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The next generation of commercial supersonic flight:

understanding the industry and the consumer perspectives



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Abstract

Background: For decades, the speed of commercial aviation was constrained by the sound barrier. However, recent noticeable growth in air traffic and the recognition of the "time" as a valuable asset for passengers, call for more efficient, faster commercial transport. The commercial supersonic flight, able to fly above the speed of the sound has not been around ever since Concorde made its last trip in 2003, but it is promised to be on its way back. Currently, several existing and emerging companies are competing to revive the concept by developing and launching efficient supersonic plane between 2020-2025. The aircraft could operate on long-haul intercontinental flights about 2.6 times faster than current subsonic airplanes, targeting primarily business travelers. However, such a technological leapfrogging innovation embodies several engineering, economic, environmental and other factors, vital for its commercial success.

Purpose: The overall purpose of this master thesis is to investigate which factors could ensure the success of the upcoming supersonic commercial flight. The research will examine whether the new generation of supersonic planes can achieve maintainable commercial success by introducing industry expert opinions and exploring the perceptions of potential passengers towards supersonic flight as a possible future transportation mode.

Method: The limited literature on the subject created the need for descriptive research to expand the understanding. The chosen deductive approach relies on adopting the theoretical conceptions on the Theory of Disruptive Innovation and the Extended GAP Model of Service Quality. Pragmatic research philosophy is used due to the fact that it was deemed necessary to pursue multiple views to enable best answering the research questions. Qualitative interviews with ten industry experts have been conducted, capturing both the market specifications and the technical functions of the planes. Furthermore, 28 potential consumers who have flown in a business class on a long-haul flight gave valuable insights on the service quality perceptions.

Conclusion: The results show that demand for supersonic flight exists and people are willing to use it as long as the plane satisfies their expectations of service quality. Based on the predictions of industry experts and the high level of curiosity of the potential customers interviewed, and their positive perceptions towards using it, the commercial supersonic flight has the scale possibility to be highly successful. However, the upcoming supersonic aircraft should find a balance between the main service quality attributes, such as speed, comfort, convenience, and safety, in relation to the economic, environmental, and engineering challenges.

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We hope you will find the thesis interesting and enjoyable.

Disclaimer

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Glossary and abbreviations

The following terms are going to be used during this thesis.

Mach: A term to indicate the speed of an object in the medium through which the object is moving, with Mach 1 being the speed of sound.

Type rating: Certification of a pilot to be allowed to fly a certain type of aircraft that requires additional training on top of the regular license and aircraft class training.

Disruptive innovation: A non-breakthrough innovation that comes with a major improvement. The disruptive innovation makes something affordable and accessible to a much larger population that did not have access to it in the past.

Upgrade: When a passenger gets a better seat than he or she paid for on board of a commercial aircraft. This could be due to a full economy class and unoccupied seats in business class. Upgrades can either be free of charge or they can be purchased last minute for a lower price than the original one.

The most common abbreviations are listed below.

BA: British Airways

AF: Air France

M.: Mach

DI: Disruptive Innovation

Outline of the study



Chapter 1 Introduction

This chapter aims to provide the reader with an overview of the thesis topic. Background to the air travel industry will be given as well as a discussion of the retired supersonic commercial aircraft "Concorde" and the problem that will be addressed in our study concerning the upcoming generation of supersonic transport. This chapter will be concluded by stating the purpose as well as the two research questions that will be answered throughout the thesis.

1.1 Background

Air travel is continuing to experience the fastest growth among all modes of contemporary transport. The International Air Transport Association (IATA) expects 7.2 billion passengers to travel in 2035, a near doubling of the 3.8 billion air travelers in 2016. Moreover, the global aviation industry is expected to reach up to 38.4 billion profits in US dollars in 2018, compared to 'only' 8.3 billion US dollars in 2011 (IATA, 2016). The revenues from passengers (business solely) are expected to grow by 9.2% from 532 billion in 2017 to 581 billion US dollars in 2018. Strong performance is supported by an expected GDP growth of 3.1% for the passenger transportation mode, which is the strongest since 2010 (IATA, 2017). According to the Airbus forecast of global market trends for the period 2016 - 2035, an increase of 95% is anticipated for the long-haul traffic (Airbus, 2016). Moreover, Boeing's current market outlook (2015 - 2034) is also forecasting growth of 5% annually (Boeing, 2015).

The air travel industry plays a key role in the service sector itself, as well as it contributes significantly to other industries through the ability to transport passengers to their required locations all over the globe (Rhoades, 2008). The noticeable growth in air traffic calls for more efficient, faster commercial transport. The favorable figures attract competition and development of innovations on the market. The market itself has been and is, growing rapidly, but the technology seems to have stagnated. The time required to fly across the Atlantic Ocean is no different than it was 40 years ago which is remarkable for such a big industry (Dourado, 2016). The market growth and the increased demand in intercontinental flights set a quite promising ground for developing high-speed commercial airplanes.

1.2 Research problem

Nowadays, the commercial supersonic flight is not around anymore, but it is promised to be on its way back, and several companies are competing to revive the concept. This thesis will provide more insight into the phenomenon of supersonic flight, which already existed in the past but failed to achieve maintainable commercial success. A successful commercial supersonic plane will give passengers the ability to get from one place in the world to another in a way that they have not been able to fly since Concorde retired in 2003.

Supersonic transport (SST) is a civilian supersonic aircraft that can transport passengers faster than the speed of sound. The speed of sound depends among other things on the

air temperature and humidity; a relationship embodied in the term **Mach**¹. It indicates the speed of a certain object compared to the speed of sound. Mach 1 is exactly the speed of sound. However, it is a real challenge to balance the concerns raised by supersonic flights in the past with the benefits offered by the high speeds (Sun, 2017).

Aviation is the fastest-growing source of greenhouse gas emissions in the world with a more substantial impact on the atmosphere and climate (Economist, 2006). Conventional aircraft manufacturers have been continuously working to reduce fuel burn through the use of lighter materials and novel engine designs. Still, this remains one of the most robust sectors to decarbonize. It is known that 2% of the total CO₂ emissions in the world belong to the air travel industry (ACRP, 2011). The environmental concerns among which are - noise around airports, sonic boom (which prevents supersonic flight over land), climate change, depletion of atmospheric ozone, local air quality, fuel inefficiency, polluting emissions, cosmic radiation, etc. raised by Concorde have been the major barriers for future civil supersonic aircraft (Sun, 2017).

For decades, the speed of commercial aviation was constrained by the sound barrier. A fundamental issue preventing the return of supersonic flight is the sonic boom which is not acceptable when flying over populated areas. In this sense, the new generation of upcoming supersonic jets that burn fuel at higher rates than conventional planes seem to go in precisely the opposite direction — even if they will save travelers time. Avoiding dangerously substantial temperature increases have been already a problem of the 21st Century, thus a new fuel-inefficient, possibly polluting plane seems like a real concern (Plumer, 2016). Critics argue that it will make luxury travel even more luxurious for a few people, and more inhumane for the rest.

The public's perceived acceptance of the supersonic aircraft is still highly uncertain, although it is a revolutionary and exclusive innovation that has the real opportunity to make crossing the globe possible within a brief time, taking that "time" is considered to be the most valuable resource that people have. The transatlantic routes are in great demand for business transports, thus having a supersonic flight would make a one-day return possible from London to New York. Recognition of the value of time has led to increased interest in the feasibility of supersonic jets and turns out to be the "big selling point" for the supersonic transport. A new supersonic commercial aircraft could reduce long-range flight by about 50% making it an attractive value proposition for business and VIP travel (Sun, 2017).

Affordable, reliable, and safe air transportation is important to the quality of life and economic growth (Committee on Breakthrough Technology, 2001). Currently, the airline industry might be on its way to make one or even two steps forward by re-introducing commercial supersonic flight with the combination of improved and new technology. The SST has the potential to be a promising **disruptive innovation**² which could reshape the airline industry by putting into operation affordable and accessible high-speed airplanes that will be spread to a larger population (Morgenstern, 2017).

¹ A term to indicate the speed of an object in the medium through which the object is moving, with Mach 1 being the speed of sound.

² A non-breakthrough innovation that comes with a major improvement. The disruptive innovation makes something affordable and accessible to a much larger population that did not have access to it in the past.

1.3 The Concorde era

The commercial supersonic flight had been struggling to be efficient enough to become a maintainable commercial method of transportation from 1976 till 2003. At that time, three economic blocks were developing supersonic passenger planes, namely the Soviet Union, Europe and the US and were investing massive subsidies into these projects. The Soviet plan was mostly about attaining prestige and power. However, in the US the project was halted during the development stage for economic reasons (Van den Ende, 2008).

The first commercial supersonic flight became a reality in 1976 due to the joint efforts of the Concorde programme operated by the British and the French government. This programme was not uncoincidentally called Concorde. "Concorde's name, meaning harmony or union, reflects the cooperation on the project between the United Kingdom and France" (Prigg, 2016).

Partly due to economic inefficiencies very few passengers have enjoyed the primary time-saving convenience of a supersonic flight. Both the Concorde (M. 2.04) (Prigg, 2016) and the Soviet Union's Tupolev Tu-144 (M. 2.35) (Bartley, 2006) faced early retirements for different reasons. The Concorde aircraft operated by Air France and British Airways used an extensive amount of fuel and was much more expensive to operate than other planes of similar sizes. They were abrasively loud to operate (sonic boom of 104 PLdB), and multiple environmental concerns arose which made traveling over land very difficult, leading to a ban on supersonic flights over U.S. territory. At that time, supersonic flights were not considered as a commercially profitable opportunity due to the high operational costs.

Moreover, all the orders for the Concorde were canceled when the Tupolev Tu-144 crashed during an air show in 1973, killing 14 people. This made the many airlines that placed their orders for this aircraft doubt too much whether a supersonic plane would be ready for safe commercial flight and, therefore, cancel the orders they had placed. Due to this, the joint programme of the British and the French government became a very expensive one. In the end, British Airways and Air France were the only users of the Concorde planes because at that time these airlines were basically forced by their governments to take the fourteen newly produced Concorde commercially available into their fleet. Seven of these were for the fleet AF, and the other seven were for BA's fleet.

These airlines, however, were not very enthusiastic in the first place. BA purchased the Concorde for the symbolic amount of 1 pound per plane, while Air France got them for 1 Franc each. This made the Concorde profitable for the airlines since the first day of operating. Rumors were going on that the Concorde was not profitable, but since the airlines did not have to pay for the actual planes these rumors were simply not true. This actually meant that the planes were financed by the British and French taxpayers since the governments of these countries financed the Concorde development programme.

Being a very uncommon plane with many special characteristics compared to regular, subsonic commercial passenger planes, Concorde required a special training programme for pilots in order to be able to fly this plane. Today's **type rating**³ training takes about four weeks to complete, the conversion course for the Concorde took up to five months

³ Certification of a pilot to be allowed to fly a certain type of aircraft that requires additional training on top of the regular license and aircraft class training.

(BAA Training, 2015). The difference in training, thus, is significant. The training was therefore also very expensive. At the time it was “every pilot’s dream” to join the Concorde programme and be one of the few pilots to fly this very special plane.

Concorde made its last flight in 2003 due to multiple reasons. One of the main reasons was Airbus’ lack of support for maintenance to this plane with outdated instruments after this period. One Concorde crashed in July 2000, shortly after taking off and 113 people died during this accident. Then, the terrorist attacks of September 11, 2001, drastically led to a change in the airline travel industry and the number of airline passengers significantly diminished in the following years. Currently, international commercial airplanes are restricted to subsonic speeds of M. 0.85 and top business jets fly at around Mach 0.9 (Freed, 2017).

1.4 The new market players

Since the Concorde era, several enterprises engaged in developing entry models of supersonic business jets and yet they all went bankrupt. Currently, the promising key players are relying on venture capital funding models. All competitors listed in *Table 1* below are planning to launch supersonic planes between 2020-2025. All these projects originated in the United States are designing for much smaller supersonic aircraft than Concorde targeting business executives and the high-income individuals.

The most prominent potential market sector is predicted to be North America, with an estimated need for 377 aircrafts while European carriers would be the second-biggest with a requirement for more than 360 jets. Nowadays, America accounts for roughly 44.4% of all flights and Europe accounts for 33.1%. The Middle East and Africa regions could be the third-biggest customer group with about 250 airplanes while the Asia-Pacific and China sectors could potentially take 200 planes. In total 1,300 aircraft worth around \$260 billion will be required in the next ten years (AviationWeek, 2016). The market potential size decreases with increasing passenger capacity as very few city pairs will bear enough demand for bigger aircraft, and on the other hand, the total number of passengers can be distributed to fewer planes. However, the cost per passenger will be significantly lower with larger aircrafts due to economies of scale (Liebhardt, 2011).

Moreover, the existing ban on supersonic overland imposes a severe cap on the potential market size since roughly half of all passenger flights would occur over United States (AviationWeek, 2016). Currently, there are no existing carbon dioxide regulations on European or international levels considering the next generation of supersonic aircraft. In 2020, the International Civil Aviation Organisation (Icao) expects to develop a standard and begin certifying (ICAO,2018). From one side, new data is needed to develop these standards and not to rely on historical data from Concorde. However, once the new market players build prototypes, the standards most likely will be set around the technology, because of the money that has already been invested in it. The problem that is likely to arise is the typical “a chicken and egg situation” where the market should be driven by the standards and not the other way around (Neslen, 2017).

On the other side of the market are airlines which will run supersonic jets and will need to integrate a premium product into their existing fleets and charge premium fares to cover the high operating and purchase costs. The greatest expenses of adding a supersonic

plane will certainly result from ownership and fuel consumption (Liebhardt and Lütjens, 2011). Hence, it is uncertain how many airlines would like to purchase supersonic planes for the average price of \$150 million each considering that the traditional business class services of subsonic jets are already proven profitable strategy (Traveller, 2018).

Boom Supersonic Inc. and Aerion Corp. are the major competitors whose jets would only fly supersonic over water. Thus, they could coexist with the current ban on overland travel. One can see in the table below that Boom's plane would cost almost double than Aerion's but will be able to carry on board five times more passengers and is aiming to be the fastest among the considered ongoing projects (Boom, 2018). As cruise Mach increases, the most efficient engine bypass flow ratio diminishes, causing high jet velocities and high noise at take-off. By following this, all the presented competitors except Boom Supersonic aim for a moderate speed of Mach 1.4 to 1.6. Higher Mach numbers increase engine and airframe temperature of the plane, and higher fuel consumption drives market acceptance through potentially higher fares (Kroo, 2005).

A big problem is that Aerion and Boom's aircraft will only be able to fly around 8,300km without refuelling. Hence, for the passengers paying a premium price to get to their destination quickly, a refuelling stop could defeat the purpose (The Economist, 2018).

The market of supersonic jets flying solely overseas is relatively limited, thus designing a plane that does not produce high sonic booms and can operate over land sounds more logical. This innovative idea is under development by NASA partnering with Lockheed Martin and Spike Aerospace partnering with Airbus Group who strive to change the way the air flows around an airplane in an attempt to eliminate the shockwaves. Those companies are looking for a solution which can overcome the ban on supersonic flights over the US (Dowling, 2016). They strive to make a quiet airplane that is thin, light and small volume as possible which on the other hand does not allow many passengers on board, considering that sonic boom intensity is very sensitive to the number of passengers. However, NASA has the ambition to launch aircraft that can fly over land and transport 120 people (NASA,2017).

