wind tunnels, airframe construction, and many others, it is unlikely that an SST would have ever been realized beyond a basic concept.[110] The leading issue that had to be dealt with in any supersonic aircraft was the problem of drag at near supersonic speeds. An aircraft approaching the speed of sound is forced to deal with the changes in the behavior of the airflow around the wings. It simply cannot be pushed out of the way fast enough, causing a high amount of drag on the plane. This can prevent an aircraft from efficiently breaking the sound barrier or remaining airborne at all..[111] To overcome this issue, dozens of tests using wind tunnels and various designs had to be done, along with endless calculations. The NACA developed the Eight-Foot-High Speed Tunnel, a wind tunnel that could simulate speeds of up to Mach 0.95.[112] This was essential for the development of supersonic aerodynamics. Eventually, the theory known as the area rule was developed, which resulted in an overhaul of airplane fuselage design.[113] It shifted from the more cigar style body that was common in most planes of the 1950s to an airframe that was tapered near the tail, specifically where the wings attached to the body of the plane. This reduction in the size of the fuselage at the tail of the plane enabled the air to flow more freely even at high speeds, resulting in significantly less drag and higher efficiency. This design concept was mainly developed

---

110 Costello, *Concorde Conspiracy*, 20-22.

111 Ibid, 24-26.

112 Conway, *High-Speed Dreams*, 23-24.

113 NASA. Accessed March 03, 2019. https://history.nasa.gov/SP-4219/Chapter5.html.

by Richard Whitcomb, one of the head aeronautical engineers at the NACA. While he did not directly work on any of the SST projects, he did develop some initial concepts.[114] His primary work on overcoming transonic drag was crucial to the development of supersonic war planes. This concept was also essential to the development of any SST project. His findings and research were immediately applied to aircraft already under construction, specifically the F-102 program. His new designs enabled to plane to maintain speeds at Mach 1.2 in stable flight, thus creating one of the first supersonic fighter jets.[115]

Aside from issues with basic fuselage design, other difficulties existed for developing a supersonic airplane. Perhaps one of the largest issues was the differences in aerodynamics at supersonic speeds and at subsonic speeds. Airplanes behave differently at these two different speeds as the air around them behaves differently.[116] An aircraft at supersonic speeds has to deal with different issues revolving around lift and drag that are simply not present at subsonic speeds. Developing an aircraft that could not only fly effectively at supersonic speeds, but also be able to fly and land at subsonic speeds was perhaps the most difficult hurdle to overcome. No other passenger aircraft had ever been designed to overcome this particular challenge. Essentially, at speeds above Mach 1.5, the movement of the plane through the air creates what is known as a Mach cone.[117] Depending on wing design, this can cause greater drag on the plane. As a general rule, the longer the wingspan or the thicker the wing the greater the drag when a plane

---

114 Ibid.

115 Ibid.

116 "SKYbrary Wiki." Hypoxia - SKYbrary Aviation Safety. Accessed March 03, 2019. https://www.skybrary.aero/index.php/Transonic_Flight.

117 NASA. Accessed March 03, 2019. https://www.grc.nasa.gov/www/k-12/airplane/machang.html.

approaches supersonic speeds. If the drag increases too much, the plane will no longer be able to fly effectively. A delta wing has the advantage of being a thinner wing that reduces the wave drag caused by transonic speeds as well as providing sufficient surface area to provide enough lift for the aircraft. The delta design overall works to minimize many of the aerodynamic issues caused by airflow at near supersonic speeds. Initially it was believed that a plane with a delta wing would be unable to perform as required at low speeds, and was thought to have a low upper limit to its maximum Mach speed before it succumbed to issues with drag. The multivariable swept wing was initially considered to be the best possible design for a supersonic aircraft. This design, which incorporated the traditional swept wing that was becoming common on most aircraft, was also able to change its position to the best optimal location for the speed the plane was at currently.[118] The plane could have the wings in the closed position, thus closest to the body of the plane to minimize drag at supersonic speeds. As the plane slowed during takeoff or landing, the wings would be in a more traditional swept or open position, allowing for greater control at slower speeds allowing the plane to land. Initial wind tunnel tests showed that a delta design would not be able to land at any reasonable speed, due to its lack of control at subsonic speeds. The disadvantage of this was added weight as well as increased technological complexity. Much of the initial research on supersonic aircraft was centered in the idea that a multivariable swept wing was the only design that would work for any aircraft seeking to break the sound barrier in a stable fashion.[119] This was later proven to be incorrect, and multivariable wings eventually were no longer used in

---

118 Conway, *High Speed Dreams*, 87-89.

119 Conway, *High Speed Dreams*, 87-88.

aircraft design. But the choice between the two designs led to various debates and designs when first drawing up the specifications for an SST.

One other developmental problem that had to be overcome was the engine design for supersonic aircraft. Prop and rocket engines were the two major types of engine designs used in aircraft in the late 1940s and early 1950s.[120] Rockets were used for all of the early supersonic aircraft tests. Rockets were not practical for long term use due to fuel consumption and generally low flight stability.[121] A prop engine could not generate enough thrust to move an aircraft pass the speed of sound. Jet engines had been developed by the Germans at the end of World War Two and were beginning to be used on most aircraft by the 1950s. Jet engines work by ingesting air, heating it up further, and using that heat as thrust. As an aircraft approaches the speed of sound, the drag and friction created from the flight heats up the air around the plane considerably. Thus, a jet engine would be unable to heat the air further. Jet engines had to be redesigned to either cool the air before it entered the engine, or slow it down so that there was less friction and more time to heat it up to an appropriate temperature for ideal trust ratios. Turbo-props would be developed later to combine some of the more useful attributes of a prop engine with the power of a jet turbine, but these had limits of their own such as top speed and maximum flight altitude.[122]

---

120 Costello, Concorde Conspiracy, 41-43.

121 Conway, *High Speed Dreams*, 18-20.

122 Tedeschi, Diane. "How Things Work: Supersonic Inlets." Air & Space Magazine. Accessed March 03, 2019. https://www.airspacemag.com/military-aviation/how-things-work-supersonic-inlets-35428453/.

The idea of a supersonic commercial airplane emerged in its most basic form in the middle of the 1950s. Various engineers proposed that such an aircraft design was possible. The first jet airliner, the British Comet, began service in 1952. An aircraft under its own power had exceeded the speed of sound in 1946 with the Bell X-1 aircraft.[123] Conceptually, a commercial airplane that could exceed the speed of sound was considered to be a logical next step in airplane development at this point in time. Planes were continually getting more efficient and faster, and eventually breaking the sound barrier would be common place for even civilian aircraft. By the 1960s when the various governments of the world were considering funding an SST project, the sound barrier was less elusive to large aircraft then it had been a decade prior.[124] Many fighter aircraft were capable of exceeding Mach 1 for a period of time. This gave researchers looking into the SST project a basic framework about the needed aerodynamics of a plane that would continuously fly at supersonic speeds for extended periods of time. However, a fighter aircraft had vastly different characteristics and roles compared to an airline, and thus was designed using different criteria to match those desired characteristics. Essentially, when working to design the SST, the engineers and researchers were working with the bare minimum of data, and were often pushing the technology available to test their theories to its limit, or going beyond.[125] And while larger military supersonic aircraft began to emerge in the 1950s, designing a plane that could break the sound barrier, meet technical and safety requirements put down by various governments, as well

---

123 Dunbar, Brian. "First Generation X-1." NASA. August 12, 2015. Accessed March 03, 2019. https://www.nasa.gov/centers/armstrong/news/FactSheets/FS-085-DFRC.html.

124 Horwitch, *Clipped Wings*, 10-13.

125 Conway, *High-Speed Dreams*, 15-16.

as be economical to build, maintain, and fly was quite a different goal to achieve.[126] Military aircraft did not have to be economical nor did they have to meet strict federal guidelines imposed upon civilian aircraft.

This is not to say that supersonic commercial aircraft brought new challenges to the realm of aircraft development. The same basic principles of flight apply to a supersonic aircraft as they do to a subsonic aircraft. The factors that govern flight at subsonic speeds are simply more extreme at higher speeds. The major difference involves the motion of the air around the wings of the plane, but this is simply an extension of the factors that impact subsonic flight. The variables that are present in the transonic realm between Mach 0.8 and Mach 1.2 are somewhat different than normal flight concerns, but an aircraft would not want to maintain a consistent transonic speed due to these more diverse variables influencing the stability of flight.[127] Simply put an aircraft that is to fly consistently at speeds higher than the speed of sound would have to deal with the same environment as any other plane. But it would also have to endure the expanded complications put upon it by supersonic speeds including diverse temperatures and greater stress on the airframe. But the same basic principles of flight still apply. The properties of lift and drag are still of central importance to a supersonic aircraft. However, the airframe design must be different to stably fly at supersonic speeds.[128]

---

126 Stratford, *Air Transport Economics*, 284-288.

127 "SKYbrary Wiki." Hypoxia - SKYbrary Aviation Safety. Accessed March 03, 2019. https://www.skybrary.aero/index.php/Transonic_Flight.

128 NASA. Accessed March 04, 2019. https://www.grc.nasa.gov/www/k-12/airplane/ldrat.html.

These technological developments were crucial for designing planes that could consistently travel faster than the speed of sound. Without the military investments, it is unlikely the commercial sector would have been able to design or develop any supersonic aircraft outside of test models and a few experimental airframes.[129] Military funding proved to be essential to developing the basic theories for supersonic flight, as well as improving on existing aircraft technologies. The intertwined nature of the commercial sector and the military industrial complex that spawned from World War Two was both new and unique. The military was rarely involved in any developments in the commercial sphere. Commercial developments did generally have some impact on military technology, as various elements or ideas were repurposed for military use.[130] But, especially in the field of transportation technologies, generally civilian scientists and engineers were at the forefront of development. Military usefulness was never a consideration. Cars and trains were of course used and refined later by the military for their own purpose, but not to the degree that is present in the initial stages of supersonic flight.

