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Exploring business opportunities in aviation industry

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Thesis abstract

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The aim of this thesis was to discover new opportunities in aviation industry to facilitate a profitable and viable business in Finland with the possibility to expand worldwide propelled by the disruption of the industry by COVID-19. The thesis reviews the aviation industry and explores four potential business opportunities with the help of Lean Canvas models and cost-revenue calculations. With an online survey, more in-depth results were gathered to validate the alternatives and eventually the best opportunity was further developed to a more complete strategic business plan.

The research data was primarily collected by using quantitative research method and an online survey. The objective of the online survey was to gather data from aviation industry experts and professionals in order to find out the market potential and possible stumbling blocks of the opportunities. In addition, this thesis gathered and compared data from variable online resources and was able to create a picture of the global situation of the COVID-19 affected aviation industry with some predictions for the future.

The results indicate that there exists a need for drone pilot training due to safety concerns created by increased amounts of drones and lack of regulations concerning skills and knowledge of the drone pilots. Looking at the business opportunity after conducting different analyses it is obvious that drone pilots will be needed at least in the next decade and even later until automation technology reaches a safe and reliable status, especially in terms of big drones and specialized drone services.

Keywords: aviation industry business opportunities, multidisciplinary educational platform, drone pilot training, fear of flying, augmented reality, virtual reality

SEINÄJOEN AMMATTIKORKEAKOULU

Opinnäytetyön tiivistelmä

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Opinnäytetyön tavoitteena oli tutkia uusia mahdollisuuksia ilmailualalla mahdollistaen kannattavan ja toteuttamiskelpoisen yrityksen Suomessa ja mahdollisuutta laajentua maailmanlaajuisesti COVID-19 viruksen aiheuttamassa alan häiriötilanteessa. Opinnäytetyö tarkastelee neljää liiketoimintamahdollisuutta Lean Canvas-mallien ja kustannus-tulolaskelmien avulla. Internet-kyselyä käyttäen kerättiin perusteellisempia tietoja vaihtoehtojen validoimiseksi ja lopulta paras liiketoimintamahdollisuus kehitettiin kattavammaksi strategiseksi liiketoimintasuunnitelmaksi.

Tutkimustiedot kerättiin pääasiassa käyttäen kvantitatiivista tutkimusmenetelmää ja internet-kyselyä. Internet-kyselyn tavoitteena oli kerätä tietoja ilmailualan asiantuntijoilta ja ammattilaisilta, jotta liiketoimintamahdollisuuksien markkinapotentiaali ja kompastuskivet saataisiin selville. Lisäksi tämä opinnäytetyö keräsi ja vertasi tietoja erilaisista verkkolähteistä ja sai luotua kuvan COVID-19 vaikutuksesta ilmailualan maailmantilanteeseen muutamien ennusteiden kera.

Tulokset osoittavat, että drone-lentäjäkoulutukselle on olemassa tarvetta johtuen turvallisuushuolista, joita lisääntyneet droonimäärät ja drone-lentäjien taitoja ja tietoja koskevien säännösten puute aiheuttavat. Kun tarkastellaan liiketoimintamahdollisuuksia erilaisten analyysien suorittamisen jälkeen, on selvää, että drone-lentäjiä tarvitaan ainakin seuraavana vuosikymmenenä ja jopa myöhemmin, kunnes automaatioteknologia saavuttaa turvallisen ja luotettavan statuksen, etenkin suurten droonien ja erikoistuneiden droonipalveluiden suhteen.

Asiasanat: ilmailualan liiketoimintamahdollisuudet, monitieteellinen koulutus foorumi, drone-lentäjäkoulutus, lentopelko, lisätty todellisuus, virtuaalitodellisuus

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Terms and Abbreviations

AI	Artificial Intelligence
AR	Augmented Reality
ATPL	Airline Transport Pilot Licence
CAGR	Compound Annual Growth Rate
COVID-19	Corona Virus Disease 2019
CPL	Commercial Pilot Licence
EASA	European Aviation Safety Agency
FAA	Finnish Aeronautical Association
FNPT	Flight and Navigation Procedures Trainer
FTK	Freight Tonne Kilometre
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technology
IVAO	International Virtual Aviation Organization
m^2	Square meter
N/A	Not applicable
pcs	Pieces
PPL	Private Pilot Licence
RPK	Revenue Passenger Kilometre
RTK	Revenue Tonne Kilometre