Company and Partner	Name of a plane	Target Speed	Passengers	Sonic boom	Range	Sales price of a plane	Specifications
Boom Supersonic Inc.	XB-1	Mach 2.2 (2,300 km/h)	55	only over-water itineraries	4,500 nmi (8,334 km)	\$200m.	carbon-fiber composites, turbofan three engines that are more efficient, quieter, and more environmentally friendly
Aerion Corp. and GE Aviation	Aerion AS2	Mach 1.4 (1,487 km/h)	12	only over-water itineraries	4,500 nmi (8,300 km)	\$120m.	dynamic curves along the fuselage to optimize aerodynamics and three engines, laminar flow design
Spike Aerospace Inc. and Airbus Group	S-512	Mach 1.6 (1,700 km/h)	18	70 PLdB (quite enough to permit flight over land)	6,200 nmi (11,500 km)	\$100m.	windowless with panoramic interior displays of the view outside, twin-engine design

Lockheed Martin and NASA	QueSTT X-plane	Mach 1.4 (1,487 km/h)	120	75 PLdB (quite enough to permit flight over land)	5,500 nmi	\$300m.	single engine on top of the plane, unique design which shockwaves produce a diffuse "sonic thump" instead of the usual boom.
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Table 1: Main characteristics of the key competitors in 2018

1.5 The case of Boom Supersonic Inc.

For this thesis, the authors will refer to the furthest advanced of the presented above supersonic jet projects - the company Boom Supersonic. It aims to build the fastest, medium-size supersonic jet that will fly overseas (Boom, 2016).

After a decade of a lull, the start-up company Boom Supersonic Inc. launched in 2014 in Denver; Colorado started actively working on producing the world's first successful commercially viable supersonic aircraft. The founder/CEO is the thirty-six-year-old Blake Scholl, former Amazon manager, technology entrepreneur and certified pilot. The company hopes to test a prototype of the Boom XB-1 by the end of 2018 and have the full-sized aircraft in operation by 2023. In the past, the supersonic flight has been the province of governments and militaries. The XB-1 is the first independently developed and privately-funded supersonic jet aiming to break the sound barrier ever since Concorde's attempts (Boom, 2016). The commercial supersonic flight could have a big impact on the airline industry. If Boom Supersonic manages to succeed their new concept of supersonic flying, it will potentially have a significant impact on the airline industry which is enormous and yet still growing. Last year, the revenue of commercial airlines worldwide was over 750 billion U.S. Dollars (Statista, 2018).

Boom's airliner is designed to maximize efficiency while producing at least 30 times quieter, 10% faster and a lot smaller size of a plane than Concorde. The Concorde's sonic boom reached 100-110 decibels, which is comparable to the sound of an explosion. A noise limit of 80 decibels would allow supersonic jets overland which has not yet been achieved (Hammond, 2016).

The Supersonic plane will be 2.6 times faster than any other airliner in operation which aims to remove the current travel barrier known as "long flight" (Boom, 2017). However, supersonic flight still will be feasible only over oceans due to the high level of shock waves and excessive sound, emissions and various costs involved (Scholl, 2016).

The Boom XB-1 plane would be able to travel from London to New York in about 3 hours and 15 minutes carrying up to 55 premium passengers on board. As another example, the distance between San Francisco and Tokyo would take a little over 5 hours, compared to the current 11, through reaching a speed of Mach 2.2. With 500 viable daily routes, the untapped market opportunity is for 1,000 supersonic airliners (Pettit, 2017).

Boom Supersonic established a recent partnership with Japan Airlines (JAL), one of the world's leading passenger flight providers. JAL has invested \$10 million into Boom and is also providing help with aircraft design and with certain aspects of the in-flight passenger experience. As part of this arrangement, JAL also has the opportunity to purchase up to 20 Boom Supersonic aircraft once they become commercially available. This adds to the

total of 76 existing orders from five global airlines - such as Virgin Group that the company has already received (Etherington, 2017).

Nowadays, travellers pay higher amounts of money for business class tickets, even though those seats do not arrive any sooner than economy. Passengers in all service classes pay a premium for non-stop (vs. connecting) service, thus it is reasonable to expect that the Supersonic passenger ticket will be of higher fares for the faster service that it provides. However, the airliner will enable fares 75% lower than Concorde and about the same price as today's business class services of about \$5000 a seat on a return flight. Moreover, there are cost saving factors associated with a supersonic flight that need to be considered as value-added benefits - such as saved executive time, saved hotel expenses and saved meals and entertainment expenses (Boom, 2016).

However, it is unclear whether or not the supersonic plan will be successful. The company Boom presents itself as a solution for most of the reasons why Concorde was not as successful as initially was hoped for. The information which is provided by Boom is only from one perspective, and they would never want to 'undersell' themselves, which is why the information could not be fully objective.

1.6 Purpose of the research and research questions

The overall purpose of this master thesis is to investigate which factors could ensure the success of the upcoming supersonic commercial flight. The research will examine whether the new generation of supersonic planes can achieve maintainable commercial success, a task which was unsuccessfully executed by their precedent Concorde. The research intends to show the reader how the new solution could differ from Concorde and will introduce industry expert insights into the subject at hand. Furthermore, the study will encompass and thoroughly explore the target passengers' point of view and their perception of supersonic flight as a possible future transportation option.

All of the considerations above lead to the two main research questions of the research project:

- 1) How could the next generation of commercial supersonic passenger flight be viable and successful?**
- 2) What is the perception of the target group and their willingness to change to supersonic flight service?**

Chapter 2 Theoretical framework

This framework consists of two main theories. The first theory is on disruptive innovation, which is a crucial component for understanding the adoption of innovations and the changes they can have on existing marketplaces. The second one is the Extended Gap model of Service Quality, addressing consumer expectations and perceptions of service. The model provides five gaps that are believed to represent the discrepancies that arise between the marketer and the consumer in order to analyse and conceptualize service quality.

2.1 Theory of disruptive innovation

Companies can have troubles to succeed due to weaknesses, but well-managed organizations that have their competitive advantage and invest in new technologies can still lose market dominance. It can happen in both fast- and slow-moving industries (Christensen, 1997, p. 7). This could potentially happen to the first- and business class sections of regular commercial travel as well if there emerges a swift towards flying supersonic. Since there is no other supersonic commercial aircraft at the moment, it is hard for airlines to determine what effect a re-introduction of commercial supersonic flight will have on the market.

Innovation is essentially about learning and change and is often disruptive, risky and costly. The object of innovation can be classified as things (products and services), or as changes in the way, companies create and deliver products and services (processes) (Assink, 2006). In general, companies that have succeeded in disruptive innovation initially took the characteristics and capabilities of the technology for granted and then aimed to create a new market that would value and accept those attributes (Christensen, 1997, p. 150). The same applies for commercial supersonic passenger flight; the technology is available to be used, but there has not been found a way yet to make it a commercial success. Innovation is driven by the ability of companies to see connections, to spot technological and market opportunities and to take advantage of them (Tidd, 2005). By designing a new airplane, the new industry key players strive to make it successful by touching the already existing business class travellers that could pay similar prices for their supersonic tickets. The upcoming supersonic generation of flights strives to provide a fast solution and disrupt the associated sonic boom. The belief is that customers will value the attributes that companies such as Boom Supersonic have to offer (high speed and exclusive comfort) over comfort and less speed.

Disruptive innovation (DI) is not a breakthrough innovation that makes good products a lot better, but it has a very specific definition, that is "it transforms a product that historically was so expensive and complicated that only a few people with a lot of money and a lot of skill had access to. A disruptive innovation makes it so much more affordable and accessible that a much larger population has access to it" (Harvard Business Review, 2012). Further, researchers contributed to the theory by providing a more general measure of disruptiveness by including the notion of high-end innovations. They define the high-end disruptions as disruptive innovations having improved technology and a lower end price (Govindarajan, 2006).

Furthermore, '*disruptive innovation*' can serve as a "game changer" on the market. It is a powerful way to create and to sustain business growth (Georgantzias, 2005). The outcome is superior to what exists on the market by design, technology, and performance and it is often considered as a "point of differentiation" employed by manufacturers. However, the purpose of the supersonic plane is not to replace highly efficient subsonic aircraft but to beneficially disrupt the existing market by introducing an extraordinary, innovative and improved transportation mode (Chudoba, 2008).

Disruptive technologies generally improve at a parallel pace with established ones – their performance trajectories do not intersect. In general, they do not have to and do not need to surpass the performance of the existing products because they establish a specific market segment (Christensen, 1997, p.51). However, other researchers argue that the goal of creating a disruptive innovation is to become a successfully exploited product, service or business model that significantly transforms the demand and needs of an existing market and disrupts its former key players (Thomond and Lettice, 2002). The research on disruptive innovation states that start-up firms have a better chance of success because of their smaller sizes, shorter (path-dependent) histories, and limited commitments to established value networks and technological paradigms (Macher, 2004).

The performance is often initially weaker compared to the existing solutions because it takes time from the point where people try out the new product/service and spread out their experience until they eventually switch and become loyal to it. Review of the literature suggests that people who would try the innovation first are often the ones willing to pay a high initial price due to greater resources and the pursuit of social status (Govindarajan, 2006). Over time, the disruptive innovation expands, firms reinvest profits in improving the product/service and introduce subsequent offerings more appealing to the mass market. For instance, cellular phones are considered being a disruptive innovation with an initially higher price. They were first accepted by corporate executives who appreciated its convenience and portability. When the product reached the mainstream market, target customers still preferred landline phones because of their reliability, cost, and coverage. However, further developments in cellular technology allowed it to offer reliable coverage at a price point that satisfied the needs of the mass, which caused the disruption (Yu, 2010). Thus, a disruptive innovation could be described as a process rather than a single event (Christensen & Raynor, 2003).

To be successful at launching and continuously growing a disruptive model, a business needs to become aligned with the disruptive context in all its critical aspects: vision, decision making, business processes and cost specifications. The performance of an innovative airplane relies on technological specifications as well as market characteristics. Each is uncertain on its own, and they are even more difficult to consider jointly. For example, the cost of flying at different speeds and the customer demand for different duration travel times between cities combine both engineering challenges and market forces (Greve, 2015).

Studies have focused on how innovations are perceived by consumers, which is usually tested by their behaviors and reactions to the offering and how these may change with time and experience (Kim, 2009). In fact, people who adopt an innovation early have different characteristics than people who adopt an innovation later (Nuttley, 2002). The book "Crossing the chasm: Marketing and Selling Disruptive Products to Mainstream Customers" argues that "the customer list and size of the order can look the same",

though “the basis for the sale... is radically different” (Moore, 2001). Therefore, one might assume that the passengers of Concorde 20 years ago might share different values than the ones who will have the opportunity to fly on a supersonic aircraft in the near future. Furthermore, the establishers of the Concorde had focused on continuing the development of the aviation industry, rather than focusing on the needs of the customers in the aviation market. As a result, Concorde delivered more performance (reducing travel times over long distance), but less value, to the consumer which is the main driver for innovations success (Besrour, 2016).

Eventually, passenger demand for supersonic tickets might turn out higher than expected if the service’s appeal to premium passengers is underestimated or if numerous new passengers appear - tourists, previous non-flyers or habitual private jet users (Liebhardt, 2017). In fact, the opposite scenario is also possible if the market offering is not in line with the consumers’ demand and perception of service. Theory on disruptive innovation has often been perceived as rather pessimistic regarding the ability of established firms to succeed in these shifts. The main reason for this appears to be that the success of firms is controlled by forces beyond their own boundaries (customers) (Sandström, 2010).

Companies who want to be successful by introducing a disruptive innovation should be able to not just meet customers’ current needs but anticipate their unstated or future needs (Govindarajan, 2006). Disruptive innovation theory is based on the fact that the reasons that contribute to a firm’s success can also play a significant role in its failure when it comes to the introduction of new technologies that do not meet their customer’s need (Gemici, 2015). Therefore, understanding customer needs is deemed to be crucial, and it plays an extensive role in the current research. However, to the majority of the customers, the current transportation solutions are their frame of reference, so it could be very difficult to think about a service that potentially could be highly disruptive in the future and for which currently the social media channels do not provide much information on the topic.

To summarize, the Disruptive innovation theory seeks to explain changes and new entries into markets. The result of disruptive innovation could be evaluated when mainstream customers switch to the new disruptive product/service that is gaining market share on the market (Corsi, 2014). Many disruptive technologies combine both new-market and low-end approaches. For instance, on the opposite side of the air transportation market, low-fare airliners target both the low-end of the market and the non-consumption (people who drive cars or travel by international bus lines).

In its early development stage, each product based on a particularly disruptive technology could only serve niche segments that value its nonstandard performance attributes (Yu, 2010). In the case of Supersonic aircraft niche, the goal is to pull customers out of the traditional business passenger service into the new offering. It is likely that private, business individuals will be happy with a supersonic passenger jet whenever it occurs. However, as competition in the market develops, launching plans of the key players may increase in significance as a discriminating factor – especially when huge investments are involved (Christensen et al., 2011).

The historical case studies executed by the DI theory author Clayton Christensen are considered having rich empirical data on the success of various disruptive innovations. However, the real challenge to this theory is the extent to which it can make predictions

on future disruptive innovations (Danneels, 2004). The key to avoiding the negative effects of disruptive technologies is to focus on what is happening with the customer and operational needs (Yu, 2010). A later research application of the DI theory suggests that consumers' decisions to purchase a product or service follow a progression based on a hierarchy of attributes referred to as the "basis of demand" and which generally occurs in the following order: functionality, reliability, customer convenience, and cost.

	ATTRIBUTE	EXPLANATION
1.	Functionality	Presuming the basic requirement to reach their destination is met, can be defined in terms of performance requirements, flight duration, environmental damage. Innovation in this category means adding a feature to the product, thus increasing its functionality.
2.	Reliability	Refers to the ability of a firm to perform promised service dependably and accurately. Reliability can be described primarily in terms of flight safety and security.
3.	Customer convenience	Involves passenger experience, facilities (e.g. cabin environment, seat comfort), service accessibility, flight frequency that reassures customers' comfort.
4.	Cost	Customers are willing to pay a higher price if their expectations for high functionality and reliability standards are covered (Christensen et. al, 2011). However, along with the financial costs, there are also intangible costs. These include psychological factors such as stress incurred by using the product, as well as factors such as the negative impact on the environment.

Table 2: Consumers' criteria for evaluation of disruptive innovation (Christensen et al., 2011)

Customers typically compare products to evaluate which option meets their requirements in each of the "basis of demand" touch points. However, it should be noted that the progression is typical, not absolute, meaning individual customer segments may follow variations of this hierarchy – for example the "cost" factor could be the most significant for the target consumer group and thus appear before customer convenience or functionality (Christensen et al., 2011).

The air travel industry is part of a steadily growing service sector (Lovelock and Patterson, 2004). This service sector is associated with strong customer involvement. It is suggested that the three fundamental factors that affect passenger demand in the air travel industry are incomes, fares and service levels (Hanlon, 1999). Hence, we introduce the Extended Gap Model of Service Quality to understand better on which purposes customers, on the individual level, would adopt a service innovation.

2.2 Extended Gap Model of Service Quality

The role of service quality is widely recognized as being a critical determinant for the success of companies, considering the increasing competition. Zeithaml et al. (1990, p.

19), defines service quality “as the extent of the discrepancy between customers' expectations or desires and their perceptions.”

At the same time, consumers are getting more aware of rising standards in service have developed higher expectations (Frost, 2000). Customer services expectations towards service quality could be divided into two levels: adequate and desired. The former level of expectations represents the “acceptable” level of service by the consumer, while the latter represents a service a consumer desired to be performed (Parasuraman et al., 1991).

Parasuraman et al. (1985, pp.41-50) have formulated a service quality model that highlights the importance of the main requirements for a successful delivering of high-quality service. The Extended Gap model of Service Quality presented below will serve as a theoretical foundation that will explain possible gaps that could be filled, and it includes both the perspective of the targeted passenger and the marketer.

The model illustrates five gaps which display the causes for unsuccessful service delivery. Those gaps need to be closed to enable companies to deliver service that satisfies their customers (Parasuraman, 1985). Accordingly, passengers will judge supersonic flights based on their perceptions of service quality.

Importance of quality of service has demonstrated its positive relationship with future purchase intentions of customers (Babin, 2016). When a perceived value is low, the customer will be less willing to try a service, even if the latter is claimed to be an innovative solution (Frost, 2000).

Customer perceptions and expectations of service quality are increasingly used to forecast company profitability and success and in this case the willingness of premium passengers to change to supersonic service. Service quality involves a comparison of expectations with performance: it is a measure of how well the service level delivered matches customer expectations on a consistent basis (Parasuraman, 1991).