From the onset of the development of the methods and tools needed to propel an aircraft faster than the speed of sound, both military and civilian applications were considered at the same time. Initially, the commercial applications were almost fantastical, and were rarely given any thought further than some artistic sketches of what a commercial SST could look like or how it could operate. But, the idea of using the ability to fly faster than the speed of sound for commercial applications was still present

---

129 Conway, *High-Speed Dreams*, 50-55.

130 Horwitch, *Clipped Wings*, 5-8.

from the beginning.[131] After supersonic aircraft were proven viable, serious development on commercial planes began. As the commercial sector did not have the resources or reason to develop a supersonic aircraft independently of any military applications, it is unlikely that any commercial ventures into supersonic aircraft would have happened.[132] Unlike other developments in transportation, the commercial supersonic aircraft programs were directly linked to developments in military aviation. But, as military aircraft that could break the sound barrier became the norm, the same companies that built these warplanes envisioned a similar plane for the commercial market. As the theories and technology behind supersonic planes was still new, the problems and issues with the aircraft were still being discovered. Commercial supersonic plans were envisioned by some to not only be profitable but also more economical due to the lower travel times. Air travel was already becoming the dominant form of long distance transportation. And the idea of connecting the world by air where distances could be traversed in mere hours was appealing to airplane manufacturers and airlines looking to please and attract new customers.[133] Military uses could often avoid concerns like fuel consumption, cost, and potential returns as they are not designed to take things into consideration. Commercial airplanes on the other hand, were concerned about such things.[134] Developing a new airplane cost millions of dollars. Commercial airlines, although intrigued by the concept of faster aircraft, were also concerned about the vast funding needed for development and construction of these new planes. The military spent

---

131 Costello, *Concorde Conspiracy*, 18-21.

132 Conway, *High-Speed Dreams*, 82-85.

133 Owen, *Concorde and the Americans*, 41-44.

134 Conway, *High-Speed Dreams*, 79-81.

vast sums of money to develop the technology and theory to build supersonic aircraft. And while the same basic design principles could be applied to a commercial airliner, the craft would still have to be designed from the ground up as there was no other vehicle that could be used as a base.[135] Traditional aircraft could not be used as a baseline as the design would have to be radically different to deal with the stress of supersonic flight, as well as enabling the plane to achieve such speeds. However, even with all the concerns about the viability and financial ability to develop such aircraft, various companies and governments were already drawn in by the allure of supersonic aircraft, and also had government backing to push forward on such a plane. The world had, after a fashion, been taken in by the allure of supersonic aircraft in the technological boom of post World War II.[136] As a part of that, companies were more willing to overlook initial potential concerns with the development of a supersonic aircraft to be able to keep pace with modern trends and developments. Globalization was beginning to develop. The world was getting smaller as communications and travel continued to bridge greater distances and shortened time between destinations.[137] Many believed supersonic flight to be the penultimate end of transportation and aircraft development. And due to the cultural, political, and military influence, various companies and organizations sought to push forward with plans to develop a supersonic plane in three regions. In England and France, America, and Russia, work towards developing a supersonic commercial aircraft was

---

135 Ibid, 84.

136 Ibid, 10-12.

137 Ibid, 2-4.

made over the course of several decades.[138] This work would prove that a commercial supersonic plane could be developed, but its viability would always be in question.

One major issue that arose with supersonic aircraft was the trade off for speed over maximum number of passengers that it could carry. As supersonic aircraft were mostly designed with trans-Atlantic or other similar long distance flights in mind, this was a delicate balance.[139] Most designs for a commercial SST allowed for about one hundred passengers plus crew. A Boeing 747, a common aircraft that makes trans-Atlantic flights, can carry anywhere from four to six hundred passengers depending on the layout. The trade off, of course, is that an SST could make the flight from New York City to Paris in less than four hours. A Boeing 747 would take between seven to eight hours for the same trip. A commercial SST also flew at a higher altitude due to the nature of the planes, thus resulting in less congested routes as well as more direct paths due to less interference from the weather. However, the SST did consume more fuel. Therefore, you had a plane that could make a journey in less than half the time but only carry at best one quarter the number of passengers. This became one of the core economic issues that developed when dealing with the viability of sustainable commercial supersonic aircraft.

Any discussion of the overall viability of any commercial supersonic flight project must also deal with the premise of need and demand in the aircraft industry. By the 1950s, when the SST was in its early stages, transatlantic flights were becoming common place.[140] By the 1960s, jet engines had become the mainstay of airline fleets,

---

138 Owen, *Concorde and the Americans*, 3-9.

139 Conway, *High Speed Dreams*, 85-90.

140 Stratford, *Air Transport Economics*, 12-16

and demand for air travel was adequately met by them. Older prop planes were slowly being phased out in favor of the faster and more efficient jet engine powered planes. One concern that was always at the forefront of a commercial SST was the role that it would fill.[141] There again was no immediate or pressing need for a new plane that could simply fly faster than its competition. It could be considered to be a luxury item.[142] But instead of being on a completely different level, the various SST projects would find themselves on the same playing field as other commercial aircraft, with their only advantage being reduced travel time. From a certain point of view, the development of the commercial SST was forced on the realm of technological development by a combination of different factors.

Three different programs developed that worked towards making a viable commercial supersonic airliner. These programs were in France and England with the development of the Concorde, in the United States with the work by Boeing with their 2707 aircraft, and the work in Russia to develop the Tupolev TU-144. These three aircraft are the only commercial attempts to develop a supersonic airliner, and they all had various levels of success. Both the Concorde and the TU-144 were developed into aircraft that fulfilled their intended role for a few decades. The Boeing 2707 never made it past the prototype stage. However, all three of these craft shared similar developmental backgrounds and also received substantial government backing. In the case of the TU-144, it was entirely funded by the USSR government. Boeing won a contract from the

---

141 Horwitch, *Clipped Wings*, 43-46.

142 Costello, Concorde Conspiracy, 34-385

American government to develop its version of a supersonic airliner. The Concorde was a joint project between France and England and various companies in both nations.[143]

The governments of the three regions that worked toward a commercial supersonic aircraft initially used military designs and advancements as the hotbed for the basic designs for future potential supersonic aircraft. Fighter jets and bombers proved and refined the core aerodynamic theories that were needed to maintain safe and stable supersonic flight.[144] The commercial industries would utilize these proven principles to develop their variants of supersonic aircraft to transport passengers.[145] However, due to different safety regulations, costs, time constraints, and entirely different design purpose, different problems would arise in the commercial sector on the road to developing a plane that could sustain subsonic and supersonic flight.[146]

The most successful of the three designs was the Concorde. The Concorde was a joint program between the English and French governments and various engineering and aeronautical companies from both nations. The major companies involved were the British Aircraft Corporation, now British Aerospace, and Aerospatiale from France developing the airframe, and Rolls-Royce and SNECMA, Safran Aircraft Engines, also from France, designing the engines. Dozens of smaller companies were also involved in the development and construction of this plane along with thousands of workers.[147] The

---

143 Owen, *Concorde and the Americans*, 3-11.

144 Conway, *High-Speed Dreams*, 38-45.

145 NASA. Accessed March 03, 2019. https://history.nasa.gov/SP-4219/Chapter3.html.

146 Conway, *High Speed Dreams*, 89-95.

147 Costello, *Concorde Conspiracy*, 45-47.

project was deeply integrated into the aviation industry of many western European nations. Governments were also heavily involved, providing the bulk of the financing for the project. No single company had the capital to develop such an aircraft. Unlike its Soviet and American counterparts, the Concorde was designed from a reactionary standpoint. The American aircraft industry had eclipsed their European counterparts after World War Two.[148] Many of the civilian airliners by the 1970s were being supplied by American companies, stifling the various companies in Europe. The Concorde was to be seen as a strike back by Europe, to gain some ground in the realm of civilian aircraft. As many different jet airliners existed, produced by multiple companies, the joint Anglo-French venture sought to create a new aircraft and a new market. That aircraft was supersonic commercial aircraft that would create a demand for exceptionally rapid international travel.[149] Such an aircraft could travel many times faster than a traditional jet airliner. With the advantage of speed, the Concorde was developed to be a competitor to existing aircraft designs and bring a share of the aviation industry to Europe. Thus, the Concorde was seen more as an economic necessity to keep various industries alive. Various social and political elements were another element of its design. The United States had eclipsed Europe as both a technological and industrial giant. A few decades prior, France and England had been on par with United States in both sectors. Now, they were slipping behind the United States primarily due to the devastation and costs of two world wars. In the 1950s, both English and French companies and governments were

---

148 Ibid, 19-21

149 Ibid, 19-24.

pursuing a basic interest in supersonic flight for commercial sectors.[150] Initially, both countries had no desire to start any sort of partnership or treaty to pursue this venture. However, as the hurdles and expenses for the project became better understood, a partnership was considered. England had a superior engine design and France had already laid groundwork on a basic airframe for various types of supersonic aircraft. Due to these various economic and political issues, France and England signed a treaty in 1962 to pursue the joint venture to develop a commercial SST. With the joint technical staff and financial capital of both nations, the project to develop a supersonic commercial aircraft was able to proceed.[151]

One element that helped to get the Concorde SST project off the ground in England was the loss of national and political prestige in the realm of aerospace. England had introduced the very first commercial jet airliner with the DH 106 Comet, which had revolutionized the aviation industry.[152] This plane had several design and structural issues which caused long lasting issues for British aviation design. Several crashes created concerns about the design and its viability. The plane was able to have a reasonable lifespan in service, but more importantly it changed plane design going forward. Jet powered aircraft were the way forward.[153] However, a decade later Boeing and Douglas, two American aircraft manufacturers had begun to dominate the commercial aircraft market, leaving the English and other European nations behind in both technological

---

150 Ibid, 40-43.

151 Ibid, 46-49.

152 "De Havilland DH106 Comet 1 & 2." BAE Systems | United States. Accessed March 04, 2019. https://www.baesystems.com/en/heritage/de-havilland-comet-1---2.

153 Costello, *Concorde Conspiracy*, 163-165.

progress for aircraft design and also market share. The Concorde program was seen as the best path forward to not only gain back a share of the market by creating a state of the art aircraft that could compete with the best American designs, but also help to foster aviation innovation in Europe once again. It was thought that aviation progress was a crucial element of modern economic and technological growth. The weakness of that sector in Europe was noted by many, and the Concorde was thought to be the project that could bring that deficit to an end.

Even with the treaty and the backing of two first world nations, the road to the development and deployment of the Concorde was tumultuous. England and France had a long history of rivalry, and the companies involved in this project were no exception.[154] The major aviation companies in England and France involved in this project were, prior to the treaty, rivals in selling and designing aircraft. Now they were to be partners and jointly design a brand-new aircraft. Basic aircraft requirements, such as what the range of the aircraft would be, had to be hammered out. The French initially wanted a short-range aircraft for routes within Europe.[155] The British wanted a transatlantic aircraft, mainly in hopes of selling to various American airlines. As little was known about how a supersonic commercial plane would actually function, many of the initial design ideas were unrealistic. The desire for different roles for the aircraft created additional complexity. The French built a mockup model of their desired shorter range SST, but due to lack of a market as well as the low calculated efficiency of the short-range aircraft the design was scrapped. The design that was developed into the Concord became the final

---

154 Ibid, 50-52.

155 Ibid, 40-44.

aircraft developed by this joint project. Settling on one single blueprint helped to streamline the already difficult process. Attention was no longer divided between diverging ideas and priorities.[156]

The single largest issue that arose during the development of the Concord SST was the matter of finances.[157] The plane originally was given a specific budget. As this was primarily being funded by the governments of England and France, both nations were well aware of the danger of cost overruns. France had more leeway over its budget as the project was given high priority, and those government officials involved were easily able to secure more government funding. In England, securing additional funding for the project that continually ballooned in terms of cost was proving to be more difficult. Initially, the total cost of the project was deemed to be about one hundred sixty million pounds split evenly between England and France.[158] Thus, England and France were initially planning that their total responsibility would be about seventy-five million pounds spread over the course of eight years. This was initially seen as fairly reasonable but also far fetched by some financial firms as well as other elements within the governments of England and France.[159] As the expenses increased, both the governments and people saw the program as becoming less and less vital as it was originally purposed to be. The English politicians in control of funding became more reticent to increase funding for the SST project. It had become clear that few companies outside of England