R&D	Research and Development
Traficom	Finnish Transport and Communications Agency
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
USD	United States Dollar
VR	Virtual Reality

Tables and Figures

Special Symbols

€	Euro – currency of countries of the euro area

1 INTRODUCTION

1.1 Outline of the thesis

This thesis research mainly lies on the analysis of resources from various trustworthy organizations and authors such as ICAO, IATA, and industry expert authors. Official documents such as Future of Aviation article and Aviation Benefits Report published by ICAO ([ref. 14 April 2020; 2019) in addition to industry expert organization's and author's publications such as Efficient Technology by Aviation Benefits Beyond Borders ([ref. 13 April 2020]) and Dean Donovan's (2020) article How The Airline Industry Will Transform Itself As It Comes Back From Coronavirus published in Forbes, are only a few examples of a great variety of resources used to form a clear image of the potential business opportunities in the aviation industry. Furthermore, European, and Finnish local aviation authority websites and statistical analysis providers such as Statista were used to validate the overall situation of the aviation industry.

The past, current situation and future of the aviation industry are discussed and some specific moments in the history are highlighted considering the difficulties that COVID-19 pandemic has posed. Until 2019 the industry had a bright future, increasing importance, and forecasts were showing great expansion of airplane fleets as well as direct and indirect aviation related employment. However, since the virus outbreak, the industry forecasts were not applicable anymore and new forecasts had to be made. Only during a few months' time between April and July, the forecasts have changed and are currently predominantly showing a slower than expected recovery to the pre-virus traveling levels.

It has been a trend for decades to strive for new technological innovations to develop the industry and it is evident that this trend will continue. Many resources indicate that the most relevant developments in aviation industry will be some sort of technological breakthroughs such as wider use of augmented reality in commercial air travel operations. However, this thesis also considers opportunities which are not technology dependent by nature but rather show their potential in fields not yet fully

explored. An example of such opportunity would be to find a way to help passengers to cope with their fear of flying effectively.

The opportunities covered in this thesis were chosen according current information retained from the trustworthy resources and findings made by the author by analyzing industry numbers. These opportunities were further studied with the help of Lean Canvas business plan template and cost-revenue calculations based on the average figures of each topic in question in Finland. Eventually a more focused online survey was conducted to find out in-depth information from industry experts.

Valuable information was gathered from the survey and the best business opportunity was chosen and a possible business concept was created by comparing similar operating companies in Finland. Finally, some recommendations for further research were given to fully explore the potential of the opportunity.

1.2 The opportunity

Although year 2020 is going to be rather devastating for the entire aviation industry due to the COVID-19 virus pandemic outbreak, the past years have indicated increasing passenger amounts leading to increasing number of employees and aviation enthusiasts. This suggests that in the near future some of the pilots, airplane mechanics and air traffic controllers who temporarily cease their work, might want to maintain their professional skills through being in touch with other professionals or they might be looking for new work opportunities related to the industry.

This also would be a good opportunity to activate the current aviation personnel to cooperate in tutoring and training in a simulated environment. After a while, when the aviation industry returns back to normal, this new way of education would have already sparked more interest and popularity among professionals and engaged them to be willing to share their knowledge and know-how with aviation enthusiasts. In aviation studies the topics are vast and there is much to learn. Sometimes it can be challenging to picture some matters without seeing them in real life and there is limited time for consultation with the teachers. Especially exams for the pilot licenses can be demanding since they are focused on specific matters that might require

comprehensive studying. This can be achieved via support of professionals on their free time.

These professionals could also help people to relieve the fear and stress of flying through explaining the flight operations with physical equipment and visual aids. The explanations could have a calming effect on these people and could help them to cope better in the real airplane environment.

One commercial field, which has made a significant impact to the aviation, is unmanned aircraft systems i.e. UAS or more commonly known as drones. The usage of these devices in commercial sector has increased dramatically within the past five years, and all the time new opportunities are discovered.