For this research, it is important to gather an in-depth understanding of the consumers' target population by collecting data that will help or hinder the success of such a solution. It should be noted that perception and expectation are both subjective, which is why this model will only serve for qualitative research. Previous researchers argue that customers do perceive quality in more than one way and they also have perceptions about multiple factors when quality is assessed (Zeithaml and Bitner, 2000).

Parasuraman et al. proposed a service gaps model indicating five gaps that are likely to affect service quality:

Gap 1: Consumer expectation-company perception gap - represents discrepancy between consumer expectations of service quality and management perceptions of these expectations. Companies may not always understand what features a service must have to meet consumer needs and what levels of performance on those features are needed to bring high-quality service. This results in affecting the way consumers evaluate service quality. The reasons for that could be that the company might not be interacting directly with their customers or that the firm is reluctant to ask about those expectations or even that they are unwilling to address them.

Gap 2: Company perceptions-service specifications perception gap - that is, the gap between management perceptions of consumer expectations and the firm's service quality specifications. This gap arises when the company identifies what the consumers want, but the means to deliver to the expectation do not exist. Some factors that affect this gap could be resource constraints, market conditions, and management indifference. These could affect the service quality perception of the consumer. The service quality specifications are being translated out of the management perceptions of the consumer expectations mentioned in gap 1. If there has been made a mistake in gap 1, then gap 2 cannot be reliable.

Gap 3: Service quality specifications-service delivery gap, the gap between service quality specifications and actual service quality. This gap is not applicable since the actual service delivery cannot be measured yet. Another fact about the simultaneity experienced in services is that the customer judges both the production and consumption at the same time based on the promises made by the company. However, at the time of which the customers will be able to experience the service will be strongly dependent on the interaction between the customer and the employees of the company offering the service.

Gap 4: Service delivery-external communications gap, or the gap between actual service delivery and external communications about the service; as a result of inadequate horizontal communications and propensity to over-promise. Companies can neglect to inform consumers on certain hidden aspects such as environmental concerns or health risk that are not visible to them, and this could influence service quality perceptions by consumers. This gap will also not apply to the research since it involves the rating of the actual service delivery which cannot be measured yet.

Gap 5: The discrepancy between the expected and the perceived service: because of the influences exerted from the customer side and the shortfalls (gaps) on the part of the service provider. In this case, customer expectations are influenced by both internal factors such as personal needs and past service experiences, and external forces, such as word of mouth recommendations. The key to ensuring proper service quality is meeting or exceeding what consumers expect from the service. Although the expectations can be positive, in that one looks forward to an event, but equally, they can be bad; in which case, one does not look forward to the market release of a new supersonic plane.

Parasuraman et al. (1985) argued that "gap analyses" are critical for identification of discrepancies between the provider's perceptions of service-quality dimensions and the consumers' perceptions of those dimensions. Customer perceptions of service quality can be viewed as a trade-off between perceived benefits and perceived costs. However, the more disruptive the innovation is, the more complex it is to assess the perceived quality of consumer and the potential for market success (Assink, 2006).

2.3 Applied Gap Model of Service Quality

The gaps that apply to this research are gap 1, 2 and 5 in particular. The suggested framework is an internal adaptation of the Gap Model and will be used as an aid to answering the research questions of this thesis.

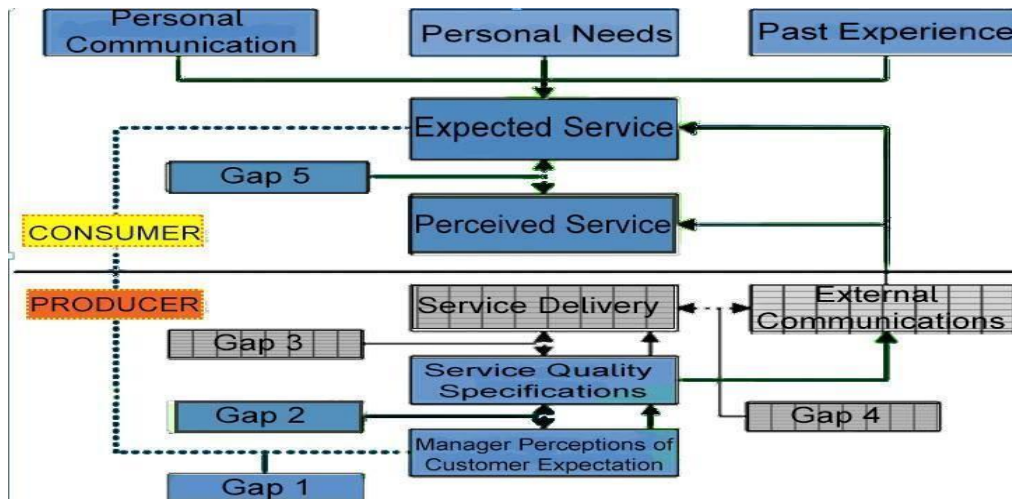


Figure 1: Applied gap model of service quality (adapted from Parasuraman et al. (1991))

The model shown in Figure 1 presents an integrated view of the consumer-company relationship. Consequently, three gaps were chosen to apply to this particular research. Gap 5 is the main gap, and it is a function of the other four gaps. It should be necessary to control, and the ideal situation is to close these gaps (Parasuraman, Parsu & Zeithaml, 1988). By using the applied gap model, gaps 3 and 4 will not be covered, which is why gap 5 will be a function of only gaps 1 and 2. The first two gaps, require companies to understand accurately customers' expectations and translate that understanding into service standards (Parasuraman, 2010).

$$\text{Gap5} = f(\text{Gap1}, \text{Gap2})$$

The airline product delivered to passengers is not a "physical item at all, but services that consumers find useful" (Wensveen, 2007). Service provided have personalized meanings that each passenger might perceive and experience it in a completely different way. The gaps in the service quality are caused by the difference in the service known to the service providers and the real service standards perceived by the customers. A consistent issue in managing service quality is the problem of identifying what comprises a service to determine the dimensions of the service customers use to assess quality (Lovelock and Wirtz, 2004). Hence, it is vital for the companies planning to bring back the supersonic commercial flight not only to understand the perception of passengers but as well find out what customers expect from the services and what factors target customers consider most important. In the air travel industry, services are composed of a very complex mix of intangibles as the consumers receive performances and experiences. Thus, service quality is a key to boost customer demand for an innovative solution such as the supersonic commercial airplane.

Gaps 1 and 2, prior to gap 5, are found to be important for this research because any failure of service in air travel industry or unmet market needs has a broad effect and bad performance is often criticized publicly as it was in the case of Concorde. Thus, investigating both the industry and the consumer perspective of the upcoming generation of commercial supersonic flight is justified. Delivering superior service quality by understanding customer perception is a key to success and survival (Chen & Chang, 2005).

For the commercial supersonic flight to become a success in the airline industry, the following attributes **(1) functionality, (2) reliability, (3) customer convenience and (4) cost** from the DI theory will be tested further in cohesion with the applied gap model of service quality. *Figure 2* below presents a customized created by the authors model, merging the two theoretical foundations discussed in this study.

2.4 Customized Unifying Model

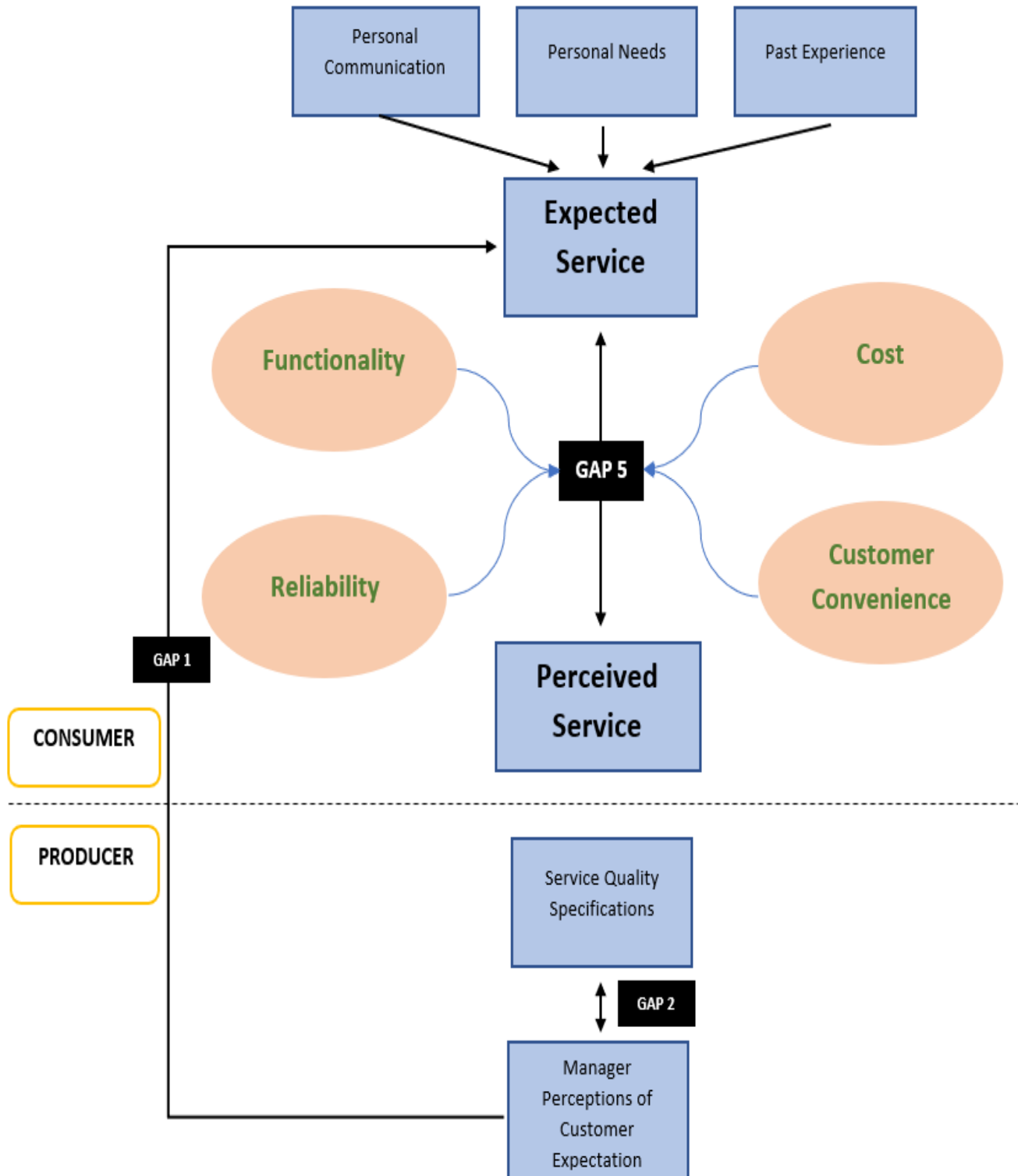


Figure 2: Customized unifying model (created by the authors)

Chapter 3 Research Methodology

The methodology describes how answering the research question was pursued and explains the adequacy of the selected methods concerning the aim of the study. The researchers will collect data through qualitative interviews with potential customers and industry representatives, to explore what they perceive to be the key determinants in their evaluations of service quality applied to supersonic commercial flight.

3.1 Research Philosophy

Research philosophy depends on the way that you think about the development of knowledge. **Pragmatic research philosophy** is used due to the fact that it was deemed necessary to pursue multiple views to enable best answering the research objective (Saunders, 2012, p. 140). The philosophy argues that it is possible to work within both positivist and interpretive positions and it could integrate different perspectives to help collect and interpret data. The pragmatist epistemology is characterized by its ability to build a constructive knowledge which is not solely restricted to explanations (a form of positivism) or understanding (a principal form of interpretivism). Other pillars, such as normative (exhibiting values) and prospective (suggesting possibilities) are used, which in turn provides broader research design possibilities (Goldkuhl, 2011).

Takkori and Teddlie (1998) also state that pragmatic point of view avoids vague discussions about the nature of knowledge, reality, and truth, at the same time making the research questions the most important part of the research, meaning that different approaches can be used in order to find the answers the research questions. This ontology is a very goal-oriented one and links the choice of approach directly to the purpose (Creswell, 2003). It is considered the most appropriate philosophical practice because it aims to be highly objective by relying on theoretical foundations and collecting industry expert opinions, meanwhile embracing the subjective views of the target passengers and further interpreting through the prism of the researchers' understanding.

The limited literature on the subject created the need for **descriptive research** to expand the understanding and further isolate and explain possible factors that could ensure the success of a commercial supersonic aircraft. By choosing to conduct a descriptive study, the focus is initially broad and becomes progressively narrower as the research progresses in collecting qualitative data. Specific hypotheses or actual measurements would not be involved. This type of research is considered as an effective tool for understanding a certain phenomenon within the pragmatic stance and providing a holistic view of it (Malhotra, 2012).

3.2 Research Approach

For the purposes of this research, **deductive approach**, also known as theory testing process, has been taken. It is a funnel-structured approach grounded in scientific principles where the researchers move from a general level to a more specific one, and from abstract concepts to concrete inferences (Saunders, 2012). The chosen approach relies on adopting the theoretical conceptions on the Theory of Disruptive Innovation and the Extended GAP Model of Service Quality, also testing further if these theories are valid

in the given circumstances. At the end of the exploratory research, the chosen theories will be either supported or not.

The authors of this thesis found the deductive approach to be the most appropriate for this study - to find the key factors that could ensure the success of the upcoming generation of supersonic jets and to understand the perceptions of the target passengers. One reason for choosing a deductive approach is that it is preferred by natural sciences, which means that it relies primarily on the objective collection and analysis of data and facts upon. Although generally associated with collection and analyses of quantitative data, the deductive reasoning can be used when collecting theory-guided qualitative data (Babin, 2016). By conducting semi-structured qualitative interviews with some of the questions grounded in theory, the descriptive research shall be fulfilled.

3.3 Data Collection Method

Secondary data

The writers of this thesis use secondary data that at an initial stage to develop contextual or confirmatory elements of research and later on primary data will be collected to provide the data that would produce answers to the research objectives.

In order to acquire a comprehensive knowledge of the examined subject, a thorough literature review has been executed. The extensive literature collection has been conducted using various databases such as the Jönköping University Library database, social science citation index (SSCI), Google Scholar, ScienceDirect, and EBSCOhost. The preliminary search was based on different combinations of keywords such as innovation, disruptive innovation, technological innovation, airlines, air transportation, passenger flight, Concorde, service innovation, supersonic commercial transport, etc. The secondary data collection was carried through reviewing a vast number of academic articles and empirical studies containing primary and secondary data related to the Disruptive Innovation theory, the GAP model and the new players of promising supersonic passenger jets.

Primary data

Furthermore, qualitative data will be gathered and analysed to address the research problem. **Semi-structured face-to-face and Skype/phone interviews** (the latter in the cases where a personal meeting is not possible due to geographical restrictions) will be conducted with **industry experts as well as potential passengers**. The sample for the consumer interviews consists of long-haul travellers in the age between 20-80 years old who at some point in their life have flown in a business class. The interviewees do not necessarily need to be frequent business class travellers and to cover certain income requirements. Hence, the chosen participants are not all on the same income level. However, it is important for the interviewees to have an understanding of how it is to fly business class on a long-haul flight in order to give a valuable opinion on the service quality specifications.

Interviews could be facilitated to obtain information in a detailed manner, which might aid the researchers to deeper understand the phenomenon (Kvale, 1996). The interviews with

the experts are semi-standardised and help to gather an objective opinion based on knowledge. Mainly, the same questions will be asked, but some will be personalized based on their professional expertise and background. A number of experts will have knowledge on the market and others on the technical functions of the planes. The semi-structured interview approach is highly beneficial for this study, as it provides a certain level of flexibility and the interview is guided by the answers of the respondent, enabling the interviewer to react to the situation and delve into critical issues (Merriam, 2009). On the other hand, the subjective meaning that potential customers attach to their perceptions of supersonic transportation will be gathered through standardized interviews. The names of the participants of the consumer research will not be disclosed, although this information could be easily provided along with the full transcripts upon request. Since this study is an exploratory study, the exact sample size is hard to set in advance. In order to gain as much insight and understanding as possible, the preliminary goal is to conduct 8-10 interviews with industry experts and around 25 interviews with representatives of the target passengers. Each interview should last approximately 30 minutes.