---

156 Ibid, 75-77.

157 Ibid, 72-73.

158 Ibid, 72-74.

159 Ibid, 27-28.

and France were interested in buying this new plane. The lack of market interest developed a vision showing that it would be difficult to recoup the money spent on research and development, not to mention production, by sales of the aircraft.[160] It quickly became clear that the majority of the financial burden for this SST aircraft would fall on the state. This circumstance was often difficult to accept, as the viability and usefulness of such a craft was seen to be potentially limited. However, no matter how much the English government wanted to cut its losses and remove itself from this project, the treaty with France and the desire of that nation to back out of the treaty forced England to carry on with the project.[161]

The final cost of the entire project eventually eclipsed over one billion pounds. Many factors that forced the total cost this high were entirely outside the ability of either government to manage. Inflation and currency value changed, labor costs increased, and the price of materials fluctuated. Factors such as these were entirely out of control of the overseeing bodies for this project. Furthermore, the initial estimates were based on current known costs of aircraft construction and a simple sketch that had been drawn as a relative idea for the plane.[162] Nothing was initially known about how a commercial supersonic airframe would be built from its materials to the actual structure itself. As the costs began to increase dramatically, the respective governments began to be concerned about lack of oversight and accountability, especially in relation to costs and overruns. One of the problems that caused such a massive increase in costs was the difference in

---

160 Ibid, 213-216.

161 Ibid, 244-248.

162 Ibid, 26-28.

overall organization between England the France.[163] In England, bureaucracy ruled over their end of the project. Men debated and ruled on costs and design ideas. France, however, ruled via a more centralized system, with a few men dictating how things should be done, without much dissent or discussion. As this was a joint project, there was an Anglo-French committee that oversaw it. Due to these differing ideas for how a project should be run, disagreements arose about many aspects of the plane.[164] Other elements of cost escalation arose from having to develop entirely new industries to support and build this plane. As it required precision and design that had never been seen before, these new industries were crucial towards its development. Costello eloquently describes this problematic situation: "A 1970 survey by the British Centre for the Study of Industrial Innovation had shown that over 700 companies were involved in supplying the Concorde with everything from ash trays to automated flight systems; many firmly believed that Concorde had helped to raise their technical standards."[165] But, as with any new venture, starting a new industry to support a single massive project is inordinately expensive.

The first major hurdle that the Concorde project faced was in 1964 when control of the British government shifted from the Tory party to the Labor party. The Tory party had been in control when the project was initiated, and the runaway expenditures from the project had won them little political favor. Aside from the Concorde, the British government was also facing a general financial crisis due to other military and social

---

163 Ibid, 73-76.

164 Ibid, 77-80.

165 Ibid, 13-14.

expenses.[166] The government was facing a major deficit of external debt. As such, the new government sought to reduce debt while still maintaining social projects, as social and welfare projects were at the core of the Labor party at this time. The major project that seemed to be draining vast sums of money was the Concorde.

However, regardless of how much any politician wanted to end the joint venture with France, the French were not so inclined to just let them drop out. The treaty was signed and was backed by the power of the United Nations. Without French agreement, the British could not back out.[167] And the French indeed did not agree to the British attempts to absolve themselves from their commitments.[168] The French had invested too much into it and did not want to stop. They still viewed the project as a way to challenge the technological might of America, and reclaim some of their former glory. Furthermore, entirely too much money and time had been spent to simply drop the project only a few years into it.

Another element that ensured the survival of the Concorde project in 1964 was the influence of labor unions and general economics.[169] The Concorde project incorporated a majority of the aviation industry of both France and England. This included hundreds of employees, many of whom were apart of large and powerful unions. The cutting of this program would result in the loss of many of these jobs. There was no other major project being developed concurrently that this sort of manpower

---

166 Ibid, 86-88.

167 "1962 Concorde Treaty | Heritage Concorde." Heritage Concorde. Accessed March 04, 2019. https://www.heritageconcorde.com/1962-concorde-treaty.

168 Costello, Concorde Conspiracy, 51-52.

169 Ibid, 87-88.

could simply be diverted to that would keep these people employed. These unions and industries used as much leverage as they could to convince the new labor politicians that backing out of this joint project would not only be a political and international blunder, but would also have major economic ramifications for England as a whole.[170] Similar conditions existed in France as well. France even threatened to go to other nations, including the USSR, to get funding for the plane as well as engine designs. Such international humiliations, as well as the other factors already mentioned, were impossible for England to bear. Therefore, the English government was forced to find other projects to cancel to aid its budget issues. Three British military aircraft projects were scrapped instead of the Concord. These included the P-1154, the HS-681, and the TSR-2.[171] These three planes were projects designed to fulfill various important roles in the British military. Ironically, the gaps that these canceled projects created were fulfilled by American aircraft designs. As a result of these programs being cut, the British aviation industry had few projects to keep itself afloat. The Concord became the major project still being funded, and thus was the lifeblood of the airplane manufacturers in England. In their attempts to cancel the Concord program, the new Labor government accidentally made it more important to both English prestige and economics than ever before. The Concorde was the only advanced European plane currently being developed. If they wished to fulfill the goal of not being entirely reliant on American technology, the Concorde had to be finished. Furthermore, the political drama that threatened the Concorde project helped to push the English and French people actually working on the

---

170 Ibid, 95-97.

171 Ibid, 86-87.

plane closer together in their goal to complete this technological money pit. Their very jobs and welfare depended on the project's continued funding.[172]

One important element that helped to keep the Concorde project alive despite the ever-increasing costs was the European Economic Community, or the European Common Market.[173] This new market system was a trade agreement between several nations in Western Europe that sought to increase the economic cooperation between them. It eventually became part of the foundation for the current EU. Initially, it was designed to help all the war-torn regions of Western Europe recover more effectively by reducing economic barriers and competition between the nations that took part. France was one of the more powerful and influential nations in this economic treaty and had rejected previous attempts by England to join.[174] As the Concorde was seen as the pet prestige project of the French government, the English politicians sought to use their continued support, albeit begrudgingly due to the costs, of the Concorde project. This helped to keep political entities in England dedicated to the project, as they saw it as a potential tool to use to gain access to the lucrative economic treaty that had been established on the mainland of Europe.[175] However, France kept blocking many of the attempts by England to join this union.[176] Often, this was due to factors outside of the control of England, but primarily it was due to the fluctuating value of the pound. Oddly enough, the very Concorde project that was kept alive by England's desire to appease the French often was

---

172 Ibid, 98-100.

173 Ibid, 53-55.

174 Owen, *Concorde and the Americans*, 35-38.

175 Ibid, 42-44.

176 Ibid, 67-68.

a partial source of the financial issues of the English government that had an impact on the value of the pound as England was forced to borrow and use other measures to keep itself financially viable. Furthermore, France saw England as an extension of American interests.[177] And many nations in Europe wanted to keep America out of European economics and politics.

In 1968, the pound again lost value as the English government scrambled to cut expenditures to save its financial situation from further damage. Again, the Concorde program was considered for termination.[178] But by this time the project had advanced too far. It involved four major companies in England and France as well as a plethora of small subcontractors around the world. Entirely too much money had been sunk into the project to simply cut it at this point, especially since two of the test planes were nearing completion and about to head to the testing and trial phase. There was still the glimmer of hope, since the project had gotten this far, that there could still be a reasonable financial return on the advanced plane. But as the English and French engineers and designers finished the last elements of the two testing airframes, one factor was helping to boost confidence in the project. The economies of both nations had undergone significant stress and pressure. Both nations had various degrees of social and political turmoil. The Concorde project, this new technological wonder that some thought would change the world as it was known, was a project of immense prestige and political importance to many.[179] This helped to keep the project on its course. It was a symbol that, despite its

---

177 Costello, *Concorde Conspiracy*, 56-58.

178 Ibid, 137-139.

179 Ibid, 133-135.

immense costs, could be looked to by the nations of France and England as a source of pride and accomplishment. As England and France were being forced to cut back in many other areas, such as social projects and the military, the Concorde was seen as a representation of European success. The Concorde project was essential to show the rest of the world that despite some setbacks, these nations were still preeminent on the world stage.[180]

Any project attempting to build something state of the art will run into problems. This is compounded when you are working with any sort of engineering project in a relatively new field. The Concorde was no exception to this. It was fraught with delays, design changes, performance enhancement, and every other possible problem that a massive enterprise such as this could encounter. The entire project was delayed by a year, and the first test flight occurred in March of 1969.[181] Dozens of other tests on the ground had proved the other systems of the plane were in good working order. On the second of March, 1969, the Concorde took to the skies for the first time from an airport in France. The French used this as a major political, social, and economic marketing point. The entire nation was still in full support of the project, and this publicity stunt helped to prove their support was placed in the right place. The Concorde had become something of a public figure in France, where it was used as a national symbol of pride and accomplishment.[182] While the British were ostentatiously left out of the media circus that ensued from this first test in France, the BAC flew their own test model a month later.

---

180 Ibid, 140-142.

181 Ibid, 156-158.

182 Ibid, 158-160.

This plane was also a success, and performed as expected. However, it was not the media and publicity coup that the French had so readily used. Both of these tests proved that the new plane was airworthy, and that just maybe all of the time and money that had been spent in developing and building it was not in vain. By now, this project had severely damaged both participating countries, and the value of their currencies had dropped.[183] But, the new plane was complete. Its first tests had been the publicity stunt of the past few decades, and various investors and airline companies were waiting to see how viable this new cutting edge aircraft could be for them.

Throughout its tumultuous development history, multiple entities sought to hinder the progress of the Concorde project. Concerns, even before the plane went into production, included the sonic boom, pollution, and the ever-present runaway costs associated with the plane.[184] As the costs of the plane began increase though, it did make the program more difficult to cancel. Vast sums had already been spent. Canceling the plane before it had a chance to prove its economic viability was consided by some politicians to be the obvious decision. Many hoped that the plane would fail during its testing trials, thus proving that it was not a viable concept. Moving back to the drawing board at that stage would have been far too costly. But, even though the trails did result in some modifications to the plane for performance and efficiency, the plane did prove to be capable of sustained and stable flight.[185]

---

183 Ibid, 158-162.

184 Orlebar, Christopher. *The Concorde Story*. 7th ed. Oxford: Osprey, 2011, 76-80.

185 Costello, *Concorde Conspiracy*, 164-165.

Two test planes had been built and were undergoing trials, tests, and demos in the early 1970s. One major element of these tests was to attempt to prove the marketability of this plane. Preorders for the new super-sonic plane had been placed by some of the major airline companies around the world.[186] However, many of these orders had been placed during the research and development of the plane. The airline market had evolved in the eight years that were required for the development of the plane. Air travel was becoming the most common method of long distance travel, and changes and marketing had lowered the overall cost.[187] Air travel was now in the reach of more people than ever before. Therefore, the markets for new aircraft had become more interested in moving the largest number of passengers possible for the lowest possible costs in fuel and maintenance. The Concord did not have these factors in its favor. It was an extremely expensive plane to develop and also consumed massive amounts of fuel. Furthermore, its seating capacity was lower than the newer jets that had been developed.[188] These new planes were capable of seating between three to four hundred passengers in relative comfort. The Concorde, on the other hand, only had a seating capacity of ninety to one hundred forty depending on its configuration. What the Concorde did have in its favor was the backing of the airline industries in both France and England, the support of the French and English governments, and the novelty of the plane. This vehicle had been theorized, promised and developed over the past decade. The curiosity about it and its performance were still key points to its marketability along with its maximum operational