Along with drones, augmented reality (AR) and virtual reality (VR) are becoming increasingly attractive to utilize in aviation, mainly in entertainment but also as a cost-effective performance enhancement.

Aviation has an important economic global role. Figure 1 shows that direct effects of aviation to the global economy in 2016 was over 704 billion USD and the overall effect including indirect, induced and tourism was altogether 2.7 trillion USD. Furthermore, predictions by ICAO (2019, 7-9), show that aviation will continue to have an important role in the future and by 2036 the economic impact will double form the level in 2016. The number of active pilots in airline industry in 2018 worldwide, according to statistics by Mazareanu (2019) in Figure 2, was 305 000. Mazareanu also forecasts the number of pilots to increase by 160 000 within ten years and reaching a total of 465 000 pilots by 2028. Both figures tell the same story, aviation industry and the worldwide economic benefits are already globally significant, and they are expected to grow substantially.

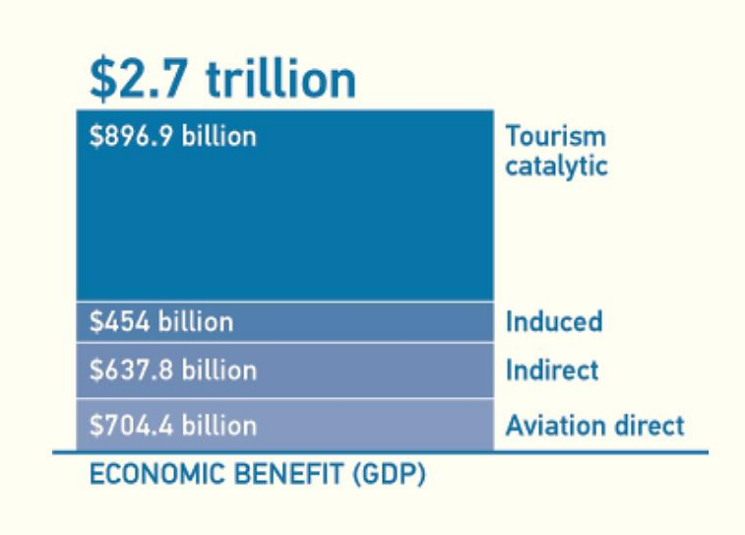

Figure 1. Aviation industry value to the global economy (Aviation Benefits Beyond Borders [ref. 6 May 2020]).