At an early stage, we considered complementing interviews with industry representatives by using surveys that would be answered by target consumers. However, a survey questionnaire was decided to be unnecessary as this study is not about measurements but understanding customer perceptions. Conducting qualitative interviews has been placed as a central part of the study because the writers of this thesis believe that personal interaction with interviewees is highly valuable and more credible than for example anonymous views expressed through survey data.

The primary data has to be collected based on two distinctive interview guidelines, see *Appendix 1* for the main questions asked to industry representatives, and respectively *Appendix 2*, including the potential consumers' interview outline, ensuring that during the interviews all the relevant information is going to be covered. A master student in Journalism was invited to test the questionnaire for the target passengers in order to ensure that the questionnaire would be clearly understood by the participants. The researchers may exclude some questions in particular interviews, given a specific organisational context that is encountered in relation to the research topic. The order of questions may also be varied depending on the flow of the conversation. On the other hand, additional questions may be required to explore the research questions, especially when collecting the opinion of the experts. Probing questions may also be used to seek an explanation where the researchers do not understand the interviewee's meaning or where the response does not reveal the reasoning involved (Saunders, 2012). A disadvantage in semi-structured interviews over highly structured ones is that answers are more difficult to be compared from one interview to another due to the variations in the questions asked (Collis, 2009).

The objectives for conducting the interviews with the experts and the target passengers vary. The experts can provide data regarding the contemporary trends in the industry and give insight on technological, environmental and economic issues related to the success of the Supersonic aircraft. At the beginning of the research, a pilot interview has been conducted which provides an initial insight on the matter. On the other side, target passengers will reveal the consumers' perception, opinion and demand for the supersonic service, as well as conclusions on the aircraft's success based on their willingness to use the service, will be made.

3.4 Sample Selection

Once the research problem is defined, and the method of data collection is chosen, it is necessary for the research to precisely select the target population from which the sample will be taken. The interviewees representing the industry perspective will be selected using **non-probability (non-random), purposive (judgmental) sampling** which enables the researchers to use their own judgment to select cases that will best enable to answer the research questions and to meet the objectives (Saunders, 2012). Those individuals are selected through referrals (**snowball sampling technique**) as the population of interest is hard-to-reach. Other experts will be searched for through LinkedIn to find people who work for the companies that are currently developing supersonic aircraft or have been involved in the air travel industry in some way or have conducted previous research related to the studied topic.

On the other hand, the target passengers will be identified through **non-probability, convenience sampling** technique which is particularly appropriate as the selected cases were directly extracted from the immediate network of the researchers. Under this approach, participants will be asked to suggest someone else who might be willing and appropriate to take part in the research which again is a form of snowball sampling. The authors will also try to interview target passengers from different sectors of interests, employment, and areas of living, in order to attempt diversification. The study seeks to generate a direction for further work and not to generalize for the population of interest. The extracted cases will provide an interesting insight and a deeper knowledge of the subject, and the findings would be transferable for studies on the same subject.

3.5 Reliability and Validity

Saunders et al. (2007, p. 149) define reliability as "the extent to which your data collection techniques or analysis procedures will yield consistent findings." The authors of this research acknowledged the possibility of bias that could emerge during the interviews. As there would be two people conducting the interviews, there is a potential for observer error regarding two different ways of asking questions to elicit answers and then there may have been two different ways of interpreting the replies. Introducing a high degree of a structure through the use of interview guides will lessen this threat to reliability.

Thus, to reduce the scope of bias and increase the reliability of the obtained information, several steps were undertaken:

- 1) Prior research on selected participants' profiles will be conducted to ensure that they fit the target group.
- 2) Selected participants will be contacted over the phone, email and/or social media.
- 3) Relevant information about the researcher's role and the research will be told to the participants before the start of the interviews to gain interviewees' confidence and start the discussion. To make sure that all the interviewees will understand the topic before the interviews take place the researchers must make a clear description of the supersonic flight concept.
- 4) Data will be recorded during the interviews with the consent of the participants and then carefully transcribed by the two researchers in order to provide data evidence. The

identity of the participants will not be revealed without their explicit consent, and it was ensured that the information had been collected for the explained research purposes only.

3.6 Analyses of the Data

The data to be collected will be of a **qualitative** nature. The initial coding and analysis process of the open-ended textual data is likely to occur as the data are being collected well before all interviews have been completed, due to the limited time frame for this research. Analysing the collected data involved listening to the recorded tapes and transcribing the interviews. After the interviews, the researchers will develop a more hierarchical approach to the categorization of the transcribed data, whereby some category codes or labels will be developed and used to indicate emerging analytical linkages. The researchers will look for patterns in the data that will lead the discussion in a structured and valid way. One of the advantages of the semi-structured interviews is that results can be used to make statements (Saunders, 2012). An integral part of qualitative data preparation and analysis will require the researchers to reflect upon their own learning and the ways they may interpret what they see and hear. The analysis of the interviews will be first done "within-case" and then "cross-case" between the different interviews. All relevant information collected by the authors from the interviews will be presented in the following empirical chapter.

3.7 Delimitations

In this section, the choices made by the researchers are described and the boundaries set for the study. The research topic has been narrowed down considering the time frame. Furthermore, due to lack of monetary capital, a visit to Boom Supersonic Inc. to conduct face-to-face interviews with representatives in the company and enrich the insight on the topic through practical observation will not be performed. The business is located in the United States, and the researchers are conducting the study in Sweden, which makes it too expensive to execute this kind of field research.

Regarding the theoretical framework, the choice to use the Theory of Disruptive innovation in combination with the Extended GAP Model of Service Quality has been made and broadly discussed in Chapter 2.

The literature on disruptive innovation is particularly unclear regarding how exactly a disruptive technology creates value for the customer and what challenges are related to commercializing such an innovation. One reason why this question has not been sufficiently understood is that the disruptive innovation theory has a strong focus on performance dimensions, rather than economic value and total utility for the consumer (Adner, 2002). While recognized as a powerful framework for the evaluation of the success of technological innovations, DI theory has been criticized for being more focused on supplier performance rather than the dynamics of consumer demand. The assumption that innovation is the consequence of coupling technological opportunity and market demand is too limited. It needs to include the less obvious social concerns, expectations, and pressures (Tidd, 2005).

However, the decision to build the theoretical framework in the described way was taken after evaluating other potentially suitable to be included theories, such as the Diffusion of Innovations theory (DOI). The latter refers to the process that occurs over time as an innovative idea or product becomes diffused and spread amongst the population. The theory, developed by E.M. Rogers in 1962 categorizes the adopters of innovation into six categories: innovators, early adopters, early majority, late majority, laggards, and non-adopters (LaMorte, 2016). The writers of this thesis have decided that this theory would be appropriate to be involved in subsequent research in a couple of years when the supersonic plane will be already released on the market. Currently, the upcoming market players are in early stages of development and forecasts on the distribution of the population within the six categories cannot be made. It would be interesting in the future (once a supersonic plane is launched) to examine in detail the actual decision of the target passengers to adopt or reject the innovation. The results of this decision would have a direct impact on the long-term commercial success of the supersonic airplane and will validate with strong evidence whether the supersonic transportation is actually being a disruptive innovation.

In sections 3.3 and 3.4 has been already discussed the data collection technique appropriate for the population of interest and the sample attributes within the scope of the research. This choice of the direction of the study has been made against the opportunity to collect primary data by contacting major Airlines operating overseas (such as Japan Airlines) that already plan to add supersonic planes to their fleets. Thus, the researchers do not intend to gather knowledge on how airlines perceive the success of this innovation, exploring the key considerations behind such an investment and what are the perceived benefits for the end-customers according to the key airliners. This approach has not been adopted because of the alleged probability that airline managers responsible for decisions regarding the purchase of supersonic aircraft will not be reached. Instead, interviewing around 35 representative people of the target population (including both expert opinions and passenger perceptions) will reveal true views regarding the topic at firsthand and that would help to construct valid conclusions.

Chapter 4 Empirical Findings

This chapter will present the empirical findings of the research separated for the consumers and the experts. At first, the demographics of the sample are discussed briefly, and after that, the findings will be discussed apart from each other.

4.1 Consumer research

For this part of the research, 28 people have been interviewed. These people have at least flown once on a long-haul business class flight in their lives, but most of them have flown many more times. One interview has been executed with two people at the same time, they are a wife and a husband that have flown on Concorde, and they preferred to be interviewed together. This wish has been accepted, so this means that there have been 27 interviews with 28 people. An overview of the consumers' demographics can be found in *Appendix 3*.

These 28 people consist of eighteen males and ten females. An interesting aspect concerning differences in male and female service values was brought: "because I'm a woman I would like the plane to be elegant and sophisticated as well when I would be flying supersonic". Moreover, one suggests that the flight experience of supersonic flight should not end at the aircraft door. Upon arrival, people and especially females may feel insecure at the destination country, so additional, premium services should be incorporated in the offering that will make people more willing to switch to supersonic flight.

Potential customers are most likely to perceive the service experience as one whole process as described below. The service delivery process is divided into eight steps, each step representing a point where a customer may experience different types of services that will form the overall experience and are the determinants for not only "trying once supersonic flight," but "switching completely" to it when it comes to intercontinental flights. Hence, the significance of service quality will be influenced by these attributes.

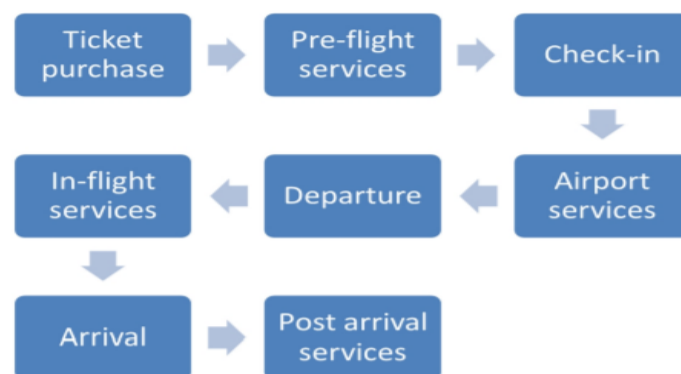


Figure 3: Service delivery process (created by the authors)

Although the interviewees said that they are very willing to try the supersonic flight, in practice changing to something new could not be that easy due to the established habits unless the new offering provides additional services that justify the high-ticket price.

There is a wide variety of nationalities as well, with some people even having two nationalities. The total number of nationalities that have been covered in these interviews is 16, which ensures a global view on the subject. Slight patterns of variability in relation to culture, in terms of expectations and perceptions of service quality, have been found. For instance, Eastern and Central Europeans interviewed (5 Bulgarians, 2 Hungarians, 1 Greek and 1 Romanian) tend to be more concerned regarding the price and their perceptions of service quality and willingness to try a supersonic flight strongly correlates with that. Their expectations of a "fair price" that they would spend are way below the preliminary price of 5,000\$ given by companies like Boom Supersonic Inc. A supporting example of that claim is an Eastern European mentioning: "I am willing to pay up to 2500 EUR."

The ages of the interviewees are in the range of 23 till 80, with an average age of 40.3 years old. As it has been expected, the younger travellers have not flown business class as much as the older ones. Generally, they seem to be more adaptable to planes that do not offer a higher level of comfort, but at the same time, they are very open to new experiences and thus, willing to try a supersonic flight. Another result, i.e., occupation highlighted some interesting facts that highest number of business travellers are not labour class but professionals and people from managerial positions. In this research, people from 21 different professional backgrounds have been interviewed, as well as a few students and retired individuals.

4.2 Main outcomes of the consumer interviews

Out of the 28 people, nine people have business as their main reason to fly, twelve have leisure, and seven people have an equal division between business and leisure.

Most of the interviewees fly more than five times every year. Also, 26 out of 28 people state that not all of their flights are in the business or first class. It is usually half of the times per year, but not on every flight even if the purpose of the journey is a business occasion.

The bar chart below shows the main values of the passengers when they fly on a long-haul trip. The interviewees had the opportunity to mention several values. Hence the total number does not add up to 28. The factors comfort and speed have been mentioned the most, in that order. Business people value comfort because "if you don't have the comfort you will feel very tired when land. The majority of them need to be fresh "because when I land I sometimes get to work immediately" (interviewee, 2018). Direct flights, safety, and quality of service are other factors that the interviewees came up with by themselves. Price, convenience, on-time flights, airport location and space have also been mentioned by a few people but not as often. The airport is actually quite important to people, who tend to avoid too big and crowded airports and places in general.

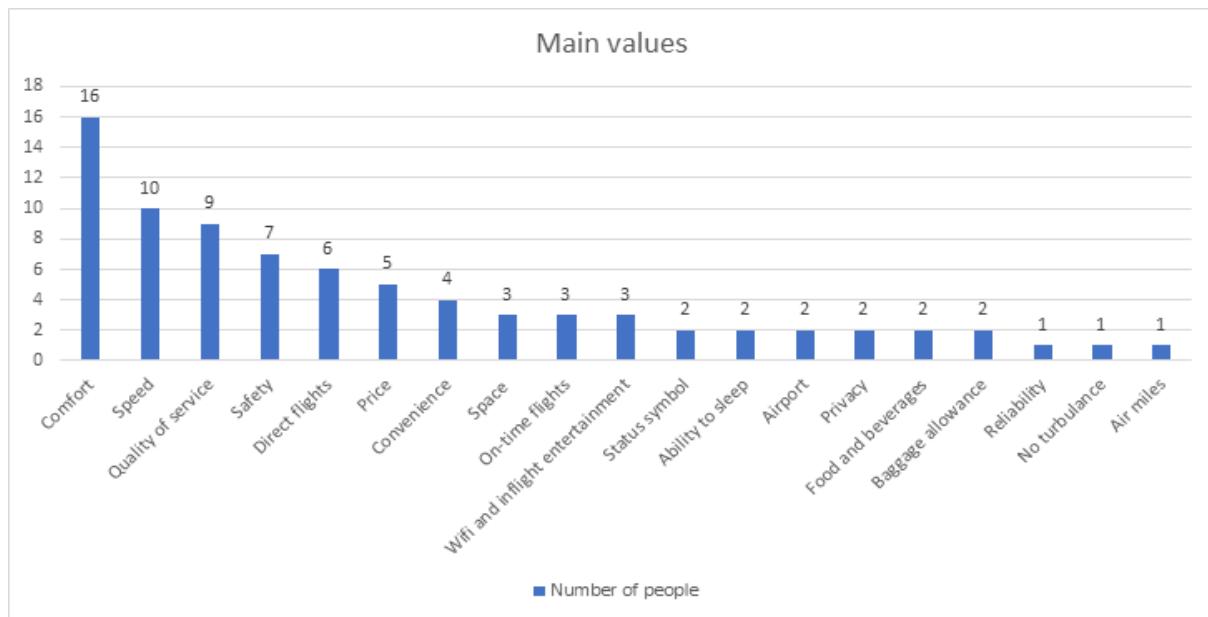


Figure 4: Main values

The most important reason for the passengers to fly business class is by far the comfort in general - "If you travel long distance it makes your experience much less stressful, if you travel for work – you arrive in much more relaxed state, and you can go straight to business sooner and in better shape" (interviewee, 2018). The "comfort" as described by the interviewees includes the nice chair, the ability to sleep and the amount of personal space. The better meal and beverage service is also considered an important factor, but it is not mentioned as much because people might take it for granted. The entertainment system, perception of privacy and the priority boarding offered by the business class travelling have not been stated as often. People have shared the general notion that business class provides higher passenger comfort, more relaxed environment and less noise in regards to people conversations. "Flight attendants pay more attention to business class passengers, just because they are less than all other economy class passengers, so each passenger's needs can be addressed more quickly and more precisely" (interviewee, 2018).