---

186 Ibid, 63-65.

187 Stratford, *Air Transport Economics*, 64-74.

188 Costello, *Concorde Conspiracy*, 192-193.

speed. Even though capacity and efficiency were the core elements that airline companies wanted in a plane, the fact that the Concorde could fly more than twice as fast as any other commercial plane was still an important factor.[189]

With the plane's performance specifications and potential purchase and operating costs in hand, the representatives from the respective companies in England and France began to approach the various airlines around the world to attempt to sell the plane.[190] Some companies had made initial orders during the development of the Concorde. It would remain to be seen if these purchase orders would still be kept now that the final costs to own and operate the plane were known. The largest airlines in England and France were both relatively willing to buy the Concorde. They were state run, and thus were able to develop a contract to operate the planes while the governments handled some of the risk. The harder sell was to the two major American airlines, TWA and Pan Am. By this point, the Boeing SST project had been canceled by the U.S. government. No potential American rival SST would be built. Meanwhile the Russian SST was not being sold outside of their influence sphere. For the Concorde to be truly successful and make back all the money that was spent on it, it needed to be sold in America. Breaking into the American airline market was not only an economic concern, but a political concern as well.[191] One of the major driving forces that started this entire project was the desire to counter the emerging American technological dominance. If this could not be achieved, then one of the initial reasons for this project would now lack the impetus that

---

189 Ibid, 93-94.

190 Ibid, 213-216.

191 Ibid, 215-218.

originally inspired it. However, the timing for attempting to market a new plane to American airlines was extremely poor. Both TWA and Pan Am had recently purchased multiple new Boeing 747s both to replace their older aircraft and to attempt to increase their overall passenger carrying capacity. Further damaging the situation was the economic slowdown that was occurring in 1973 that resulted in fewer passengers as well as all around monetary problems for both of the airlines.[192] This resulted in these airlines having brand new expensive airplanes that could seat dozens more people than previous planes along with lower operating costs. But, with the economic downturn fewer people were buying tickets. These airlines were stuck with massive new planes and no passengers to fill them. Due to this and the large amounts of capital sunk into buying the new Boeing plane, trying to convince them to buy another plane that cost twice as much as a 747 along with higher operating costs was a difficult sell in the best of economic times. The higher purchase and operating costs were countered by the speed and luxury of the Concorde. The representatives for the plane used various market research studies, which showed that first class passengers would be willing to pay higher airfare to fly on a faster and technologically cutting edge plane. In the world of business, time was money, and the Concorde attempted to capitalize on its ability to save time as much as it possibly could.

At the end of the negotiations, neither Pan Am nor TWA purchased any of the Concorde planes, and thus they backed out of their agreements.[193] Both airlines were not able to see the ability to make a profit off this expensive investment. Pan Am was also on

---

192 Ibid, 213-214,216-220.

193 Ibid, 222-223.

the verge of bankruptcy, partially due to the large purchase order of 747s followed by the decline in ticket sales from the global economic slowdown.[194] Furthermore, the different regulations that the Federal Aviation Administration in America posed on the planes and the ones they developed for their own potential super-sonic aircraft caused concerns during procurement negotiations. The desire to only buy American-made planes was also still present in the American aviation industry. The public reticence to buying a foreign plane played into the final decision to not buy the Concorde for use by American airlines.[195] The lure of high paying first class customers willing to pay extra for the cutting edge and saved time was not enough. As a result, only the national airlines of England and France were the ones to fly the Concorde for the entirety of its lifespan.

Overall, twenty total aircraft were developed and built. Fourteen of them were used by the two airlines that flew them; the other six were for testing purposes. Aside from the immense costs of developing the plane, building them was also expensive. The technology and factories used for their construction was either brand new or was not used anywhere else at that time.[196] No other commercial plane on the market required similar construction design. Generally, the economy of scale can make an even initially expensive project more cost effective to produce if you can build it on a large scale to distribute costs as well as develop a base for building other things with the tools and factories you have created. Since the Concorde was only being flown by two airlines, the construction of large numbers of the planes could not be justified or funded. Furthermore,

---

194 Orlebar, *The Concorde Story*, 86-88.

195 Owen, *Concorde and the Americans*, 91-95.

196 Orlebar, *The Concorde Story*, 86-88.

as the planes failed to be sold to any outside airlines, the government and public were not willing to continue to pour money into this design, no matter how much of a propaganda or technological feature it might be. Even large first world nations have limited funding, and the funding for the Concorde ended at twenty total airframes. Due to this small run of aircraft, it was impossible for the companies involved in its development to recoup the costs.[197] The idea that this plane would be a financial boon and gain back its development and construction costs was dead once it was confirmed that no other airline was interested in buying the Concorde.[198] Therefore, the French and English governments were forced to absorb the full costs of the project. This not only enabled their pet project to survive, but also allowed for the companies that built the plane to remain active and not fall into total financial collapse from this extremely costly project. The development and construction of this plane had become a core element of BAD and Sud Aviation.[199] Factories, workers, technical contractors and many other elements made up the industry that had arisen to build and support these planes. Such an infrastructure could not be done away with easily, especially as the unions had power in the government and the companies themselves still had money to influence politicians and keep this project alive. All of the political support that helped to keep the Concorde project afloat and moving during its development was still there. The idea that this plane was a symbol of European progress against the overwhelming influence of the United States was still keenly felt in both France and England in the 1970s. England still saw the plane as the way to enter the European economic block. The end of the project helped to convince France and the

---

197 Ibid, 94-97.

198 Costello, *The Concorde Conspiracy*, 252-254.

199 Ibid, 253-256.

other European nations involved in this joint economic venture that England would be a worthwhile addition and that the nation of England was not as constrained by American influence as had once been thought by many.

As the final tests on the two prototype Concorde planes neared completion, the ultimate fate of the plane was still not certain.[200] With the idea that only twenty aircraft would be built, the builders were concerned about their ability to recoup costs. As mentioned, building only a small number of planes that cost over thirty million dollars each was not an economical way to introduce a new plane to the market. These expenses could only be recouped if the plane was built and sold in large numbers. But budgetary concerns of the English and French governments loomed over any expansion of production of the plane.[201] It also made no sense to continue building airframes if no other airline was interested in buying them. Even at this late stage, when millions of dollars had been spent to get the plane to this point, some political figures still sought to end the program. The combined might of the unions and industry that had developed as well as the French desire to continue the program helped to stop this last-ditch effort to actually build the plane. But, a hard limit was set on sixteen aircraft unless another buyer was interested. The majority of the concern came from England and British Airways. The various political parties were always concerned about the ever-expanding budgets. The Concorde was always a big-ticket item that seemed easy to dispose of and reduce the burden on the government. British Airlines feared that they would not be able to operate the plane at a profit due to issues in America and the potential that few American airports

---

200 Ibid, 224-230.

201 Ibid, 248-247.

would be willing to allow the plane to even land there.[202] Operations alongside subsonic jets and the combined upkeep costs were feared to be overwhelming. However, the government deemed that the plane was far too advanced to cancel, as the costs to back out of the program at this stage would outweigh the costs already put into it,

One core principle that the proponents of the Concorde brought up during different arguments in the 1970s over the fate of the plane was that the Concorde had brought back a level of technical expertise and advancement that had not been seen in England for quite some time. Even though millions of dollars had been thrown into this project, the plane itself was not the only positive result.[203] New techniques for handing metal and developing sophisticated avionics had been designed. The work to develop an airframe that could fly efficiently at supersonic speeds had lead to breakthroughs in other areas of avionics as well. And many of the tools and techniques that were developed to produce the specialized components of the Concorde were eventually transitioned into other products and tools for public consumption in difference economic sectors. Although these effects perhaps did not equal the actual costs of the plane itself, it did help to prove its worth to an extent and was a useful arguing point for keeping the project alive.[204]

Other issues and problems threatened to derail the Concorde project even before the plane was built. Problems included political rivalries, economic issues, budget concerns, environmental activism, concerns about sonic booms, and vast technological

---

202 Ibid, 256-259.

203 Ibid, 252-255.

204 Ibid, 254-257.

difficulties.[205] When the plane was finished, and put into service, these problems still persisted. The plane was still being funded under the government budget, a situation that not all politicians agreed with. The plane was still a political and propaganda tool, which often came with its own problems. It was also extremely sophisticated and expensive to fly and maintain.[206] The industry that had developed around the research and design for the plane had to be kept intact to support it or else it would be unable to continue its service. The delicate cooperative agreement between England and France had to continue as long as the plane was in service.

One major worldwide economic issue that derailed many attempts to sell the Concorde to other airlines outside of England and France, and also caused concerns within their own airlines, was the Oil Crisis of 1973.[207] This event, caused by the oil producing nations of the Middle East, was an embargo of oil to many nations, including England and the United States. This embargo caused the price of oil to climb dramatically. This had an impact on many sectors as oil was crucial to every economic area. Airline traffic was of course dependant on oil for fuel, and was impacted significantly as a result of increased costs to maintain the planes. Many airlines suffered major economic and financial issues from this crisis. Due to the high fuel consumption rates of the Concorde, this event caused airlines, such as TWA and Pan Am, to be less interested in a plane that consumed considerably more fuel than a standard jet,

---

205 Ibid, 263-268.

206 Stratford, *Air Transport Economics*, 324-327.

207 Kleinfield, N. R. "AMERICAN WAY OF LIFE ALTERED BY FUEL CRISIS." The New York Times. September 26, 1983. Accessed March 04, 2019. https://www.nytimes.com/1983/09/26/business/american-way-of-life-altered-by-fuel-crisis.html.

compounded by their own economic issues from having to secure more fuel reserves at higher prices.[208]

With no major airlines interested in the Concorde due to financial, economic, environmental, or political issues the survival and profitability of the plane depended on a couple of factors. First and foremost, it had to prove that it could fly the routes it was able to in an economic fashion both in terms of flying a full passenger compliment over a predetermined range and doing so with enough efficiency for the ticket sales to outweigh the costs of fuel and maintenance. The biggest customer group that the Concorde sought to acquire was the high priced first class business related ticket sales. These people were willing to pay a premium for speed or luxury or both.[209] The Concorde did not have many luxury features that other planes could potentially offer, but nothing could match its speed. The success of the plane depended on getting these customers.[210] Most other airlines also depended on these high paying first class customers to make their flights profitable. If the Concorde was able to steal these customers away, it could force these other airlines to buy a Concorde in order to survive. It had limited success in doing this and enabled the plane to fly at a profit for almost thirty years; however, it was not enough to encourage other airlines to buy the plane. After the final sixteenth flight-ready aircraft was finished, no other Concorde plane was started.