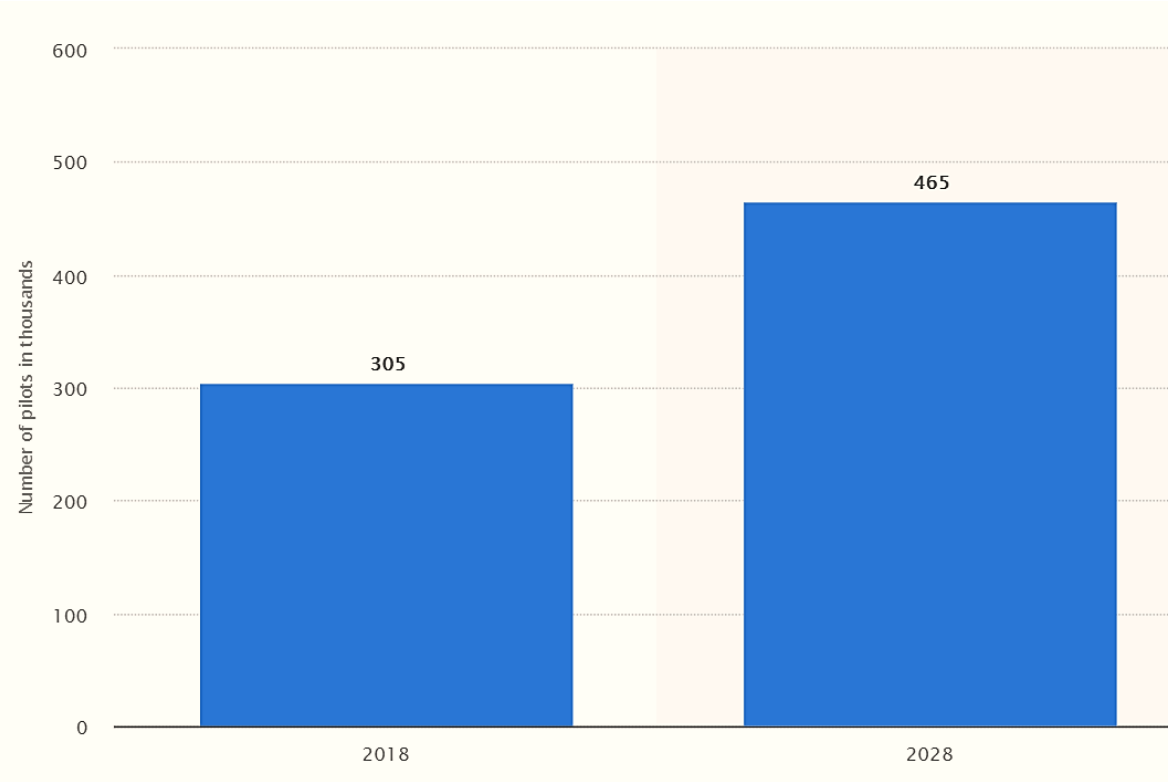

Figure 2. Number of active pilots in the airline industry in 2018 and 2028 (Mazareanu 2019).

However, these predictions are bound to change due to effects caused by COVID-19 outbreak. Since the beginning of 2020, aviation industry has been trying to survive the huge cuts in passenger amounts and decreased revenues. Nonetheless, the new situation might open new uncharted business opportunities or make already existing ones viable and profitable.

1.3 Objectives

The objectives of this thesis were to research the market potential for a new business opportunity in the aviation field in Finland and potentially worldwide. The research focused on targeting new business opportunities and finding ways to merge them with most suitable operations by defining general overview of the business models.

By analyzing different aspects of the aviation industry, comparing future predictions in technology, and researching business fields which remain not fully explored, four potential business opportunities were identified. Lean Canvas study and the outcomes from the online survey were analyzed and the most suitable options for the business were chosen. Online survey was conducted to gain more knowledge and professional opinions.

For the thesis, different opportunities were chosen, separately reviewed and compared in depth to reach a decision of the most suitable business opportunity for a new company. Additionally, an appropriate research method was considered and chosen to achieve enough data for analysis and to be able to create more accurate recommendations for the business opportunities.

The research aimed to create a set of feasible options for a new business in aviation industry in order to establish a competitive advantage by cross examining and comparing different relevant opportunities showing great potential for the future. This thesis does not discuss all the business opportunities available, rather it focuses on the deeper investigation of four topics.

2 INDUSTRY ANALYSIS

2.1 Overview of aviation

Aviation has become the enabler of global business and provides the only rapid worldwide transportation network, generating economic growth, creating jobs, and facilitating international trade and tourism (ICAO [ref. 14 April 2020]). Aviation is mainly divided to two main categories, civil and military aviation. Civil aviation can be further divided to general aviation and scheduled air transport. Scheduled air transport encompasses passenger and cargo transportation. General aviation consists of all non-scheduled civil aviation and includes a vast number of activities such as private aviation, flight training, air ambulance and, as a newcomer starting from July 2020 in EASA member states, drones to mention but a few (ICAO 2010, 37).

The golden years of aviation in terms of passenger comfort and glamour took place between 1920s and 1970s (Hadaway 2013). However, during the past decade, transportation of passengers and cargo has become more common. The popularity increase of aviation can be also seen in Figure 3 statistics by Mazareanu (2020), showing growth over 800 million in passenger amounts three years in a row since 2015 and altogether almost 1.9 billion between 2008 and 2018.