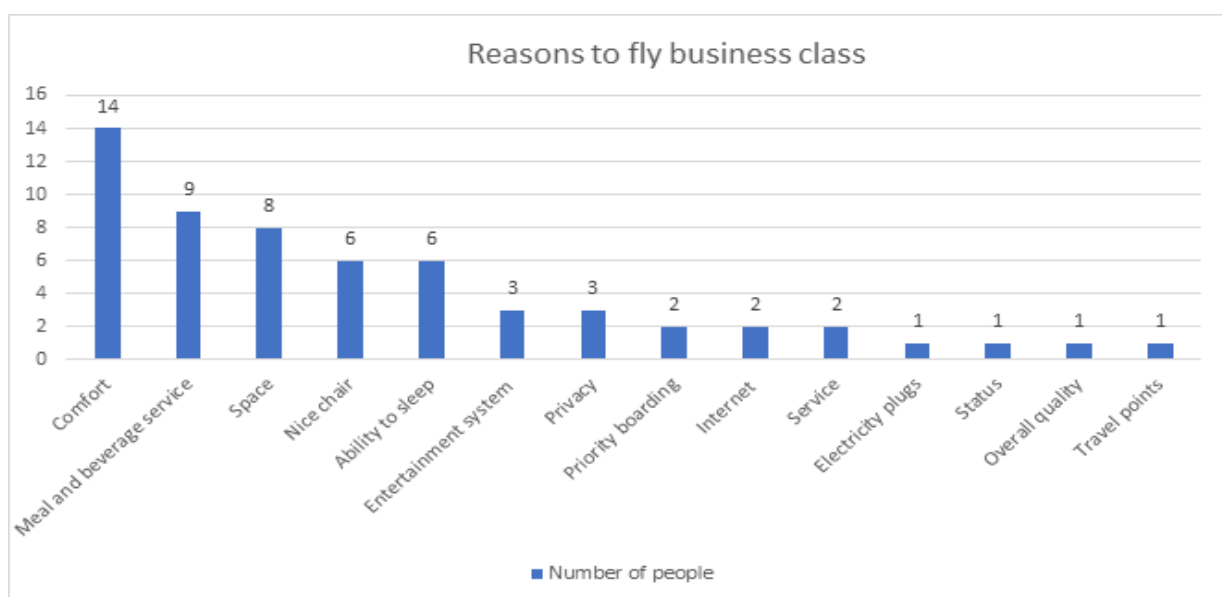


Figure 5: Reasons to fly business class

At the beginning of the interview, people were free to express their main values of travelling and comfort was mentioned more times than speed in that section. Later on, when they were asked to compare the importance of “speed” to “comfort”, speed was mentioned many more times than comfort, as can be seen in *Figure 6* below.

According to many participants “perfect plane travel experience would be fewer flight hours and more comfortable planes and service.” However, comfort matters less when the duration of the flight is shorter. If you fly intercontinental nowadays, there has to be comfort because of the vast amount of time it takes. In general, when only those two factors are compared by the interviewees, speed is considered to be more important than the comfort solely on short flights. On a 12-hour flight, if you fly comfortable, it makes the whole trip more bearable, but you lose one complete day on the whole travelling.”

People seem to be willing to give up on some comfort to get faster to their destination, but not the other way around. Speed is important: “I don’t think anyone will mind to arrive at their destination faster. I believe there is a lot of space for improvement when it comes to the time of arriving. Yes, airplanes are the fastest transportation but in today’s world of technologies everything could be better.” Moreover, arriving faster demands less comfort - “I would sacrifice a bit of comfort for speed.” The need for comfort is mainly said to be there because of the long duration of long-haul flights. Decreasing flight times also decreases the demand for comfort in general. Several interviewees stated that “I prefer the comfort on long flights, but on shorter flights I prefer speed”; “Respectively, on a longer flight I would prefer more space and comfort, so I would be more willing to treat myself with a business class journey.”

There are some people who mention that comfort is more important than speed - “if the higher speed is affecting my experience then I would prefer a flight which is slower but more comfortable.” These people are mainly leisure travellers, and the main argument is that the convenience of a leisure trip is more important than the speed. They prefer to pay for comfort instead of speed, so they would not be likely to pay a business class price for flying supersonic. Also, the whole trip that includes going to the airport and getting from the other airport to the final destination takes a lot of time as well.

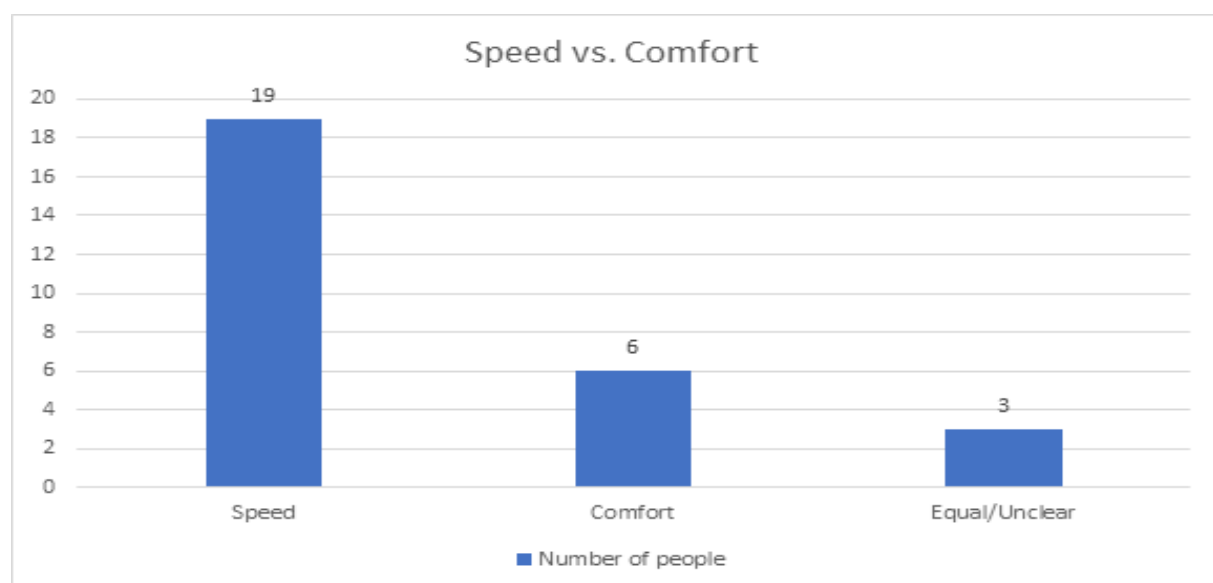


Figure 6: Speed vs. Comfort

Out of the 28 people that have been interviewed, 24 are saying they would try supersonic flight for sure if it costs the same as a business class ticket - "I think that I would definitely try it, because the most important value is time, since time is limited"; "time is money", and only four of the interviewees state that they might be likely to try it. Hence, not a single participant answered the question negatively. There seems to be an interest among the interviewees for supersonic flying, and they expect when they travel slower to pay less and vice versa. The people at least seem curious enough and extremely willing to try it out. People that like technological innovations are definitely willing to try it at a cost even higher than a business class ticket. However, the majority would like to fly supersonic if it is at least as safe as regular flying even if the tickets are affordable.

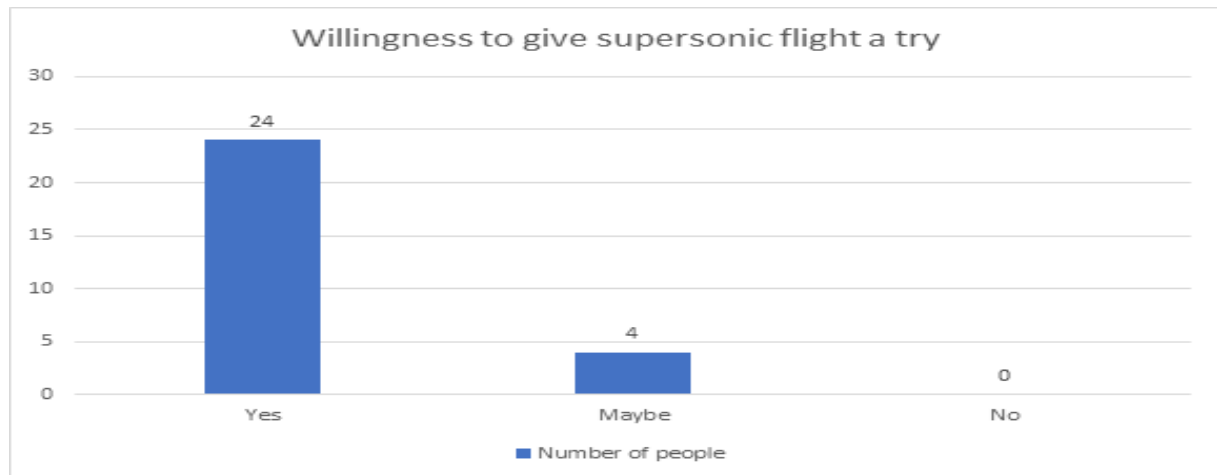


Figure 7: Willingness to give supersonic flight a try

Out of the 28 people, 25 mentioned that their attitude towards long distances and frequency of travel would change to a certain extent if they would be able to fly more than 2.5 times faster to anywhere in the world. Main arguments were that remote places like Australia would become relatively less remote and the existence of supersonic flight will increase their desire to visit places that are far away - "shrinking the world." One interviewee shared that "I am studying in Sweden and even if I could go back home to Mexico every other week for free, I would not do it due to the long travel times. If it could be 2 and a half times faster, I would certainly do it", another said, "I would probably travel more because it makes face to face meetings easier and that meeting people is important, and that cannot be replaced by video calls." Many people mentioned as well that they would be willing to make more long-haul trips per year to visit family or for other purposes since it consumes less time. One interviewee specifically said: "I would become more open to traveling to destinations far away and plan my business trips differently. When you have to travel for 20 hours+ to get somewhere, I always take into consideration the time I'd need to recover after the flight. If the traveling time is reduced in half, I'd be able to take more trips around the world without feeling obliged to stay in a place for more than I'd like to only because of all of the traveling." A comparison with flights within Europe has been made as well. Since flying within Europe feels like a bus trip these days, this could be in the future with supersonic flying create the same feeling for the longer distances. Even more, one interviewee shared that arriving faster will be valuable for people who generally do not like traveling and ones with health issues: "I have motion sickness and travelling for a long time is something I don't like. Whenever I have to travel to Argentina I feel like the time to arrive is just too long and shortening it would be more than amazing." Another said that the speed factor would be a big

consideration for elderly people, there would be an advantage from spending less time in the cabin. Furthermore, for people traveling with kids on long distances might be a preferred option.

The three people that said "no" mentioned that the whole travel duration will still be long and also that the flight will probably pass multiple time zones which still will make people feel tired due to the natural human biorhythm. "I think my attitude will not change. I will take long distances in the future too, with or without supersonic flight" said one of the interviewees.

The people that have been interviewed mention that mostly they fly business class due to seat **upgrades**⁴. The other main reason for flying business class was that the companies they work for are paying their tickets. Hence, decision making on ticket purchase is outsourced, but there are certain strong service quality passenger needs that have to be met to influence the decision. Hardly any of the interviewees book their own business class tickets, and if they do, it is usually not something they do for every single flight taken, or it is simply because they run their own business. The majority said that if they have the opportunity "they would push for supersonic at the company."

In general, people do not take environmental factors into consideration in relation to air transportation: "I don't believe in it. I think car pollution is way worse"; "Not my main concern but not the last either". However, many are aware of the negative effect it has - "I do not think about it, but I am aware of the huge amount of pollution that goes along with air transportation"; "it applies to all types of transportation, so one should not only consider air transport as damaging." They still do not really take it into consideration because "there is no alternative than flying" but that leaves them feeling "a little guilty." Two people who have worked in the airline industry and actually flew on the board of Concorde said that "they would both be happy to pay a tax to reduce the environmental impact though to save our consciences." One interviewee said that "if there were travel that I knew that had a low environmental impact it would influence my decision," and another said: "I do care about the environment and it does make a difference to me if a company is making efforts to inflict less damage on the environment. It usually improves my opinion of that carrier and more likely to pick their company"; "I would opt for environmentally friendly plane even if I have to pay slightly more" (interviewee, 2018). It is mentioned by a few people that they would choose an environmental friendly option if it were available, but only if it is not more expensive than a regular option - "If it doesn't cost any extra I would prefer it to be good for the environment, otherwise I don't care." However, one of the interviewees expressed really strong position in favour of the environment, saying that "If I need to scale on 1-10 the importance of the environmental damage, I will give 10, really important". Another said, "I hope that all the regulations that will come with supersonic flight could preserve at least partially the environment."

Out of the 28 people that have been interviewed, only three people say specifically that they would not pay more for a supersonic flight than for a business class ticket. Five interviewees mention that they would pay the same and 3 are not completely sure. The other seventeen participants share the general opinion that arriving there two and a half

⁴ When a passenger gets a better seat than he or she paid for on board of a commercial aircraft. This could be due to a full economy class and unoccupied seats in business class. Upgrades can either be free of charge or they can be purchased last minute for a lower price than the original one.

times faster is definitely worth more than business class, and they believe that: “the price for supersonic flight should slightly exceed the price for a regular business class ticket.” However, that will still depend on the destination, the occasion, and the alternative options. They are willing to pay more for a ticket on a supersonic commercial aircraft with the majority mentioning somewhere in between 10 and 35% percent more than a regular business class ticket. One participant even said that he was willing to pay 1.5-2 times more for a supersonic ticket than a business class ticket. Also, people think that it would depend on the trip destination itself if it is worth it to pay more or not. However, the price range that people give is quite diverse from less than 1,000 up to 7,000 USD, so the perception of the price for a regular business class ticket nowadays is very different, and that is due to the different airlines, timing, and destinations that people are presumably having in mind based on past experience, when they answer this question. Also, this is strongly influenced by cultural and economic factors strongly varying between countries (i.e. Eastern and Central Europeans are less likely to spend more than 2,000 euro on a single flight).

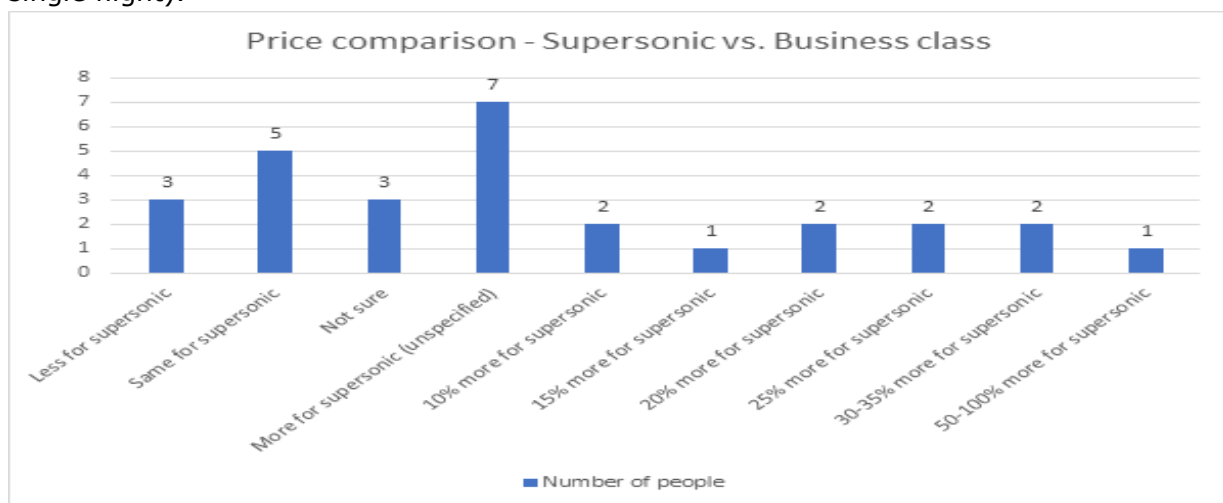


Figure 8: Price comparison - Supersonic vs. Business class

Out of the 28 interviewees, only eight interviewees mention that they are not willing to pay more to sacrifice some comfort and gain back this amount of speed, but five of them are willing to pay the same price as they would for a regular business class seat. Three of the interviewees say specifically that they would even pay less for flying supersonic - “The seat must be super comfortable, so I don't think I would change a business class seat to fly faster. I don't mind flying when I'm in a business class seat.” Others expressed the opinion that comfort and speed are equally important but depending on the price they could give up on one of them if that will save them money to use for another trip.