---

208 Costello, Concorde Conspiracy, 242-243, 279.

209 Ibid, 268-270

210 Azerrad, Lawrence. *Supersonic: The Design and Lifestyle of Concorde*. Munich: Prestel, 2018, 18-22.

During the plane's lifespan, its passengers were primarily business class or wealthy elite who could afford the high cost of the tickets. The Concorde managed to make some profit as its average ticket price was ten thousand dollars or more, and the passengers were willing to pay due to the exceptional decrease in flight time the Concorde afforded. As such, the planes often incorporated what luxuries they could, from upgrading the seats, to extensive in-flight service, gourmet food, as well as a wide assortment of high end alcohol.[211] This helped to encourage the wealthy customers to continually choose the Concorde, as they were treated better than on most other aircraft and had a shorter flight. In essence, it created its own persona as a luxury supersonic aircraft and created a one of a kind experience that only it could provide. Not only would you get to your destination faster than any flight any other aircraft could provide, but you would do so in the grandest style the airline had to offer. This culture helped create an allure around the plane which kept it popular and intriguing to its passengers for several decades.[212]

The planes were in service from 1976 to 2003. In 2003, all remaining planes were retired and sent to various museums. The decision to retire the planes was due to multiple factors. In June of 2000, an Air France Concorde flight crashed, killing all of the passengers and crew. Even though this accident was the only fatality and major incident in the plane's service history, it created a lack of confidence in the aging planes.[213] Even though the planes themselves had relatively low flight hours and extraordinarily few in-

---

211 Ibid, 130-136.

212 Ibid, 82-88.

213 Rose, David. "Concorde: The Unanswered Questions." The Guardian. May 13, 2001. Accessed March 04, 2019. https://www.theguardian.com/world/2001/may/13/davidrose.focus.

flight issues, the crash increased the lack of confidence in the viability of the plane.[214] After the September 11th attacks on the World Trade Center in New York City, there was an overall downturn in flights booked. Fewer people were flying, and even fewer were interested in the high prices that tickets on the Concorde commanded.[215] Until this point, the Concorde had been somewhat profitable due to the high prices of the tickets. Some business people who had the finances to do so enjoyed the faster travel times of the Concorde, and they were willing to pay the premium despite the lack of amenities and upgrades that other more modern planes had. The Concorde by 2003 was a relic of the 1970s, and had not seen a major update to its interior since the completion of the fourteen aircraft.[216] The cockpit was fitted with outdated technology, and the plane itself lacked the comfort or entertainment that modern jets offered to their customers. With the slowdown of airfares after the attacks, even the wealthy were not flying as much, and the Concorde was no longer as profitable. Furthermore, Airbus, the owner of what was Aerospatiale, declared that it was ending support for the Concorde.[217] Without a supply of parts, the plane could no longer be maintained. Both England and France had

---

214 Orlebar, *The Concorde Story*, 145-151.

215 Sancton, Thomas, Sally Donnelly, Nicholas Le Quesne, Scott MacLeod, and Ursula Sauter. 2000. "DOOMED. (Cover Story)." Time Europe 156 (6): 18. https://login.proxy.libraries.rutgers.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=3397295&site=ehost-live.

216 "Flight of the Imagination." 2011. History Today 61 (12): 18–20. https://login.proxy.libraries.rutgers.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=67790878&site=ehost-live.

217 CONCORDE SST : HISTORY. Accessed March 04, 2019. http://www.concordesst.com/latestnews_03_3.html.

maintained the plane out of both national pride and some degree of profit, but after these events keeping the planes in service became economically unrealistic.[218]

The Concorde, being that it flew routinely for over two decades and its unique political background, is the most useful case study of the three major SST projects. It was the most successful, but it still had many of the problems behind it that caused its eventual failure. Similarities in its development and the efforts in America's SST program can be seen, especially in the political arena, The Soviet SST was radically different, due to the nature of the country and its political system.[219] That program lacked many of the budgeting issues and political infighting that caused so many problems for the American and British projects. The Soviet government also cared little for environmental factors as well. But the core idea behind their reasoning to build an SST was still similar to that which was found in both America and England. All three planes and their development and flight history must be compared to have an sufficient view of the unique nature of the SST program and its impact on society and technology.[220]

The Concorde and the American SST have the most direct parallels. Their development was very similar, and similar reasons fueled the program initially.[221] The American program, initially worked on by both Boeing and Lockheed and eventually just Boeing, faced many of the same political and financial challenges that the Concorde

---

218 PRINCE, A. R. 2018. "Supersonic Gamble." *Aviation History* 28 (4): 64–71. https://login.proxy.libraries.rutgers.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=126583566&site=ehost-live.

219 Moon, *Soviet SST*, 4-8.

220 Owen, *Concorde and the Americans*, 3-9.

221 Ibid, 28-32.

faced. However, it was unable to overcome these problems. As the two cases are not identical, no direct conclusions can be drawn from one that can be found completely applicable to the other. There are ample comparisons that can be used to further refine the technology of supersonic transportation and its interplay with society around the world. Technological developments that were occurring at the same time as the start of the SST programs also influenced the SST programs of other nations.[222] Innovations and changes in the aerospace military and strategic nuclear arms were crucial to the timeframes of some of the programs. Advances in airframes made by the air forces of Europe and America were useful testing grounds for supersonic aircraft. Planes such as the American B-58 Hustler and the British Vulcan bomber were both test beds for early large scale supersonic aircraft. The engines used in the Vulcan bomber, the Rolls Royce Bristol Olympus[223], would become the basis and test bed for the Concorde. These aircraft and others helped to build the basics from which further supersonic aircraft could be developed.

The Concorde and the American projects did deviate in many ways. They were primarily divergent as the Concorde was completed and flew for several decades. The American designs did not make it past mock-up stages. Also, the environmentalist lobby in England and France was nowhere near as powerful in their political system as it was in American politics.[224] This lobby worked to prevent an SST from being built in America

---

222 Conway, *High-Speed Dreams*, 20-28.

223 "Rolls-Royce Olympus Mk. 30101 Turbojet Engine." National Air and Space Museum. June 12, 2018. Accessed March 04, 2019. https://airandspace.si.edu/collection-objects/rolls-royce-olympus-mk-30101-turbojet-engine.

224 Conway, *High Speed Dreams*, 118-121.

due to concerns over noise and potential atmospheric disturbances, especially to the ozone layer.[225] It even worked to prevent the Concorde from landing at any American airport, although it was much less successful at that goal.[226] The American populace never fully backed the project as was more common in England and France, and the various companies involved with the American SST project were not as dependent on it as their European counterparts. The project was also not seen as quite a necessity. Europe was using the plane as an opportunity to break back into the airliner market that was being dominated by America as well as the political and technological acclaim it would bring. America stared an SST project to simply continue their trend of technological dominance.[227] In England and France, a plethora of forces outside the control of politicians kept the Concorde project alive despite many attempts to shut it down.

The United States and Soviet Russia were vying for dominance during the Cold War era in which the SST concept was first founded. England and France, while on the side of the U.S., did not have as much of an impact on the two nations of the U.S. and Russia as Russia and the U.S. had on each other. Their technological developments and future planes were designed to deal with the current and potential political and technological landscape. The B-58 Hustler was designed to be a high speed high altitude penetration bomber for delivery of nuclear arms. The plane was capable of flying at Mach 2.0, faster than any known interceptor aircraft at the time.[228] It was also one of the

---

225 Ibid, 161-163.

226 Costello, *Concorde Conspiracy*, 233-236.

227 Conway, *High-Speed Dreams*, 38-42.

228 Ibid, 38.

first supersonic bombers deployed. Development had already started on the B-70, which was designed to fly faster than Mach 3.0 and could have theoretically been used as a test bed for an American SST.[229] However, Soviet SAM development proved to be capable of taking these planes down which resulted in rapid design and planning changes to the United States' long range nuclear deterrent and bomber command. An entire strategy, based around high speed bombers alone, had to be changed almost overnight. An expensive technological marvel was proven to be ineffective. To be able to stay out off the scope of radar, a bomber would have to fly at much lower altitude, often at slower speeds. The B-58 and the B-70 were both incapable of doing so, as they were designed for the one role of being a high altitude supersonic bomber. As such, interest in supersonic bombers fell as the US strategy for nuclear deterrence changed.[230] Supersonic bombers would be developed later once the theories behind supersonic flight were better understood, but with a different tactical role. With this, less research and development was put into large scale supersonic aircraft in the United States. Without this ongoing basis of research, an SST program in America, similar to the other nations, was forced to develop on its own path using only the basic data that had been put forward. If large supersonic bombers had stayed relatively invincible, they could have quite readily paved the war for an SST with ease in America.[231] England and France did not have this concern. They both had their own deterrents, but being far closer to Russia made their strategic concerns far different than America's. The next supersonic bomber would be the

---

229 Ibid, 38.

230 Ibid, 11-13.

231 Ibid, 43-45.

F-111 Aardvark which was introduced in 1967. This plane was much smaller than the B-58, and was capable of both high and low altitude supersonic flight. This was made capable by its multi-variable swept wing.[232] By this time, progress with the SST programs in England, France and Russia was well underway. This plane did have an impact on the American SST program design, however.

This shift in global strategy had far reaching implications. As stated, it disrupted interest in an American SST project as the military looked elsewhere for potential options for nuclear deterrents. The Russians, on the other hand, had started initial progress towards an SST design as early as 1961,[233] the same year that America realized the vulnerability of their vaunted B-58. The Russians at this point had little experience with supersonic aircraft, outside of fighter aircraft. The lack of an early American SST program gave them little to work with as far as technological espionage. Prior to this point, many recent Russian technological achievements in the realm of aircraft were made as copies of American ones, such as their version of the B-29. They of course had their own designs as well but often sought to emulate other designs that were already successful. This often led to mixed results as the Soviet industrial and technical capability was different than their western counterparts.[234] Russia was forced in this project to be on par with the rest of the world. There was no other information that could be used as the ground work for an SST as most of the nations of the world that worked on this project

---

232 "F-111." Lockheed Martin. Accessed March 04, 2019. https://www.lockheedmartin.com/en-us/news/features/history/f-111.html.