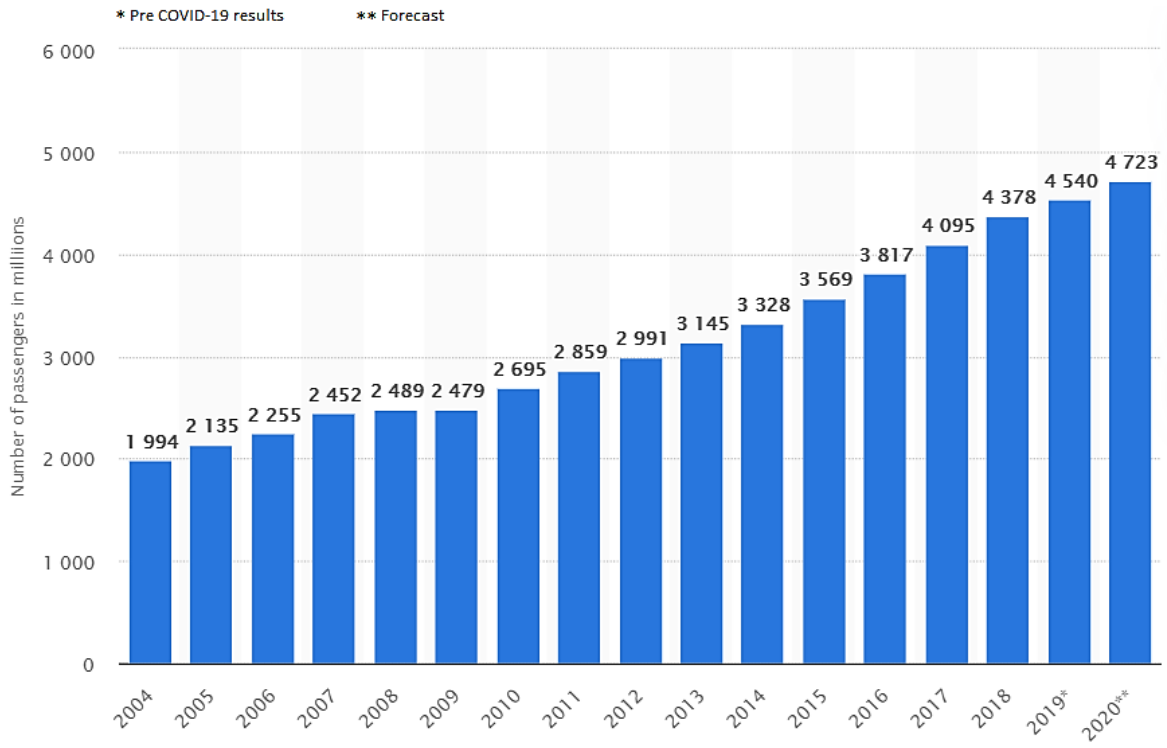

Figure 3. Global air traffic, scheduled passengers from 2004 to 2021 (Mazareanu 2020)

As can be seen in Table 1 by Khushboo (2017), the five countries in the world with the highest amount of air passengers are United States, China, United Kingdom, Germany, and Japan.

Table 1. Countries with the highest number of air passengers (Khushboo 2017).

Rank	Country	Number of Air Passengers (2015)
1	United States	798 230 000
2	China	436 183 969
3	United Kingdom	131 449 680
4	Germany	115 540 886
5	Japan	113 762 000
6	Ireland	113 144 501
7	Brazil	102 039 359
8	India	98 927 860
9	Turkey	96 604 665
10	Indonesia	8 868 576

Amount of transported goods by air cargo has also been increasing and according to IATA ([ref. 13 April 2020]), it transports yearly over 6 trillion USD worth of goods and by estimations it accounts for 35% of the world trade by value. Three main reasons are explaining the continuous global air travel growth. The reasons include the increase in number of low-cost carriers and airport infrastructure spending as well as the growth of the global middle class especially in China, resulting in higher worldwide carrying capacity. As it can be seen in Figure 4, it is estimated that China is expected to soon surpass USA as number one in air passenger amounts in the world.