The vast majority, 20 people, mention that they would fly supersonic and would sacrifice the comfort for the time if considering a business trip and an urgent situation, otherwise when traveling for leisure they do not mind to travel slower. More than half of the potential consumers believe that as long as the company making this new aircraft is able to provide low enough prices so that airliners can make a profit with low ticket prices, most people will prefer to travel faster than comfortable.

Lastly, only three of the interviewees are not completely sure. One expressed uncertainty regarding the safety vs. speed of the aircraft and two said that nowadays more and more people are getting used to traveling with lower comfort because of the budget airlines, thus comfort might even play a lesser role in the future.

4.3 Additional outcomes of the consumer interviews

- Mentioned a few times: Besides pure time saving, “efficient travel” was expressed as a point of difference that people would like to have during a supersonic flight, and that should be brought by extra service features offered. For example, to sprint across sprawling airports to catch connecting planes is really unpleasant for almost everyone, so supersonic flight should have a very convenient timing, airport locations, destinations and on-ground services offered. Hence, speed and comfort only matter from door to door; there are opportunities to improve the service process on the ground, instead of focusing on just flying faster. Supersonic flight can make a person gain time in the air but the service components prior and after departure should be accounted as well. Few examples are baggage drop off, check in process, custom control, waiting times, etc.
- Supersonic flight on short flight could be more useful because that is where people want to be as fast as possible. Long-haul flights are long anyway, so comfort starts to play a more important role.
- The people pay a lot of money for their tickets, so they expect their whole trip in style. This means good service both in the air and on the ground.
- Flying supersonic during night-time is less attractive than during day-time because during night-time one can sleep and then the speed becomes less important. Hence, flying during day-time and night-time has been distinguished as a factor influencing the experience.
- Someone mentioned the option of “creating and featuring a business class on board of a supersonic plane” as well since there are probably a few people that have more money and value speed, and comfort enough to pay an extra premium price for that.
- The safety of supersonic flight must be guaranteed, otherwise, it can fail. People might be willing to sacrifice some comfort for speed, but not safety. Hence, many trials will be needed to prove the consumer that the plane is safe. “In the past hypersonic flights had questionable safety record. I wouldn’t sacrifice my safety” said one of the interviewees who had also been partially involved in airplane architecture in the past.
- One interviewee expressed privacy concerns and shared that “I personally can’t stand sitting in between two other people. A window or aisle seat is a must for me. And that a two-seat rows would be a blessing.”

The Concorde experience summarized by two actual former passengers:

Service experience is a perception of reality, with prior experiences being essential. One interviewee said that he was a British Airways employee for 16 years and he could have flown on Concorde for 300 pounds round trip, but sadly he never did it. His decision was influenced by bad referrals of his colleagues who had tried it and said that “it was very bumpy, uncomfortable and disappointing.”

On the other side, the two people from the dual interview have flown on board of the Concorde and shared a whole story about their experience. They revealed that Concorde

was widely accepted back in the days. Initially, it was planned that many airlines would fly supersonic, but the fact they could only fly over water changed the view.

The passionate story captured in the interview is about a husband and a wife who flew on board of a BA Concorde in 1990 from London to Washington DC and then continued their journey from Washington to the West coast on a subsonic plane. The special experience already started on the ground where they had to go to a special lounge, and before the boarding, the employees even took passengers' jackets on board for them - "exclusivity was really great." The whole experience before going on board already felt special to them. When Concorde showed itself, they heard a child saying: "Oh mommy look, it's a lady plane." It was just so elegant and something different to the heavy subsonic planes which did not give the same feeling.

While boarding the plane, they noticed that there was not much space at all and that the plane was way smaller than they expected - "the Concorde inside was very small, and we even had a little bit of claustrophobia." The extraordinary service and excitement about flying above the speed of sound made them forget easily about this and gave the flight a very special charm.

Take-off was the most special point of the travel, and once they were airborne, there was no difference except for the fact that there was no turbulence. The sky they flew in was very dark because of the high attitude that it almost felt like they were flying in space. They had the feeling that most passengers felt the same excitement as them - "when you get into the air you knew you were going to hear the supersonic sound and people actually cheered when that happened. The speed was displayed as well and when it hit Mach 1, people took pictures of it because it felt so special to fly above the speed of sound." However, the interviewees said that there were also a few passengers that got into the plane and just closed their eyes and tried to sleep even before take-off, so they were probably more frequent Concorde flyers. The couple had a conversation with the cabin crew as well, and they found out that there were actually several passengers with two seats reserved for themselves because they decided to pay for some extra space, which was perceived as "quite insane" in the eyes of the interviewees. The cabin crew assured them that it happened more often and that it was quite regular for some people who had enough money anyway, considering that the cabin space was very little.

The experience on board of the Concorde made them feel like "time travellers", because they flew faster than the rotation of the Earth and almost wanted the journey to continue. However, they believe that the whole Concorde experience is difficult to be reproduced with a new supersonic plane because of the amazing service it had to offer and because it was such a beautiful aircraft. When Concorde was there, they got the feeling that it was quite early for such a unique technological leap and that it would never be a mainstream offering. But with today's trend of consumerism, it could easily become a common mean of transportation with no specialty attached. People will not be able to feel the same experience and value it. Most likely it would just be another way to fly while in the past it was more like "living in the future." The couple also said that in the past they valued time over comfort, but that perception switched once they became semi-retired.

4.4 Expert research

Ten people from six different nationalities have been interviewed for this part of the research. Nine of the experts are male, and only one is female. They have been involved in different areas of the air transportation industry which helped to obtain various perspectives. The questions asked varied strongly between the interviews and had been adapted specifically prior each one. All of the experts have been contacted initially through LinkedIn, and then a Skype/phone interview was scheduled. The full transcriptions of the interviews could be additionally provided upon request.

Two people from Spike Aerospace (Aerospace Scientist and Aerospace Engineer), as well as the Vice President of Marketing and Communications at Aerion Corporation have been interviewed. Hence, direct insight from two of the promising companies for bringing back supersonic flight have been gathered. However, no one from the company Boom Supersonic Inc., NASA or Lockheed Martin was reached which is considered as a limitation of the study. The detailed socio-demographic characteristics of the sample could be found in *Appendix 4*.

4.5 Main outcomes of the expert interviews

Out of the ten interviewed experts, eight agree that current, strong demand for supersonic commercial flight exists. Few representative examples extracted from the expert interviews show: "there is a current demand as most of the people want to reach their destination in a very short time with proper safety"; "market trends show good demand for supersonic business jets. Advances in technology make it possible for smaller business jet class supersonic aircraft to operate at costs comparable to current subsonic business jets"; "our market studies indicate a market for 600 supersonic business jets over 20 years. The trend is toward faster, longer-range, bigger business jets." The majority states that for long-haul intercontinental flights people would enjoy it if these can be shortened: "The faster the better, of course", "So far, there is no substitute for 'Physical presence' in either personal or professional life. We will always aim towards faster means to 'get somewhere' – supersonic, hypersonic, teleportation..." One interviewee in particular says that "the trick to get it right is a combination of optimization of travel time and cost to the passenger. This is what sets the trend in market, i.e. small business jet vs large commercial aircraft, supersonic vs. subsonic etc."

Two experts believe that there is a limited demand for a supersonic commercial airplane on the market. These two think that trends in the industry are increasingly for massive low-cost transport and only a limited volume of traffic will pay for the additional costs associated with supersonic flight unless the manufacturers are able to develop a supersonic commercial plane that can operate at comparable costs to current aircraft.

The interviewees believe that the main reasons for Concorde failure were high operating and fuel costs but also the safety concerns brought after one of the planes crashed on July 25, 2000. Although the aircraft pioneered new technologies and concepts, it was just not able to be operated on an economical scale, only with taxpayers' money the aircraft could be operated. That is not a solid economic basis to operate an aircraft. Noise was a big issue due to the sonic boom the plane created which made it practically impossible to

fly over land and this limited the routes Concorde could fly. One interviewee summarizes the general notion as: "It wasn't worth the effort (both time and money) to fix the technical issues. Development of Concorde was already a colossal task without the computational resources, investigating and fixing the glitches was probably unreasonable. Also, the immense pressure after a fatal incidence" (interviewee, 2018).

The upcoming supersonic flight will be focused on a small target group because of the high prices, but there is certainly a demand for it since the high speed makes far away places more accessible. In the end, the people go to a certain location with the goal to get there as fast as possible because in general nobody likes to travel and time is considered as a valuable resource. Speed will never lose its importance, but the difference is that in the 21st century in some airplanes people can use Wi-Fi and actually execute work and entertain themselves, having a direct connection with the rest of the world. This is a luxury add-on that did not exist 50 years ago, but back then nobody had internet anyways so that need was still untapped. However, the need for speed is present and just as great as it was 50 years ago.

The re-introduction of supersonic flight could lead to accumulating more investments on this field and eventually result in better-developed planes which in turn would make supersonic travelling more efficient and accessible to a greater public. Initially, it will be accessible to a smaller audience, but over time it should develop to be available on more routes and to more people. The general answer given by the experts is that it will not have a major impact immediately, but over time this will develop and most likely it will be perceived as a successful disruptive innovation with considerably high reflections on the industry.

People are expected to prefer to fly supersonic over business class because the experts mention that in general speed is more important than comfort. It is partly dependable on the situation as well but in general if the consumer is able to choose it is expected by the experts that supersonic flying (speed) is preferred over subsonic business class (comfort). The majority believe that if someone is travelling for business, which is the most common type of business class/private jet flyers, then the most critical factor for the passenger is time and he/she will prefer faster travel. However, if someone is travelling for luxury on a vacation, then maybe he/she will still prefer comfort.

Mainly due to technological developments, it is considered a logical step in the aviation industry to re-introduce commercial supersonic flight. The expectation is that there will be demand for it and it could be way more efficient nowadays compared to the time when Concorde existed. The near future is the right time to re-introduce this concept to the consumers. It is a logical next step, but then the conditions will be dictated by economics, it can only be a success if the design and concept make it a financially viable operation: "this is possible today more than ever" (interviewee, 2018).

Concorde had an oversized capacity and many times flew with a lot of empty seats. An advantage of the new emerging companies is that they have fewer seats available in their aircraft in order to create a fuel-efficient design. This creates a win-win situation compared to Concorde. Some of the emerging companies are developing the planes as real business jets that can only hold a few people so it will basically always be full which takes away the concerns regarding occupation rate. Optimal seating capacity of a commercial airliner like Booms Supersonic is under construction, and it is seen as the

main competitive advantage among the experts. The current designs handle the issue of noise much better, by design and operational measures, and the interior is much more attractive.

The opinions of the experts on why supersonic flight has not been brought back by any other company are diverse. A main factor is the risk and the uncertainty around its success. It is also mentioned that due to the economic crisis, risky investments like these were mainly avoided. Extensive research in this field has also been carried out, and it has concluded that such an innovation might not have been completely ready yet for re-introduction in order to make it a commercial success. The sonic boom and the risk that a plane that would be developed might not be able to fly over land is also seen as a huge holdback for companies to re-introduce the concept. The unknown market together with financial risks are probably the reasons why it has not been re-introduced yet, but the potential that it brings with it along with the latest technological developments are the reason that nowadays there are concrete plans that could bring back commercial supersonic flight.

The main concerns about the re-introduction of supersonic commercial flight cover safety, design factor, operating costs, regulations for flying over land. Basically, the fact that there are a lot of unknown things about this way of travelling that can only be found out when it is already flying. Also, the fuel costs are mentioned as a huge potential threat. Noise and emission of the aircraft will be among the main challenges. Indeed, the heating of the aircraft, and systems responding to that, also the sonic boom, capacity to transport any cargo. "The concerns are for a great deal associated with the concept that will be chosen for and especially the propulsion system" (Interviewee, 2018).

Flying over land is not seen as a complete necessity to make supersonic commercial flight successful, but it would certainly be beneficial if they could fly over land. Current technological development is reducing the sound of the supersonic booms in order to make flying over land in at least some parts of the world possible. The re-introduction can start with routes overseas, and if the demand and technology permit it, there can be introduced routes over land as well. Various governments would play an equally important role in making supersonic flights a commercial success with regards to certification of flights over land.

Overall, the experts do not seem too worried about the environmental concerns regarding supersonic commercial flying. When asked about the pollution they answer with a bigger concern for pollution in the way of noise. The actual environmental damage by, e.g., emission gases is not seen as a major concern. Both subsonic and supersonic aircrafts have adverse effects on the environment. One of the Aerospace engineers in particular says that "We are not even sure by how much will moving to an electric supersonic plane would bring down the overall carbon footprint until we move entirely to reliable renewable sources of energy" (Interviewee, 2018).

Oil prices are not seen as a big concern either since regular airliners will also have higher costs if the oil prices go up. Rising oil prices would be a concern for the whole airline industry, not only for the supersonic operators. However, "products and business models should be designed to mitigate the overall effects of volatile oil prices" (Interviewee, 2018).

From an engineering point of view, there might be some difficulties to design a safe supersonic commercial plane due to the heat created by the high speed it will be flying on. Thermal expansion at high temperature raises challenges to ensure safety. Engines design is also a great concern for being able to deliver the desired performance and longer life cycle. The technology, however, is much more advanced nowadays than during the Concorde era so it is expected that safer and better supersonic aircraft can be designed and developed. Overall, "companies have the right mind set and approach to make this a reality" (Interviewee, 2018).

4.6 Individual outcomes of the expert interviews

Bernd Liebhardt (one of the main researchers on the topic of supersonic flight, which academic papers also served as an initial reference in constructing the theoretical background) says that nobody knows if there is a demand for the commercial supersonic flight since it is uncharted territory. He is currently a scientist at German Aerospace Centre, and he stated firmly that Concorde was not an actual failure, despite the opinion of others who believe that Concorde was a failed programme.

Anand Amrit thinks that the re-introduction of supersonic commercial flight will have a game-changing effect in the industry, while Bernd Liebhardt thinks the impact will be very minor. Mr. Amrit who is a Ph.D. Candidate in aerodynamics and also works on supersonic design optimization at Spike Aerospace has conducted a survey which has shown that customers want to travel between countries in a single day. For example, customers from the United Arab Emirates want to go shopping in Paris in the morning and would like to have dinner back in their home in UAE.

Aniek Bressers who works at the Operations Office in AIROPS24, mentions in her interview that the re-introduction of supersonic flight might not be the most logical step at the moment for the airline industry and says that a strong environmental focus would be more logical in relation to the existing subsonic options. The consumer interviews conducted in this study pointed out the opposite.

Rahul Rana, Aeronautical Engineer at United Airways LTD, mentions that flying above Mach 2 is not safe for the passengers which could be the reason that supersonic flight has not been reintroduced yet. Strong design and highly cabin pressurize system should be used to ensure the safety of the passengers.

Aakash Chhunchha, Aerospace Engineer, and Independent Contractor Spike Aerospace, Inc. mentions that in order for supersonic commercial flight to be successful it needs to be able to fly over land. He believes that with more research and development on high-speed air travel, advanced materials, propulsion technology, there has been a significant improvement in the technology for the possibility of making supersonic travel, a commercial success. Furthermore, there are plenty of business routes (commercial corridors) which would rather be advantageous to its successfulness.