233 Moon, *Soviet SST*, 48-50.

234 Ibid, 3-6.

were starting on the cutting edge of what technology[235] they did have as they sought to move beyond that edge.[236]

As a counterbalance to the power of Russian Communist bloc during years following World War Two, the United States was in a position in which it had to maintain some degree of technological superiority. If superiority was not possible, technical parity was a requirement. To have lost that technical edge would have been dangerous in the tumultuous era that was the Cold War. The launching of Sputnik in 1957 was just such an example of the political and social ramifications, not to mention the fear and panic caused by a perceived loss of a technological edge over a rival. Most of this development was focused on maintaining parity in terms of military systems, specifically nuclear arsenals and delivery systems. This, in turn, also extended to the space race and the efforts to send men to the moon. Certain large commercial projects, when they had enough political and marketing value behind them, also fell under this category. Thus, when the major nations of the world sought to develop a supersonic commercial aircraft, for a whole host of different reasons, the United States believed that it had to be at the forefront of such a project.[237]

Initial plans for an American SST began in 1961, but due to aforementioned changes in strategic policy, no extensive research or work was done towards making this a reality. Some talks and low level research had been started as early as 1960, but no major efforts or funding was put toward any serious project. NASA Boeing, Lockheed,

---

235 Coway, *High-Speed Dreams*, 108-110.

236 Owen, *Concorde and the Americans*, 60-64.

237 Conway, *High-Speed Dreams*, 84-87.

and some of the other major companies and agencies in aerospace were studying the idea of a potential SST, but no major moves were made to make such a plane a reality outside of the paper on which it was drawn.[238] Most of this work showed that an SST would not be economically viable due to the high development costs. It was not until 1963, when the Concorde project was shown to actually be moving forward due to the joint efforts of England and France that President Kennedy pushed for a national SST program.[239] Prior to the Anglo-French treaty, England had approached the United States about a potential partnership. Although the United States was potentially interested in such a venture, they wanted a plane that was above and beyond what England was willing to work towards from a technical and monetary standpoint. Also, the allure of joining the European Common market was too much of a lure for England. So, any potential deal between England and the United States on an SST project never went anywhere. The United States could not allow another nation to develop and build a cutting-edge plane and have it be sold to United States based airlines. Not only would it make America seem weak to have other nations design and fly a plane beyond at the pinnacle of technological innovation, but the research and design for such a plane could be readily applied to other aircraft designs and theories. Plus, the United States was not indifferent to the social priorities of its day. The United States realized, as did Russia and Europe, the fast march of technological progress since World War Two.[240] Things needed to be faster or stronger, and weapons more deadly, both to keep pace with the rest of the world, but also

---

238 Ibid, 51-58.

239 Owen, *Concorde and the Americans*, 41-45.

240 Hackney, Donald I. "The Supersonic Transport as an Instrument of National Power." OAI. Accessed June 17, 2017. http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA510143.

to feed of the technological frenzy the pace of development and research had created. To stop innovating would be the same as becoming irrelevant. And America, new on the world stage as the leader of the democratic realm, was not in a position where they could afford to lose that dominance.[241]

Aside from the political, social, and technological ramifications of not joining in this SST race, the United States had a much more concrete reason to move towards developing a faster than sound commercial aircraft. And that was simple economics.[242] At this point, no one know how economically feasible building or operating an actually SST would be. The main concern was that such a plane would dominate the current market. If Europe could build a large, safe supersonic aircraft and sell it to the world, it was thought that subsonic aircraft would then become outdated and completely replaced .[243] America had the majority market share in the aircraft realm between Boeing and Douglas. This was not something they wished to lose, and the potential economic impact of the loss of this market was considered to be detrimental at best. Not to mention the potential loss of imports and trade imbalances from having to import these expensive new aircraft,[244] as well as the loss of prestige and status due to holding on to the leadership of civil air transport and then losing it not a few years later. The Americans, along with the rest of the world, believed that supersonic commercial aircraft were the next logical step

---

241 Ibid, 44-49.

242 Stratford, *Air Transport Economics*, 284-291.

243 Own, *Concorde and the Americans*, 41-43.

244 Costello, *Concorde Conspiracy*, 28-32.

in aircraft development. Standing on the sidelines for this immense project was simply not an option to them and resulted in these aforementioned conclusions.[245]

Furthermore, America was a democratic nation. It was engaged in a battle of ideologies with Russia, one that it could not afford to lose. For America to stay out of this project, this seemingly logical leap forward in aviation technology would show that they could falter. It would show that the democracy that America championed for the world, the democracy that had brought down the totalitarian regimes of Germany and Japan during World War Two was wavering as it could not keep pace with typical technological trends. In a world where merit was an important ideological foundation for governments, the leader of one side of the conflict could not afford to stand back at this juncture. This perception of preeminent national prestige as a core and essential reason for building the SST was found in both Europe and Russia, as it was being espoused by the heads of various private airplane corporations and government entities that worked with them.[246] Najeeb Halaby, the recently appointed second head of the Federal Aviation Administration, which itself was a new organization, was the largest proponent for an American SST project in the early 1960s. He espoused the belief that the SST was a project required of the nation both out of technological necessity but also national prestige and pride.[247]

---

245 Hackney, Donald I. "The Supersonic Transport as an Instrument of National Power." OAI. Accessed June 17, 2017. http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA510143.

246 Conway, *High-Speed Dreams*, 1-11.

247 Ibid, 90-93.

The importance of national prestige and American global pre-eminence to the foundations of the American SST project cannot be overstated. By the 1960s, America had moved from the relatively isolationist nation that it had been before World War Two to the protector of the free world. This mantle of world leadership came with a larger degree of potential threats, including political, economic, and military. The notion that lack of American involvement to some degree in the SST projects that were starting up around the world would be a potential weakness that could be exploited was part of the foundation that the entire American SST program was started upon.[248] America had entered the world stage, and it did not wish to leave its global preeminence under any circumstances, and it would do anything to keep itself on the center stage. And this was not simply just from a military or ideological standpoint. Economic and social dominance were also important. The SST project was viewed as essential to this dogmatic idea. By 1963, various American airlines began considering or taking orders for the Concorde before it got off the drawing board. This helped to spur America into action to get its own SST project started. They could not afford to lose their dominance in any realm.

The economic viability and impact of a new idea or technology is often rather volatile both prior to its incorporation into society and during that process.[249] Planes and cars were originally thought to be useless, the playthings of the idle rich. But eventually both became centerpieces in modern society. Cars went from being absurdly expensive to produce and maintain to being owned by most families within the course of a few

---

248 Ibid, 10-13.

249 Enke, Stephen. "Government-Industry Development of a Commercial Supersonic Transport." The American Economic Review 57, no. 2 (1967): 71-79. http://www.jstor.org/stable/1821609.

decades. What was initially thought to be a passing and irrelevant fad quickly became a cornerstone in the lifestyle of many people, especially in America. The economic impact from cars was immense, as it created a brand-new sector of the economy.[250] No economist or industrialist had been able to forecast such a major impact on the world economy. Mass automobile production impacted almost every area of the economy, from farming to warfare. Aircraft had a similar yet less pronounced impact in the world and national economies.[251] They primarily helped to facilitate long distance travel and bring the world closer together. Large bulk shipping was still done mainly by sea, but aircraft did help to revolutionize warfare in World War Two. They also created a new economic sector dedicated to maintaining and building planes, as well as the needed infrastructure that was required to fly the planes around the world in a safe and organized manner. With these two precedents in mind, it is understandable that economists and engineers thought that supersonic flight could potentially be the next large economic change for the transportation sector.[252] New jobs would be developed to build and maintain these aircraft, and faster flight times would potentially increase the profitability of airlines, not to mention the export of the aircraft once it was proven to be flight worthy and economical.[253] This sentiment, while present in both Europe and Russia, was far more widespread initially in America, at least in the government and aerospace sectors.[254] Economic considerations were a part of the European desire for an SST, but enhancing

---

250 Goddard, *Getting There*, 84-88.

251 Stratford, *Air Transport Economics*, 97-102.

252 Owen, *Concorde and the Americans*, 17-23.

253 Conway, *High Speed Dreams*, 149-151.

254 Horwitch, *Clipped Wings*, 8-15.

their dying aerospace sectors and national technological pride were greater considerations. Due to the extreme underestimations concerning the research and development funding required by an SST, the technology was considered to be generally economically favorable on return on investment.[255] Conversely, the potential economic losses that could occur from not getting into the SST race were emphatically stated by American engineers and government officials who supported such a program. Granted, these sentiments were not without opposition. Other important political figures, such as Kermit Gordon and Walter Heller, both influential budgetary and economic figures within the American government, as well as Eugene Black, a financial expert and former head of the World Bank, disagreed about the potential positive economic impact that an SST would have and sought to downplay the fears that not getting into the SST market would be detrimental to the American SST market share. The economic viability of the American SST would be an extensively debated and researched topic for the duration of its program, and was core to many of the decisions that were made.[256]

One issue that did plague the early stages of the American SST project was the question of who would control and finance the project. Many airplane companies such as Lockheed and Boeing were interested in the SST but feared excessive costs that such a project would cost. Before moving forward, they wanted a guarantee of government funding. Airlines as well were also interested in the project, but their concern was more about the economics of the plane, especially concerning its range, price point, and maintenance costs. Both entities especially felt that the government should subsidize the

---

255 Costello, *Concorde Conspiracy*, 25-28.

256 Conway, *High Speed Dreams*, 143-145.

SST project as military aviation had moved away from practical designs that could aid the civilian sector. NASA was more interested in reaching space and matching the Soviets in that realm.[257] The military was more interested in missile technology and fighter jets. Whiles these focuses would produce tangible civilian benefits, they did not directly bring results to the commercial aviation sector in terms of new engines or airframes that would result in new civilian aircraft. These various government bodies, including NASA, the FAA, and the US Air Force did all express differing degrees of interest in heading up the project. Similar to Europe, the United States realized that if such a project was to be developed, it would require government initiative but more specifically government funding. However, as already mentioned, NASA and the US Air Force had limited interest in heading up an SST program. The FAA, which had a large concern for the continued dominance of American aviation, diligently sought the government approval to both lead and fund such a program.[258]

As opposed to England and France, who both only had one company each that they could turn to for potential SST designs, America had several.[259] The government and the FAA put out a call for designs for an SST along with a substantial amount of federal funding to the winner to start designing and building a plane to rival the SST of Europe.[260] Boeing and Lockheed were the two main frontrunners of this event. Boeing put forward a revolutionary design using a swept swing wing. The swing wing concept

---

257 Ibid, 44-47.

258 Owen, *Concorde and the Americans*, 40-44.

259 Horwitch, *Clipped Wings*, 60-66.

260 Owen, *Concorde and the Americans*, 60-65.

was a relatively new one in the realm of airplane design. Only a few experimental aircraft had used the unique wing style, and the F-111 built by General Dynamics in 1964 was the first production level aircraft. No commercial aircraft had used the design. Boeing would have no real comparable precedent in creating a supersonic plane with a swept multivariable wing.[261] Lockheed's design was less ambitious. It was centered on a prominent delta wing, similar to the design being developed for the Concorde. In America at the time it was assumed that a supersonic airliner with a delta wing would not be economical. It was considered that the handling and aerodynamic characteristics of the plane at lower speeds would result in poor fuel economy as well as flight stability. The multi-variable wing could avoid this by having the ability to have an ideal wing designed for both supersonic and subsonic speeds, thus increasing performance and fuel economy. Boeing, and by extension America, wanted to build something beyond the cutting edge. Europe was building a plane that reached the limits of what was possible, but America had to be better. America was the leader of the democratic world and the most powerful nation. To maintain this status, it could not just equal the plane that was being built in Europe, but it had to exceed it in every possible way.[262]

Even though the multivariable wing was revolutionary and would solve many of the issues of a plane required to fly at supersonic and sub sonic speeds, weight was still an issue. To operate such a wing that could withstand the various stresses that would be placed upon the plane, it had to be reinforced and made of titanium alloys. Eventually, the design characteristics for such a wing simply exceeded any known ability to engineer

---

261 Conway, *High Speed Dreams*, 112-113.

262 Ibid, 110-115.

it. The wing design simply became too heavy and thus proved to be impossible to even fly. All planes must follow the basic rules of flight, and those include certain limitations on the weight of the plane for it to be able to take off as well as fly any reasonable distance. When Boeing was first granted the contact, they did have a small backup team set to design a delta wing concept for the SST. Once it proved that the swing wing was not viable, they immediately switched to working on the delta wing model.[263]

By the time Boeing had switch to the more economical and less complicated delta wing, funding for the project had already begun to evaporate. The enormous amount of money spent, the rising concerns about the economic viability of the project, protests from the public about environmental concerns, and a waning interest in the American government for the project led to the Senate cutting all funding to the SST project as it existed at the time. Aside from economic and financial concerns, a large and powerful environmentalist group had risen up to decry the plane. New potential problems such as damage to the ozone layer of the atmosphere became their central concern over an SST. Of equal concern was the noise from the sonic booms both over land and the noise of the enormous engines required by an SST heard near airports.[264] These factors also helped to contribute to the end of any serious American SST program.