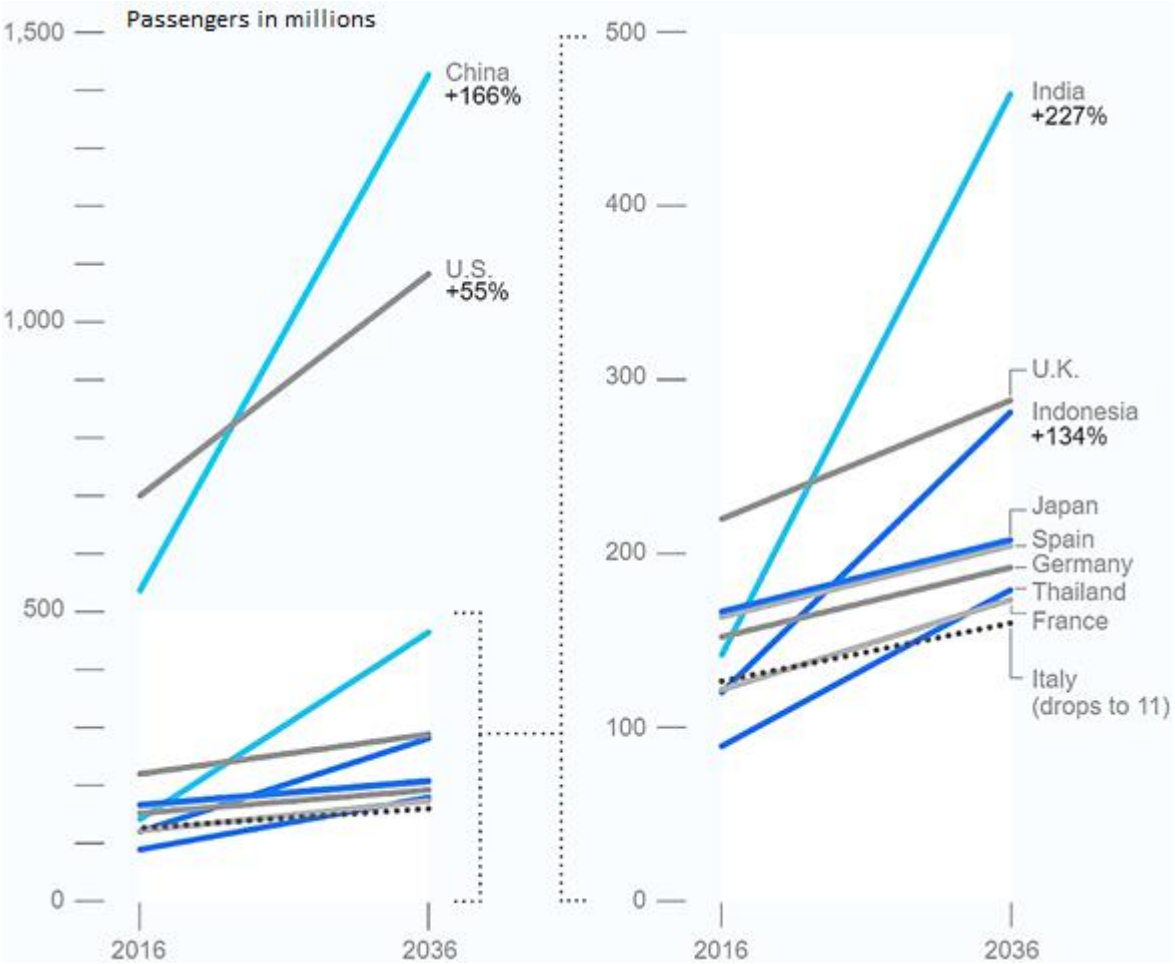

Figure 4. TOP 10 passenger markets (Rosen 2017).

The direct effects of aviation on the whole world are significant. According to ICAO (2019, 7-9), in 2016 the aviation industry supported 65.5 million jobs and had a 2.7 trillion USD economic impact. The forecast figures for the year 2036 are 97.8 million jobs and 5.7 trillion USD economic impact. Figures 5 and 6 subsequently show the passenger travel and air cargo development from 1995 and forecast until 2045. As

it can be seen, the passenger travel and air cargo are estimated to increase significantly in the following decades.