Jeff Miller, who is the Marketing Director of Aerion Corporation, says that "their plane" is meeting the latest noise regulations, so the concern would potentially be with carbon emissions. It has taken the company several years to identify an engine manufacturer (GE Aviation) and jointly define a viable supersonic engine. He also states: "From our

standpoint as manufacturer, the advantage is that there is a relatively price insensitive market for a business jet, versus an airliner. Therefore, the Aerion AS2 is a business jet not an airliner. Our position is that we can make a significant profit and invest in subsequent generations of aircraft."

Rob Duivis, KLM Program Manager Engineering & Maintenance, expressed concern regarding the environmental sustainability and a stronger belief in the concept of "space flight," instead of a supersonic flight. He also thinks that sales of the supersonic aircraft will be limited, and thus the effect on the industry will also be very limited. He expects the new market players to focus a lot on a comfortable, wide body look cabin with lots of features like Wi-Fi, entertainment etc. which are crucial despite the reduced time on air.

Anutosh Moitra, Aerospace Scientist and Airplane Designer at Spike Aerospace, Inc., suggests that there is no significant effect of speed on passengers. "Sonic boom is an issue on the ground; it does not affect passengers in the cabin. Spike's windowless fuselage cuts down cabin noise substantially compared to other airplanes. High altitude radiation will be of the same order as for current high-subsonic business jets flying at altitudes similar to those of supersonic business jets." Furthermore, he says that at this time there are significant technical challenges (propulsion, materials, sonic boom) for flight above Mach 2.0. Spike's S-512 operates at a "sweet spot" of Mach 1.6. The S-512 is designed by innovations based on available technology without relying on untested technology or technological innovations that may or may not come through in the near future. The interviewee expects that regulations in other parts of the world (excluding the US where the regulations concerning the ban over land are highly difficult to be rectified) will allow overland flight if the sonic boom does not cause excessive discomfort on land. He envisions over land operation, targeting the Europe/Asia landmass.

Konstantin Velkov, Continuing Airworthiness Management Organisation (CAMO) Engineer, thinks that Boom Supersonic will be successful because they are the pioneer that bring back supersonic flight on a bigger scale than business jets. Even when competitors come up, Boom will have the pioneer advantage. He thinks that supersonic flight has not lost any of its necessity over the years. "There might be enough opportunities for uninterrupted communication, but to many people, the face-to-face contact will always be the turning point into striking a successful deal. So, getting to a place as soon as possible would never lose its importance as a factor in travel."

Nishant Agarwal, Aerospace Engineer in Aircraft & Rocket Propulsion, says that "most major companies already have established systems, business models, production-delivery plans. The materials and manufacturing technology available today is multiple times better than in 60's and 70's. Fuel prices have gone up, but so is the paying capacity of travelers. In spite of that, the hope is that with all the advantages we have today the cost to the passengers will be less than what they paid to travel on Concorde. However, for the companies making a disruptive change in the industry can be challenging. Think about trying to steer a giant ship quickly – it is a tough task. That's where disruptive start-ups come in, and Boom Supersonic Inc. is a great example." "At the pace at which technology is growing, there is a small possibility that supersonic flight era could have a short life before we move to the 'next best thing.' The companies leading this business have to be extremely flexible and adaptive to change just like in the computer industry (Apple, Facebook, etc. – giant start-ups)."

Chapter 5 Analysis

This next chapter will provide a theoretical analysis of the empirical data.

5.1 Theory and the study conducted

According to the literature review, supersonic flight is attractive for high-net-worth individuals because of prestige, convenience, comfort, the reduction of travel time. A commercial supersonic jet would pose the ultimate status symbol for business travellers. Park et al. (2006) argued that airline passenger perceptions of service quality are the key drivers of airline passenger satisfaction in the future. The study conducted serves as a two-way premise for the industry and the consumers. Understanding both stakeholders can contribute to achieving the commercial success of the companies promising a supersonic launch in the near future, as well as ultimate customer satisfaction and switching to the supersonic flight service. Through the use of interviews, the researchers enter the world of different people, to understand their perspective.

Kotler argues that the quality starts from the needs of customers (expectations) and ends at the customer's perception. This means that good quality perception is not based on the service provider, but based on the point of view or perception of the customer (Kotler, 2003). Our research focused first on identifying those factors that, from the viewpoint of passengers must be accomplished for quality supersonic air travel. Understanding exactly what customers expect is the most crucial step in defining and delivering high-quality service (Parasuraman, 1991). Broadly, the consumer expects fast transportation with a high-quality service, and that is what the new market players are promising to offer to their potential customers. Ghobadian et al. (1994) show that organizations with perceived high-quality services usually have a higher market share and higher profitability than companies with perceived low quality.

As stated by Christensen, the fundamental challenge of disruptive technologies is "a business model problem, not a technology problem", meaning that the key challenge of technology shifts lies in the interaction between technological development and business model innovation (Christensen, 2006). Presumably, the extracted categories from the Disruptive Innovation theory are interdependent tools that encompass the main value characteristics that the companies should take into consideration. Functionality, reliability and customer convenience must be at a high level since the costs are high as well. Consumers state their perceptions of service quality based on the total service package composed of these dimensions.

The qualitative interviews of this thesis with potential customers were partly aiming to point out whether there is a gap between the management perceptions and the consumers' expectations about the new era of commercial supersonic flight. Service quality is a function of service quality gaps (Candido, 2005). The study shows that addressing gaps 1, 2 and 5 from the Extended model of Service Quality is a straightforward and appropriate way to identify inconsistencies between producer and client perceptions of service performance. Flying habits and preferences of passengers were assessed concerning overall frequency of air travel and international air travel over oceans, the primary purpose (business or leisure) for international travel, distinguished

service values. In short, the commercial society emphasizes that time is money and customers using the various needs that were recognized in a business class plane as references for the service quality evaluation criteria of a future supersonic plane. Travelers are willing to pay more for speed and premium services. The way consumers evaluate service quality is affected by the understanding of what features a service must have in order to meet consumer needs and what levels of performance on those features are needed to bring deliver high-quality service.

In terms of functionality:

The time duration that the company Boom Supersonic Inc., for instance, provides on their website, is the amount of time the aircraft spends in the air. The results of the interviews yield speed and velocity equally important, "making far places appear closer." Customers will still have to go to their gates to leave the airport and also, they will need to pick up their luggage like other people as well. Factors such as flight delays and cancellations due to security, breakdowns, and weather, can prolong time spent at the airport. This could make the whole experience not as fast as 'promised' which is a key consideration, especially to business travellers. Therefore, airlines offering supersonic flights must pay particular attention to being on time since time-saving is the core value, if this trust is broken on their first journey, then the passengers may prefer to take other travel options, and that will deteriorate the commercial success of the plane. Moreover, passengers' perceptions of service quality are directly influenced by their expectations of how the service will facilitate their activities during the time spent on waiting at the airport and the aircraft. Environmental concerns related to the airplane performance are not a primary factor of consideration for the potential passengers, but the plane producers and institutions perceive it as one of the most crucial matters.

In terms of reliability:

Reliability is deemed the most important service quality dimension along with comfort. A reliable aircraft that does not come with too many irregularities that can cause trouble is the basic goal. The service provider's ability to perform the promised service both dependable and accurately is another component of reliability. Customers expect reliable service delivery and that the service is delivered on time. The external communication, circulating on the internet about the reliability of the plane is not much into detail, but the people expect a functioning aircraft that lives up to the promises on safety from the producers' side.

In terms of customer convenience:

The companies are promising an "all-premium-class airplane." The question here is if they will be able to live up to this promise, and if travellers perceive the comfort level worth to pay for, or if they prefer the regular first- and business classes from the non-supersonic airliners. The results outlined comfort as being the main value especially for longer flights and a more important value than speed in general. People have brought tangibility as an important value consisting of all tangible objects that form the perception of service quality in a plane - i.e., comfortable seats with enough space, provision of flight meals, the convenience of baggage panels, etc. These variables from the side of the service provider could have significant differences between expectations and perceptions.

In terms of costs:

Price is initially used as the primary competitive weapon by producers. Consumers consider it as an external factor that is not directly related to service quality, but it inevitably influences their perceptions of using the supersonic flight service. The ticket prices provided by the companies are estimations, the question is if they can actually live up to the prices they promise. Even though the ticket prices are said to be three times cheaper than the Concorde's ticket prices (Johnson, 2017), a round trip London - New York would still cost around 5,000 USD. Concorde raised their ticket prices in the past up to 12, 000 USD when they noticed that people did not know how much they were paying for their tickets. It turns out that many of the business class passengers that have participated in the conducted interviews do not pay for their own tickets which is probably the reason why the price is not mentioned that often as a value. Price is mentioned by less frequent business class flyers who usually have to pay for their own tickets. There is a correlation between these two factors. The interesting part is that later in the interview, people mostly estimate supersonic flight to be worth more than a business class tickets. It is mentioned many times that people value it to be 10-25% more expensive. However, the majority of the interviewees are expecting a high quality of service in return, stated a much lower desired ticket price than what is stated as a preliminary price by companies like Boom Supersonic Inc. Hence, there is a gap between the price perceptions of the producer and the consumers' expectations on rational ticket price. In general, although all of the interviewees representing the potential consumer flew business class at some point in their life, as that was the preliminary selection criteria, most of them do not always use it, and the price seems to play a major role especially when the travel expenses are not covered by their employers.

Technology and service offering

Promising companies like Boom Supersonic Inc. have made their service quality specifications in terms of functionality and cost fairly transparent. For instance, Boom has pointed out clearly that they would be flying at M. 2.2, which is 2.6 times faster than any other airliner. This means New York to London in 3 hours and 15 minutes instead of 7 hours. "Seat dimensions will be similar to a short-haul first class with many subtle and not-so-subtle design improvements" (Boom, 2017). However, the 'subtle and not-so-subtle design improvements' can be interpreted differently by the consumer than what is meant by the company itself. Lastly, there is the reliability of the aircraft and its service. This includes the flying of the aircraft without delays of any kind, which is not completely in the hands of Boom Supersonic themselves, but also it is under the direct responsibility of the airlines. For Boom and the other key players, it is primarily important that they build a safe and reliable plane that will not come with problems which could halt the innovation.

By aligning technology with the service offering, the manufacturing firms could emphasize innovation in the value proposition offered to the potential customers. This service strategy presents a way for the firms to differentiate themselves and achieve competitive advantage. Technology may enhance air transportation with infrastructure, vehicle and fuel improvements that conserve resources, reduce pollution, or improve safety, comfort convenience and timeliness.

In this research, business and first-class passengers expressed their opinions about these service characteristics in relation to the innovative future supersonic plane. The perceived value that forms service quality encompasses three main dimensions - perceived quality, emotional value and social value. Ticket price appeared as a separate but inevitable consideration regarding service quality. We found that perceptions about service quality are differentiated among the various groups of users and influenced by socio-demographic characteristics. However, the overall perception of using supersonic flight is positive, and the willingness to change to supersonic transportation is found to be high. The model below summarizes the main dimensions yielded during the categorization process which influence and form the positive perception of the potential consumer.

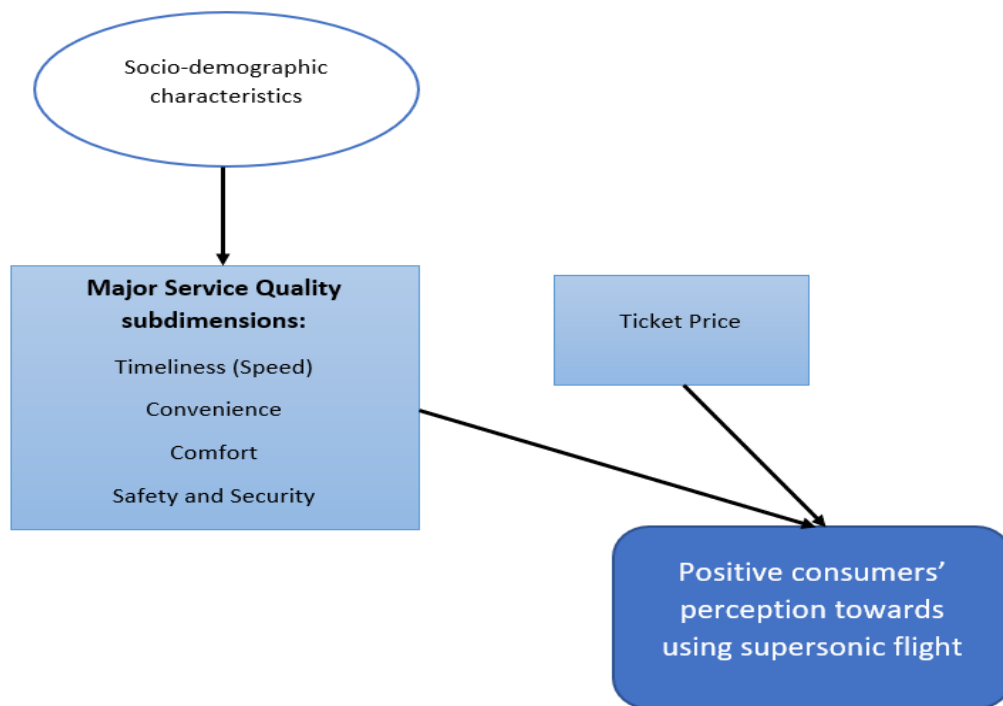


Figure 9: Factors influencing consumer perceptions of service quality when using supersonic flight (created by the authors)

In terms of the gap analysis, the next section will answer the three gaps (as 5 being a function of 1 and 2).

Gap 1 (consumer expectations - company perception gap)

The companies are focusing on the value “speed,” but that is solely regarding the speed gained in the air. The interviews pointed out that the consumers are also concerned about what happens on the ground and the time they have to spend at the airport before and after the flight. The consumers also expect smooth and a lot faster travel but probably at the end, they might not be completely satisfied considering the whole service delivery process (Figure 3, Chapter 4.1) because the overall time they save on the whole travel is not so much in the end.

Gap 2 (company perceptions - service specifications perception gap)

The people want speed but the longer the flight is, the more important the comfort becomes. Companies like Boom Supersonic Inc. are planning really far flight destinations, e.g., Sydney to Los Angeles in 6 hours and 45 min, instead of 15 hrs. However, current regular short-haul business class seats do not fulfil the preferred comfort level for such a long flight. Therefore, the producers of a supersonic aircraft should consider that sitting for 7 hours in a plane is still a long time. Thus, there might be a need of business class within a supersonic aircraft that offers extra comfort. There will probably be people willing to pay premium prices to get this extra level of comfort on top of the supersonic speed. The target audience might not be big, but there would be a demand for it. In this way, the supersonic commercial flight operators could position themselves as direct competitors to the small private business jets offering speed advantage. However, the whole service delivery process as shown in Chapter 4.1, *Figure 3*, should be restructured in a way that the supersonic flight will provide fast and smooth on-ground service which will make it able to fully compete with the existing private business jets.

Gap 5 (consumer expectations - perceptions of service delivered gap)

The personal need is to go from place A to place B as fast as possible. The supersonic flight is expected to deliver that service. The actual service is not delivered yet but based on the interview outcomes, we can predict that people are probably going to be slightly dissatisfied since the rest of the process is just the same as in regular subsonic air transportation. Eventually, the time saved on the whole travel might not be significant enough for the consumers to switch from business class to supersonic flight.

The past experience from Concorde is perceived as extremely outstanding feeling that made people feel special to be among the first flying above the speed of the sound, and their social status widely recognized. Status is closely viewed in terms of greater comfort because the current aviation speed is the same for everyone but the comfort is the main point of distinguishment. Recreating the past experience will be hard for the upcoming supersonic companies, especially as they seem to be focused more on the speed itself than everything around it. They do offer better seats than the Concorde, but furthermore, the focus is not on the experience itself. The whole Concorde experience was perceived as very special, not only due to the in-flight experience but also because of the experience on the ground before the flight. The upcoming supersonic companies seem to take this aspect less into consideration, but it was mentioned as an important part of the whole experience by the interviewees who actually flew on board of Concorde.