Various small programs continued after the funding was cut for the Boeing SST program. NASA, along with some of the major aerospace companies, had projects devoted to reviewing the development of an SST using the information gained from the Boeing efforts, the Concorde, as well as current developments within military aircraft.

---

263 Ibid, 115-117.

264 Ibid, 118-125.

Some of these projects gained minimal government funding, but none of them ever gained the funding that would be needed to seriously consider building and testing an actual plane. Supporters of the SST in America thought this would be the end of American technological dominance. [265] However, it more portrayed the weaknesses of SST programs that had not been overcome by technological momentum as well as their failure to evolve with the changing economic and social needs. The SST was very much an idea stuck in the 1960s obsession with speed and advanced technology.

The Russian supersonic aircraft, known as the Tupolev TU-144, was the only other supersonic commercial plane to ever be developed and flown.[266] In many respects, this plane was very similar to the Concorde. During the early development stages of the Concorde, several Russian informants worked to obtain whatever knowledge they could about the Concorde's development, and relay it back to Russia.[267] The Russian Communist government understood the technological and propaganda advantage that a commercial supersonic aircraft could be. The very nature of the Russian government of the time was designed to show the superiority of their governmental system in every possible aspect. Technological dominance was a core element of this ideology and was used to further political aims. Such a political feat had been accomplished with Sputnik, and it was thought that a supersonic commercial airliner would have a similar impact on the world. To the Russians, technological prestige was one of the preeminent ways to prove to the world that not only did the Soviet system work, but it was superior to any

---

265 Hotwitch, 328-331.

266 Moon, Soviet SST, 104-106.

267 Ibid, 113-115.

other system that currently existed. This mirrored, to an extent, the various ideologies that were present in both Western Europe and America. Both of these regions had their own reasons for wanting to develop a supersonic aircraft, and Russia was no different. The core perception, that technological dominance could help to further both political and social agendas, was the same no matter what nation was working to develop this plane.[268]

Initial plans for a Soviet SST were founded in the design of a plane that was pushed forward in January 1962. Prior to that, the idea of building an SST had been discussed by various Soviet airplane manufacturers and politicians. Even though the Tu-144 and the Concorde had a generally similar appearance, the two planes were still radically different. Although the Soviets were able to obtain some technical data about the Concorde, they were unable to obtain all of the needed information as well as some of the more sophisticated systems that the Concorde used. The Soviets were still up to the task of developing it themselves, as they were quite capable of developing a working airframe as well as the powerful engines needed to push the airframe past the speed of sound.[269]

In 1968 the Russians managed to capture the feat of flying a supersonic commercial plane before any other nation. Their TU-144 took flight successfully for the first time on December 31st. This shocked the world, as few knew about the progress of the Russian SST.[270] It also was a major political boon for the Soviets as it showed that they could keep up with the breakneck technological advancements of the world in every

---

268 Ibid, 45-49

269 Ibid, 105-107.

270 Costello, *Concorde Conspiracy*. 152-155.

sector. Sputnik was to be but the first of their major technological leaps that was accomplished before anyone else.[271] The Soviets sought to use this plane as a propaganda piece as much as possible, and started flying it before significant and needed tests had been completed. The Russians needed to show the world their technological superiority.[272]

Some of the problems that all supersonic aircraft face remained unresolved in these aircraft, or had cut rate solutions. The Soviets had no measure for dealing with the heat of supersonic flight on the airframe, aside from internal air conditioning. The plane itself was not at all fuel efficient, and lacked the range of its Concorde counterpart. However, in 1972 after several major changes and redesigns, it entered into production. Initial optimism about the plane did not last long. In 1973 at the Paris Air Show, a production model of the TU-144 crashed into a small French village. This caused sizeable damage, destroyed the plane, and left both the crew and several others caught in the explosion dead. Not only was this a major political disaster for the Soviets, it also brought up concerns about the safety and viability of the design.[273] If the plane was to have any practical use, it had to be allowed to land at Western European airports as well as American ones. [274] The Concorde had been designed to match these concerns. The TU-144 had not, and this created difficulty in convincing other government aviation departments to let them land.

---

271 Ibid, 154.

272 Moon, *Soviet SST*, 132-135.

273 Ibid, 154-159.

274 Ibid, 154.

The Soviet plane suffered from many issues over its short run. It only flew as a passenger plane for one year. It ceased this service after another crash and was downgraded to transporting packages and as a test vehicle. Some of the issues with the plane can be traced to the lack of standards and testing on it. Considerably less time was spent on testing the TU-144 compared to the Concorde.[275] Also, as the Soviets were less concerned with economics, the plane's engines were not efficient, and thus although powerful, they consumed fuel far more rapidly than the Concorde which helped to limit its range. Furthermore, as the Americans ceased production on their own SST and the Concorde was limited to only fourteen aircraft in service, the Russians realized the SST project was not as important of a political propaganda piece as had once been thought.[276]

Overall, while the TU-144 was an impressive and powerful plane, it lacked the refinement, technological breakthroughs, and safety that the Concorde had managed to obtain. As the Soviet Union began to experience various economic issues in its efforts to keep up with the technology of the West, pet projects such as the TU-144 lost favor and funding. Lack of critical technical expertise, division in the Soviet aerospace industry, political mishandling, several major catastrophes with the planes themselves, and external political and technical events resulted in the first SST to be mothballed almost as soon as it was pushed into service. [277]

All three of these SST projects faced similar issues. In the 1960s, the major aerodynamic theories of supersonic flight were still new. New techniques for plane

---

275 Ibid, 172.

276 Ibid, 147-148.

277 Ibid, 230-238.

design and handling had to be developed regardless of the nation doing the research. Excessive heat generated at speeds past Mach 2.0 caused problems for certain common materials used in building aircraft. This required either limitations on the speed of the aircraft, or an entirely new approached to building materials for planes. Cutting edge materials, such as titanium alloys were capable of dealing with heat and stress better, but were also expensive and difficult to work with. Costs were always a concern, even in the Soviet Union. Costs were a central issue to the demise of all three programs. Billions of dollars were spent on developing and maintaining these planes and the concepts behind them. That kind of funding without a significant return on investment is concerning even to a government that cares little about expenses. These kinds of expenses caused political backlash as the various governments involved attempted to cut costs. None of the planes built managed to recoup costs for their developers due to their limited run and lack of customers. Without the expansive government support, these programs would have never succeeded.

In both Europe and America, the SST began as a political project. Both the Concorde and the Boeing designs received vast federal grants and related funding to develop and maintain these supersonic jets. As such, these projects became deeply intertwined with the politics of their respective nations, both for budgetary reasons but also as a part of the greater context of the Cold War. New commercial technologies were often used as both political and propaganda weapons, just as much as any traditional weapons development programs were partially used as propaganda against a rival nation.

Like any major technological venture, the research and development of a commercially viable supersonic plane was expensive. In the SSTs case specifically, it

was extremely expensive and only was able to make ground with large investments from both the government as well as individual corporations. Boeing was the primary American contractor that was used to design and develop an American SST; however other American corporations were involved in the process as well. But with any such project, corporate politics played a crucial roll in the survival of such a project. And as this particular project carried pressures both from governmental figures to complete it as well as of the high risk of limited to no returns on the investment made, corporate politics were extremely important to its survival.[278] Even with significant governmental backing, the economics behind the research and development of an SST were considerably difficult. Few companies were legitimately interested in applying that much capital to a project that might not pan out. And those companies that did invest eventually lost interest as the potential for returns decreased even further as the project dragged on during development. The commercial airline industry in general is not an economically viable one as the returns on even proven aircraft can be fairly limited. Therefore, the ability of a company to create an entirely new aircraft, one that is vastly different in terms of specifications and performance than any other aircraft, is difficult to continue simply in terms of risk.

Perhaps the most interesting element the contributed to the end of the SST era was environmentalism. One of the largest roadblocks for the American and Western European SST projects, as well as supporters of the SST on the whole, was the emerging field of environmental science. Environmental and atmospheric sciences had become more

---

[278] Rosenbloom, Joshua. "The Politics of the American SST Programme: Origin, Opposition and Termination." Social Studies of Science 11, no. 4 (1981): 403-23. http://www.jstor.org/stable/284775.

relevant in the 1960s with the advent of the Keeling curve in 1958. Even though both were relatively new fields by the turn of the decade, they had both managed to secure a substantial amount of funding and political sway. Both the National Oceanic and Atmospheric Administration and the National Center for Atmospheric Research were created and federally funded. Both of these organizations worked on studying atmospheric and environmental science, and their reports held weight with both the general public as well as policy makers in Washington. The primary environmental concern of the SST outside of fuel consumption and noise was its potential impact on the ozone layer.