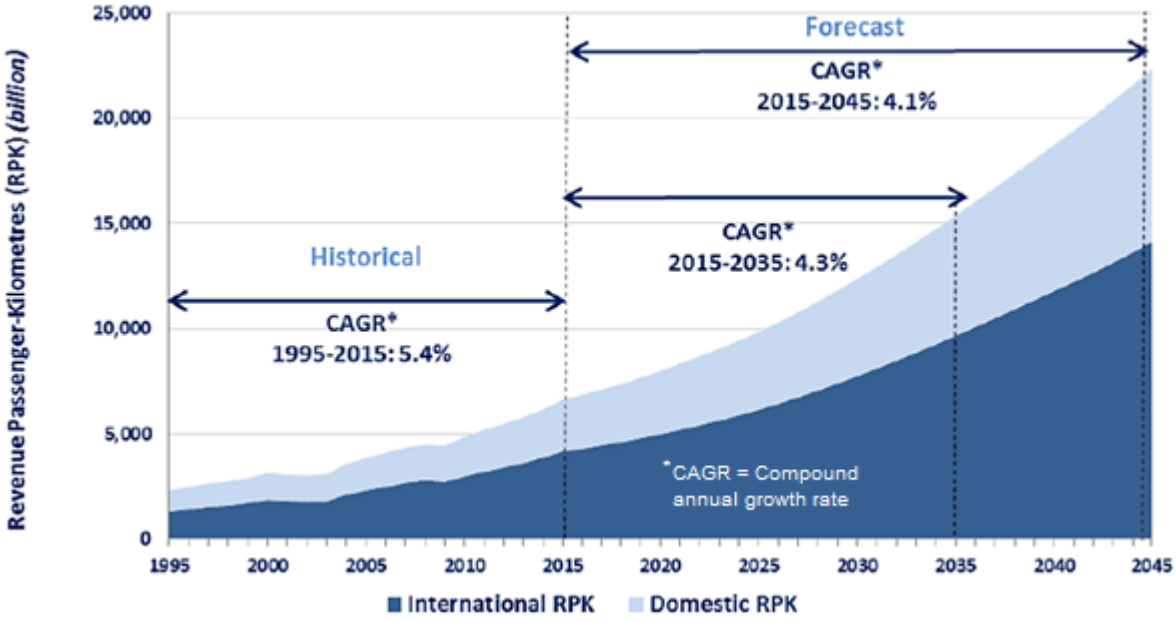

Figure 5. Revenue passenger kilometres, development from 1995 with trend until 2045 (ICAO [ref. 14 April 2020]).