Chapter 6 Conclusions

In the following chapter, the conclusions will be presented systematically in order to answer the research question and fulfil this thesis purpose.

6.1 Discussion in relation to Research Questions 1 and 2

How could the next generation of commercial supersonic passenger flight be viable and successful?

The research data collected forms a partial answer to this research question due to the fact that estimations about future cannot be made with complete certainty. In preparation for rapidly increasing air transportation demand, expansion of aircraft possibilities for shrinking the flight time seems necessary to satisfy long-term needs. The findings are in accordance with future expectations claiming that the number of passengers flying over longer distances is increasing and is expected to grow even more in the future. Therefore, a demand for supersonic flight exists and people are willing to use it as long as the plane satisfies their expectations of service quality. This means that companies like Boom Supersonic Inc. and airline management together with the joint effort of governments and institutions must have a good understanding of how passengers assess service quality. Nowadays, the homogeneity of airline services should serve as a principal factor in the design of a competitive strategy through differentiation in terms of the services that will go along with the supersonic flight. This is essential to the successful introduction of high-quality services. The research takes the most important theoretical foundations together with the outcomes of the interviews with the industry experts. Despite those being solid opinions based on knowledge and expertise in the field, the outcomes are not sufficient for a generalizable conclusion. It is impossible to determine if the next generation of supersonic flight will be successful, but at least the market players can take into account the values mentioned by the consumers in relation to the research question below.

What is the perception of the target group and their willingness to change to supersonic flight service?

The outcomes of the research provide a complete answer to this question. This study can be considered as the first systematic study of the specific impact of linkage between passenger expectations and perceptions relating to the importance of service quality and the way companies can make supersonic flight successful. While the study results can by no means be considered generalizable to the extent that it can predict passengers' likelihood of selecting supersonic flight service with absolute accuracy, it does give a reasonable expectation of how passengers will react with regard to their decision-making based upon the importance of service quality dimensions. This research has pointed out a relatively positive perception, and a high willingness - 21 out of 28 participants claimed that they would be using the future supersonic aircraft. People are curious to try the supersonic flight even though speed is not mentioned as the most important factor by the interviewees but they seem to value the concept. Instead, comfort is seen as crucial but people in general are willing to sacrifice some comfort, if they can reach their destination faster. There might be a potential to turn the current business class travellers into

frequent supersonic flight customers if the industry manages and airline service providers deliver a completely satisfying experience.

6.2 Conclusions

In a nutshell, the research tried to apply the gap-model instrument and the theory of disruptive innovation in the context of supersonic flight by collecting opinions from experts and consumers. At the beginning of the consumer interview, travellers were asked what their values are, and comfort was mentioned way more often compared to speed. That shows that speed is not the first thing that pops up in their mind. Therefore, we can conclude that the overall awareness of the concept of supersonic flight and the technological developments that come along with it is quite low. Later, when the interviewers mentioned the speed as a factor and purposefully made people actually compare it to comfort, the majority preferred speed over comfort, and they were generally willing to pay more for it. The expert opinions collected the feasibility of the upcoming generation of supersonic flight has pointed out that comfort and speed are both important. A major problem on board of the Concorde was the comfort, but this was compensated by the whole service and experience on board about the Mach 2 speed. For the new supersonic airliners, it would be viable to ensure that passengers are feeling comfortable, even though their main goal is achieving high speed. The Concorde was a fun experience, but in order to create a sustainable plane, more comfort is needed than the Concorde had.

Despite the ultimate importance of developing a high-speed commercial aircraft, the uncertainty regarding supersonic flight is still quite high due to the many technological, environmental and economic forces. Clearly, supersonic travel is not planned to be introduced as a takeover on the existing commercial aviation. However, based on the predicted by industry experts substantial market demand, the high level of curiosity of the potential customers interviewed and their positive perceptions towards using it, one can conclude that the supersonic flight has the scale possibility to be highly successful. Another important conclusion is that the prices for tickets could be even higher than business class tickets because in the interviews the consumers mostly think that the experience and the values associated with it justify the higher prices. In turn, higher ticket prices would compensate for the high operation costs affiliated to the supersonic flight.

It seems like the challenging opportunity to fly faster than the speed of the sound would be introduced in the near future, and initially, it will encompass a small target group of passengers. However, with the upcoming technological advantages and rising popularity, it will become accessible and useful to a broader public, and that could lead to a profitable supersonic commercial flight on a greater scale. Although supersonic flight over land is currently restricted due to noise concerns, according to the experts, the new market players have the ability to produce sonic booms barely audible from the ground and thus enrich the feasibility of this innovation.

Achieving a greater understanding of supersonic commercial's disruptive emergence offers tremendous practical value, and there is every reason to believe that such knowledge will only increase in importance as the supersonic passenger transportation niche continues to prominently and firmly develop itself. Moreover, the many issues

related to supersonic passenger flight as disruptive innovation could have an impact on other areas of international connectivity, ranging from major tourism stakeholders, including tourists, residents, tourism bureaus, car rentals, hotel accommodation services and governments.

6.3 Implications for further studies

The thesis is a result of our interest to study a challenging, disruptive innovation phenomenon such as the upcoming generation of commercial supersonic flight in a contemporary context, encompassing views of different social actors. Apart from the answers to the research questions reported in the previous chapter in the process of collecting empirical data the authors have gathered other valuable information that can become a starting point for further research. In this section, the authors of this thesis would like to make some preliminary implications for further research on commercial supersonic flight success. While the overall path to making this vision a reality cannot be predicted with absolute certainty, there are key elements that need to be considered. Issues raised by supersonic transport cover a broad range of scientific, technical and socio-economic disciplines, offering numerous topics deserving investigation using theoretical analysis, numerical and experimental tools. Therefore, further efforts are required for closer collaboration between both the industry and the academy that will speed up the process of bringing commercial supersonic flight back in the next years and maintaining commercial success. Moreover, this study has clear implications for service quality measurement and management.

The most immediate work that would need to be done to improve this study is determining how the planes will operate and connect with consumers. Airports near large economic centres have to be considered, in particular, as most long-haul supersonic aircraft will supposedly cover such areas. Expected growth in air traffic cannot be accommodated for long with the world's current airports and aircraft. In fact, in developed countries, there are few airports that can be added (Liebhardt, 2011). Hence, airport feasibility and major airlines such as Japan Airlines which have already ordered supersonic planes from Boom Supersonic Inc. to enlarge their fleet need to be utilized in a future study. The four extracted factors from the discussed Disruptive Innovation theory (functionality, reliability, convenience, and cost) could be further explored taking the perspective of airports and major airlines regarding supersonic commercial planes. Thus, airline managers responsible for decisions regarding the purchase of supersonic aircraft should be reached. Estimation models based on statistic data on technical characteristics, as well as information concerning the supersonic aircrafts' sales to airlines and ticket sales to consumers need to be gathered.

In this report, we have investigated the opinion of business and first class travelers who have been using standard subsonic planes. A profound analysis needs to be executed benchmarking the economic potential and cost of a supersonic plane with ultra long range and medium weight class business and private jets. The supersonic commercial plane could be at a clear disadvantage in case the higher costs and ticket price versus less flight duration do not justify consumers' time spent on waiting at airports, especially in case of connection flight immediately before or after the supersonic journey. This is vital as time is found to be the main consumer value according to the collected interview data.

Although the study frames positive perception of target consumers, independent research needs to examine a larger population to connect the gaps, as volatile public opinions and negative media reporting could keep prospective supersonic planes grounded despite satisfactory technical performance. Hence, another aspect is a deeper look at the utilization of social media platforms by the innovative companies aiming to reintroduce supersonic flight.

In order to examine the daily operation of the supersonic commercial flights as experienced by the passenger, it is required to consider time zone travel effects. It becomes essential to determine under what operational conditions the plane does provide truly practical time benefit and to comprehend the sensitivities with the help of route analysis. Moreover, a substantial post-launching competition analysis should examine which of the current promising market players have succeeded in reintroducing the plane and which ones (if any) did not bring back the plane and what were the unforeseen obstacles.

The air travel industry, currently consisting of subsonic planes should be re-examined in order to investigate how it copes with the disruptive innovation brought by the supersonic plane and the occurring challenges. Prospective research should be conducted after the first supersonic plane is launched, in order to grasp the opinions of the consumers who experienced the supersonic commercial flight and examine the actual market demand and satisfaction of the provided service quality. Major discrepancies between the results offered in this report and such kind of study could occur. The applied Extended Gap Model of Service Quality could be further applied including gaps 3: service quality specifications-service delivery gap (gap between service quality specifications and actual service quality) and 4: service delivery-external communications gap, which were both deliberately omitted in the present research.

The theories applicable in this research were developed several years ago, and they are very general in their nature. Therefore, we would like to propose that future research would focus on developing specific theories regarding the studied potential disruption within different industries. Also, integrating additional methods of data collection would increase the depth of analyses. Further research could build on this study by employing a quantitative approach, in order to statistically generalize the results and broaden the scope of the research. A similar study could be conducted with a larger sample size so that results could be generalized to the population of interest. Integrating a questionnaire would generate more respondents, thus leading to a larger amount of relevant data. This could lead to a different outcome/conclusion to the research questions, in comparison with using only qualitative interviews (Babin, 2016).

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Appendices

Appendix 1 Semi-structured interview guidelines for industry experts

1. Is there a demand for supersonic commercial airplane on the market? What are the trends in the industry?
2. Do you think that supersonic flight is still as necessary as it was 50 years ago? Since time on board is not necessarily a waste anymore given the fact that more and more airliners have internet connections on board and that people can bring their laptops to work or entertain themselves with the onboard facilities.
3. What kind of effect do you think the re-introduction of supersonic flight will have on the airline industry?
4. Do you think that people would prefer to fly above the speed of sound over business or first class in a regular airliner?
5. What was the main reason for the failure of Concorde in your opinion?
6. Do you think it is a logical step for the aviation industry to re-introduce the concept of supersonic commercial flight?
7. What do you think are the main competitive advantages of the new market players (Boom Supersonic Inc, Aerion Corp., Spike Aerospace) compared to the Concorde that could hold more passengers in a time that the fuel was less expensive?
8. Why do you think that no other company has brought back supersonic commercial passenger flight?
9. What are your main concerns about the reintroduction of supersonic commercial flight?
10. Do you think that the difficulty to fly with supersonic over land, is a big disadvantage for the upcoming generation of supersonic flights?
11. What do you think about the environmental concerns regarding supersonic flight? Assuming that it will be successful and that there will be many supersonic commercial flights each day.
12. Do you think that fluctuating oil prices might be a threat for the potential success?
13. What are the concerns from an engineering point of view? (Above 2 mach due to the heating and the speed)
14. How will the new market players reassure the comfort of the passengers? (sonic boom, flying too high, higher speed)

15. Do you think that any of these emerging companies can make supersonic commercial flight successful? Why?
16. Can you recommend us a good research on supersonic commercial flight? And/or can you recommend us somebody who has knowledge on this field as well whom we could possibly interview for further insights?

Appendix 2 Semi-structured interview guidelines for target customers

Hello, thank you for participating in this interview. We (Nadezhda Nacheva and Gijs Heldens) are conducting a neutral research for our Master thesis on the field of supersonic commercial flying. Supersonic flying means flying above the speed of sound. The research is about finding out how to make supersonic flight a commercial success. Concorde used to be the only plane that was flying supersonic, but it retired in 2003 due to various reasons. Some startup companies have plans to re-introduce supersonic commercial flight after Concorde's retirement in 2003 and we are doing research on how this could be a commercial success. During this interview I am going to ask a few questions about this subject, you have been chosen because you are flying business class or have flown business class in the past. The prices for a ticket on board of a supersonic commercial aircraft are said to be similar to the costs of flying business class nowadays, so people like you are considered to be potential customers in the future. The questions that are asked below, require little to no further knowledge, we just like to hear your honest opinion and if any question is unclear, don't hesitate to ask so it can be further explained.

AGE:

NATIONALITY:

SEX:

JOB:

1. What is your main reason to fly, business or leisure?
2. How many times do you travel by plane annually? How often do you fly business or first class?
3. What are your main values when travelling from your home to your destination if you are going to another continent?
4. What is the main reason for you to fly business or first class? What is your perception of service quality? Which factors of this service are important to you?
5. How important would you think the **velocity and speed** are when flying to another continent, and how important you would say the **comfort** of the travelling is?
6. How willing are you to give Supersonic flight a try if it is at the same cost as business/first class?

7. Do you think that the ability to get more than two and a half times faster by supersonic flight to anywhere in the world will change your attitude towards long distances? If yes; in which way?
8. Do you usually pay for your own tickets when flying business or first class? Or is it paid by e.g. the company you work for?
9. To what extent does environmental damage matter to you when you use air transportation?
10. How much would you be willing to pay for flying intercontinental at supersonic speed compared to business class? What would be worth more to you?
11. Would you be willing to fly with less comfort for the same price if that would mean that you fly more than 2 and a half times faster?
12. Is there anything you would still like to share with us on this subject? Maybe even something that we might have overlooked in this interview in your opinion?
13. Extra question: Did you ever fly on board of the Concorde? If so, could you tell about your experience? What were your main points of critics and what did you like the most about it?

Appendix 3 Consumers' interview - demographics

	Age	Nationality	Sex	Job
Interview 1	52	Dutch	Male	Business owner
Interview 2	41	Chilean	Female	Business owner
Interview 3	27	Mexican	Male	Crop dusting pilot
Interview 4	47	Dutch	Male	Technical service manager
Interview 5	26	American/ British	Female	Graduate assistant
Interview 6	29	Hungarian	Female	Software engineer
Interview 7	29	Greek	Male	Business consultant
Interview 8	26	Mexican/ Italian	Male	Student
Interview 9	23	Slovenian	Female	Student
Interview 10	39	Bulgarian	Male	Brand Marketing Specialist

Interview 11	52	Dutch	Male	Sales director
Interview 12	47	Canadian	Male	Business owner
Interview 13 (double interview)	55, 61	Irish and British	Male and Female	Marketing communications professional & Retired
Interview 14	27	Spanish	Male	Supply manager
Interview 15	58	Canadian/ American	Male	Business owner
Interview 16	80	Dutch	Female	Retired
Interview 17	30	German	Female	Media designer
Interview 18	55	Dutch	Male	Area sales manager
Interview 19	57	British	Male	Director of business development
Interview 20	32	Bulgarian	Female	Jr. culture expert
Interview 21	25	Dutch	Male	Politician/ Business owner
Interview 22	34	Bulgarian	Male	Technical Trainer
Interview 23	25	Hungarian	Male	Entrepreneur/3D Artist
Interview 24	25	Bulgarian	Female	Marketing Coordinator
Interview 25	45	Romanian	Female	Project manager
Interview 26	38	Bulgarian	Male	Architect
Interview 27	31	Saudi Arabian	Male	Freelancer

Appendix 4 Experts' interview - demographics

	Name	Nationality	Sex	Job
Interview A	Rahul Rana	Bangladesh	Male	Aeronautical Engineer at United Airways (BD) LTD
Interview B	Konstantin Velkov	Bulgarian	Male	Continuing Airworthiness Management Organisation (CAMO) Engineer

Interview C	Jeff Miller	American	Male	Vice President, Marketing and Communications at Aerion Corporation
Interview D	Bernd Liebhardt	German	Male	Scientist at German Aerospace Center
Interview E	Anutosh Moitra	Indian	Male	Aerospace Scientist, Airplane Designer at Spike Aerospace, Inc.
Interview F	Aakash Chhunchha	Indian	Male	Aerospace Engineer, Independent Contractor Spike Aerospace, Inc.
Interview G	Anand Amrit	Indian	Male	PHD Candidate at Iowa State University of Science & Technology
Interview H	Aniek Bressers	Dutch	Female	Operations Office at AIROPS24
Interview I	Rob Duivis	Dutch	Male	KLM Program Manager Engineering & Maintenance
Interview J	Nishant Agarwal	Indian	Male	Aerospace Engineer - Exp. Aerodynamics/CFD/Aircraft & Rocket Propulsion