Two types of environmental organizations existed that derailed efforts for widespread SST development and use. The largest and most influential were the government run organizations. These groups worked in tandem with other scientific organizations and were generally fairly tolerant of technological innovation. Many of these organizations were wary about the SST programs and their potential impact on the environment, but they were not outright hostile towards it. Non-profit or grassroots organizations that had no government ties and were simply groups of concerned citizens were often more disparaging of projects like the SST due to their large government subsidies, their apparent disregard for the environment, and the apparent wastefulness of such projects. And while these smaller groups did not have the direct government contacts and impact their government funded counter parts did, they still had their avenues of influence on policy and government.[279]

---

279 Owen, *Concorde and the Americas*, 91-97.

As atmospheric and climate science were both fairly new academic research at the time. Scientists who were working under government funded agencies had to prove that their work and research was valuable to the general public to continue to receive government funding. As the concern that SSTs might have a negative impact on the environment and the atmosphere arose, these scientists found themselves at odds with the project. The SST was also government funded; the scientists in these fields knew all too well how budget cuts could be damaging. And many of them agreed with the idea of the SST, but simply wanted the technology and its potential impacts to be better understood. They were forced to present funding requests in such a light as to where their concerns about the SST and the ability to study the atmospheric properties of supersonic flight would receive funding, but at the same time not damage the SST project as it was a massive project encapsulating both the private and public elements of the aerospace industry. Furthermore, the SST project was seen as a far more practical and useful enterprise for budgetary concerns than atmospheric science. Thus, these scientists had to couch their research in relation to the SST without making it seem like their research would kill this project which had already absorbed a decent amount of budgetary spending.[280]

As the cost of the SST program soared and new atmospheric research was released, atmospheric and environmental scientists began to increase in importance as advisors, even marginally, to Congress as they worked to either stop funding for the project or renew it. While doing so, these groups managed to better integrate themselves into the scientific community as well as show themselves as entities of importance to

---

[280] Conway, *High Speed Dreams*, 157-167.

government bureaucrats. Ultimately, the SST did end up forcing scientists to think of atmospheric science in a new light and with greater importance. The SST, even though it was partially defeated by environmental science, also helped to revolutionize one of the very things that halted its advancement. However, environmental factors still did play a large roll in the downfall of the American SST program, and had impacts on the British Concorde as well. Not only did they raise concerns about the potential environmental impacts of the SST, but they also brought the weak economic viability of these planes to the forefront of the arguments being used to support or denounce them. Similar concerns prevent further developments even today.[281]

Aside from atmospheric concerns, depletion of the ozone layer and over consumption of limited fuel supplies, the other major environmental factor that had the most widespread impact was the concern over sound.[282] Airports by their very nature are loud as huge planes are taking off all day and night. As any SST would have larger engines than any other civilian aircraft, concerns about how that would amplify the already obnoxious noise levels at airports, especially in America, abounded. This concern almost prevented the Concorde from getting authorization to land at certain American airports.[283] Aside from noise generated by the engines of the planes, the other largest concern was the sonic boom generated. In 1968 the United States banned commercial

---

281 Ibid, 149-156

282 Leary, Warren E. "Designing an SST: Noise, Sonic Booms and the Ozone Layer." The New York Times. April 10, 1990. Accessed March 04, 2019. https://www.nytimes.com/1990/04/10/science/designing-an-sst-noise-sonic-booms-and-the-ozone-layer.html.

283 Costello, *Concorde Conspiracy*, 233-240.

sonic booms over its territory. This helped to limit the role of the Concorde to mainly a transatlantic vehicle.[284]

Initial SST projects were primarily focused on simply designing a plane that could fly at supersonic speeds. As environmentalism was not a large concern at the time, the potential environmental impact from either the engines or the sonic boom was not a major consideration in terms of design. Later efforts, of which there were two in America, sought to overcome both of these challenges with newer technologies to make the plane more environmentally friendly. By this time, the environmentalist lobby had become strong enough that to develop a plane that had been partially defeated by similar groups in years prior would require their support. Otherwise it would have been required to at least develop a concept that they would not outright fight against. Neither of these efforts was able to develop an economical or environmentally friendly model and never made it past planning and design stages. However, some current research efforts are being made to reduce the sonic boom of a supersonic aircraft, increase potential range, decrease fuel consumption.

The history of supersonic commercial transportation is tumultuous. It started in the 1960s with high expectations and much fanfare, even as it was shadowed with concerns about practicality and economic viability. Billions of dollars were spent on research, developing new industries, and construction of the actual aircraft. Various governments, industrialists, engineers, and politicians all struggled to bring an SST to fruition. Only the Concorde flew out of the three major projects. And that plane stopped

---

[284] "Fact Sheet – Supersonic Flight." FAA Seal. September 19, 2014. Accessed March 04, 2019. https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=22754.

flights in 2003. Despite all of the efforts behind the SST, it still failed spectacularly. Countless hours of labor and billions of dollars spent resulted in one plane that had a limited lifespan. The SST was not without some extended benefits, however. Research into supersonic flight led to a better understanding of how air and planes behave at supersonic speeds. It also helped to foster development of related and subsidiary technologies in aeronautics and other fields. The development of the SST also provides an excellent example of the historiographical concept of technopolitics, as the interplay between supersonic commercial flight and the societies in which it was birthed is crucial to understanding the historical narrative behind it. Regardless, in the end, this massive global effort to push supersonic commercial flight to the forefront of the aviation industry failed, defying all expectation.

Bibliography

"50, 100 & 150 Years Ago." *Scientific American* 310, no. 6 (June 2014): 84. *Academic Search Premier*, EBSCOhost (accessed June 17, 2017).

Adams, Jay. "Concorde: Flight of the Imagination." Concorde: Flight of the Imagination | History Today. Accessed June 17, 2017. http://www.historytoday.com/jad-adams/concorde-flight-imagination.

Azerrad, Lawrence. *Supersonic: The Design and Lifestyle of Concorde*. Munich: Prestel, 2018.

Bedwell, Don. "Going Nowhere Fast." Going Nowhere Fast | Invention and Technology. Winter 2006. Accessed June 17, 2017. http://www.inventionandtech.com/content/going-nowhere-fast-0?page=show.

Committee, United States Joint Economic. "Annual Reports." The Supersonic Transport (92nd Congress) - Annual Reports - United States Joint Economic Committee. December 31, 1972. Accessed June 17, 2017. https://www.jec.senate.gov/public/index.cfm/1972/12/report-33714a5a-9fc7-4b8e-9ce1-2267d58b986b.

"Compromise Stalls Decision on SST for Three Months." In CQ Almanac 1970, 26th ed., 02-776-02-789. Washington, DC: Congressional Quarterly, 1971. http://library.cqpress.com.proxy.libraries.rutgers.edu/cqalmanac/cqal70-1295004.

"Congress Ends U.S. Funding of Supersonic Aircraft." In CQ Almanac 1971, 27th ed., 08-130-08-140. Washington, DC: Congressional Quarterly, 1972. http://library.cqpress.com.proxy.libraries.rutgers.edu/cqalmanac/cqal71-1252799.

Congress Provides $60 Million for Supersonic Transport." In *CQ Almanac 1963*, 19th ed., 502-5. Washington, DC: Congressional Quarterly, 1964. http://library.cqpress.com.proxy.libraries.rutgers.edu/cqalmanac/cqal63-1315802.

Conway, Erik M. *High-speed dreams: NASA and the technopolitics of supersonic transportation, 1945-1999*. Baltimore, MD: Johns Hopkins University Press, 2005.

Conway, Erik M. *Atmospheric science at NASA: a history*. Baltimore: Johns Hopkins University Press, 2008.

Costello, John, and Terry Hughes. *The Concorde Conspiracy*. New York: Scribner, 1976.

Drake, Frances, and Martin Purvis. "The Effect of Supersonic Transports on the Global Environment: A Debate Revisited." *Science, Technology, & Human Values* 26, no. 4 (2001): 501-28. http://www.jstor.org.proxy.libraries.rutgers.edu/stable/690166.

Edgerton, David. *The Shock of the Old Technology and Global History Since 1900*. London: Profile Books, 2006.

Enke, Stephen. "Government-Industry Development of a Commercial Supersonic Transport." *The American Economic Review* 57, no. 2 (1967): 71-79. http://www.jstor.org.proxy.libraries.rutgers.edu/stable/1821609.

Edwards, George. "Review Lecture: The Technical Aspects of Supersonic Civil Transport Aircraft." *Philosophical Transactions of the Royal Society of London. Series A, Mathematical and Physical Sciences* 275, no. 1254 (1974): 529-65. http://www.jstor.org.proxy.libraries.rutgers.edu/stable/74267.

Goddard, Stephen B. *Getting There: The Epic Struggle between Road and Rail in the American Century*. Chicago: University of Chicago Press, 1996.

Gordon, E., Dmitriĭ Komissarov, and V. G. Rigmant. *Tupolev Tu-144:The Soviet supersonic airliner*. Atglen, PA: Schiffer Publishing, Ltd., 2015.

Hackney, Donald I. "The Supersonic Transport as an Instrument of National Power." OAI. Accessed June 17, 2017. http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA510143.

Horwitch, Mel. *Clipped Wings: The American SST Conflict*. Cambridge, MA: MIT Press, 1982.

Howe, Joshua P. *Behind the curve: Science and the Politics of Global Warming*. Seattle: University of Washington Press, 2014.

Johnman, Lewis, and Frances M. B. Lynch. "The Road to Concorde: Franco-British Relations and the Supersonic Project." *Contemporary European History* 11, no. 2 (2002): 229-52. http://www.jstor.org.proxy.libraries.rutgers.edu/stable/20081830.

Keitch, Charlie, and Josh Blair. "What Impact Did the First World War Have on Aircraft and Aerial Warfare?" Imperial War Museums. December 7, 2017. Accessed April 07, 2019. https://www.iwm.org.uk/learning/resources/what-impact-did-the-first-world-war-have-on-aircraft-and-aerial-warfare.

Leary, Warren E. "Designing an SST: Noise, Sonic Booms and the Ozone Layer." The New York Times. April 09, 1990. Accessed June 17, 2017. http://www.nytimes.com/1990/04/10/science/designing-an-sst-noise-sonic-booms-and-the-ozone-layer.html?pagewanted=print.

"Message to Congress: Johnson on Transportation." In *CQ Almanac 1966*, 22nd ed., 1272-77. Washington, DC: Congressional Quarterly, 1967. http://library.cqpress.com.proxy.libraries.rutgers.edu/cqalmanac/cqal66-1299820.

"Message to Congress: Kennedy on Supersonic Transport." In *CQ Almanac 1963*, 19th ed., 982. Washington, DC: Congressional Quarterly, 1964. http://library.cqpress.com.proxy.libraries.rutgers.edu/cqalmanac/cqal63-1315128.

Moon, Howard. *Soviet SST: The Technopolitics of the Tupolev-144*. New York: Orion Books, 1989.

Mumford, Lewis. *Technics and Civilization*. Chicago, Ill.: The University of Chicago Press, 2010.

NASA. Atglen: Schiffer Publishing Ltd, 2012.

Nye, David E. *Technology Matters Questions to Live with*. Cambridge, MA: MIT Press, 2007.

Orlebar, Christopher. *The Concorde Story*. 7th ed. Oxford: Osprey, 2011.

Owen, Kenneth. *Concorde and the Americans: International Politics of the Supersonic Transport*. Shrewsburg: Airlife, 1997.

Portree, David. *NASA's Origins and the Dawn of the Space Age*. Washington, DC: NASA History Division, Office of Policy and Plans*, NASA Headquaters, 1998.*

Rose, David. "Concorde: The Unanswered Questions." The Guardian. May 13, 2001. Accessed March 04, 2019. https://www.theguardian.com/world/2001/may/13/davidrose.focus.

Schivelbusch, Wolfgang. *The Railway Journey: The Industrialization of Time and Space in the Nineteenth Century.* Oakland: University of California Press, 2014.

"Second Supplemental Cleared After SST, Transit Fight." In *CQ Almanac 1971*, 27th ed., 08-142-08-151. Washington, DC: Congressional Quarterly, 1972. http://library.cqpress.com.proxy.libraries.rutgers.edu/cqalmanac/cqal71-1252834.

Stratford, Alan H. *Air Transport Economics in the Supersonic Era*. London: Macmillan, 1973.

"Supersonic Transport." In *CQ Almanac 1965*, 21st ed., 881. Washington, DC: Congressional Quarterly, 1966. http://library.cqpress.com.proxy.libraries.rutgers.edu/cqalmanac/cqal65-1258089.

Tenner, Edward. *Why Things Bite Back: Technology and the Revenge of Unintended Consequences*. New York: Knopf, 1997.