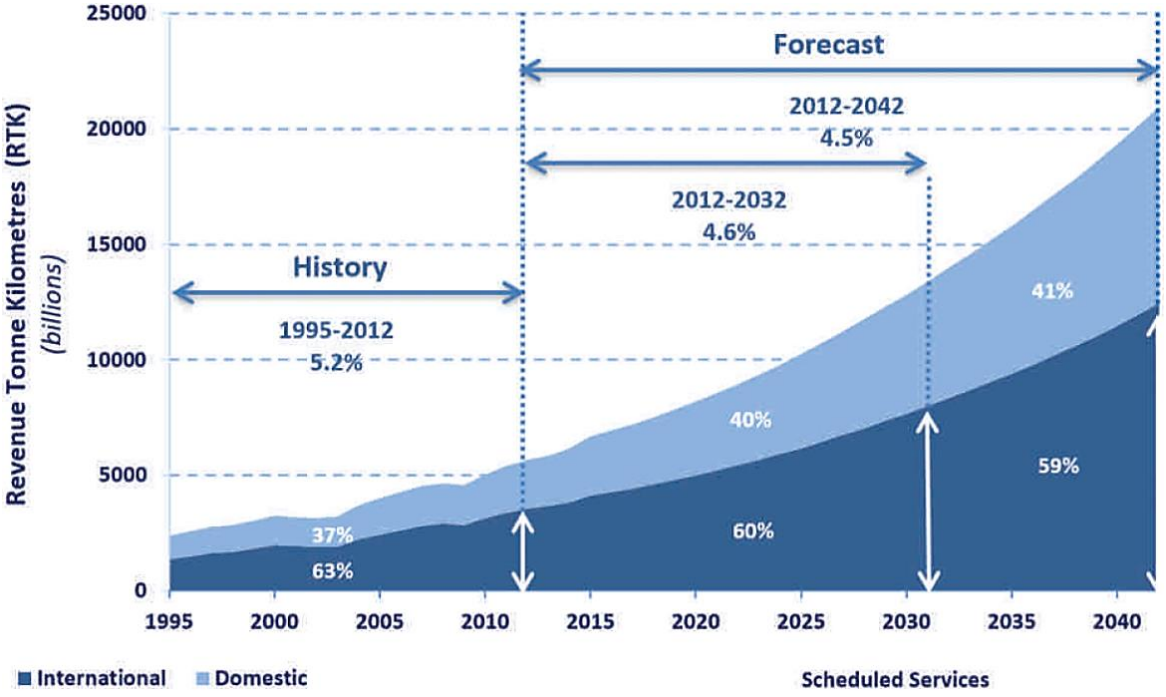

Figure 6. Revenue tonne kilometres, development from 1995 with trend until 2045 (ICAO [ref. 14 April 2020]).

Revenue passenger kilometre is a metric that shows the number of revenue-paying passengers carried multiplied by the distance flown (British Airways [ref. 20 April

2020], 136). For example, an airplane with 100 passengers that flies 500 kilometres has generated 50 000 RPK. A revenue passenger is someone who has paid a transport operator for her or his trip. That excludes non-paying passengers such as airline employees flying on free or nearly-free passes, infants and children who do not have a seat of their own. However, passengers who paid for their trip with a frequent-flyer program mileage award are usually included. Revenue passenger kilometres can be considered the basic amount of "production" that an airline creates (ICAO 2008, 10). According to ICAO (2019, 6) in 2018 airlines worldwide carried around 4.3 billion passengers annually and reached 8.3 trillion revenue passenger kilometres.

Freight tonne kilometre is the equivalent of RPK for freight. One FTK is one metric tonne of revenue load, carried one kilometre (CAPA - Centre for Aviation [ref. 22 April 2020]). ICAO (2019, 11) states that 58 million tonnes of freight were transported by air, reaching 231 billion freight tonne kilometres. Every day, aviation moves almost 12 million passengers and around USD 18 billion worth of goods on more than 100 000 flights.

Revenue tonne kilometre refers to a metric used in the freight, shipping, and transportation industries. This metric is an important factor in determining the profitability of companies (Kenton 2020). Kenton also states that RTK is the actual revenue earning load of passengers, excess baggage, mail, and freight in metric tonnes multiplied by the distance flown in kilometres.

In 2018 the four biggest manufacturers of civil transport aircraft were Airbus based in Europe, Boeing based in the United States, Bombardier based in Canada and Embraer based in Brazil (Wagner 2019).

Most of the countries of the world are members of the International Civil Aviation Organization (ICAO) and through this organization they work together to establish common standards and recommended practices for civil aviation (ICAO [ref. 10 July 2020]).

2.1.1 Recent developments influencing aviation

The development of modern aviation has been rapid throughout its short history. Although first records of aviation date all the way back to ancient Greece, the modern aviation started in the 18th century (Crouch 2003). The first commercial airline started operating in 1914 (Sharp 2018), and since the second world war the growth of air travel has been almost exponential. The propeller planes have evolved into jet planes and even supersonic jets. Within 30 years the general direction of development has steadily shifted from machine oriented into economy and ecology oriented. The development of low consumption engines and better aerodynamic frames has decreased the operating costs and through this also lowered the environmental impact. The research of jet fuel with lower greenhouse gas emissions is decreasing emissions by 80% compared to fossil jet fuel (Neste [ref. 14 April 2020]). The utilization of automation has also had significant economic and ergonomic impacts. Augmented reality, artificial intelligence, big data, and unmanned aircraft systems to mention but a few, seem to show great promises for the future (ICAO [ref. 14 April 2020]).

As it was discussed in the previous chapter, the aviation industry has been thriving during the last decade. The situation changed when the worldwide restrictions caused by the COVID-19 were applied in the beginning of 2020 to slow down the pandemic spread. As Figures 7 and 8 show, the main events affecting aviation industry most significantly during the past 20 years have been the 2001 New York World Trade Center terrorist attack, 2008 economic crisis and 2019 COVID-19 virus pandemic outbreak. These three events have caused economic crisis in aviation sector throughout the world. According to analyst for European transportation, the way the outbreak was weighing on airlines had a 9/11 feel, because the demand-induced shock was not originally related to economic development unlike the 2008 crisis (Taylor 2020).

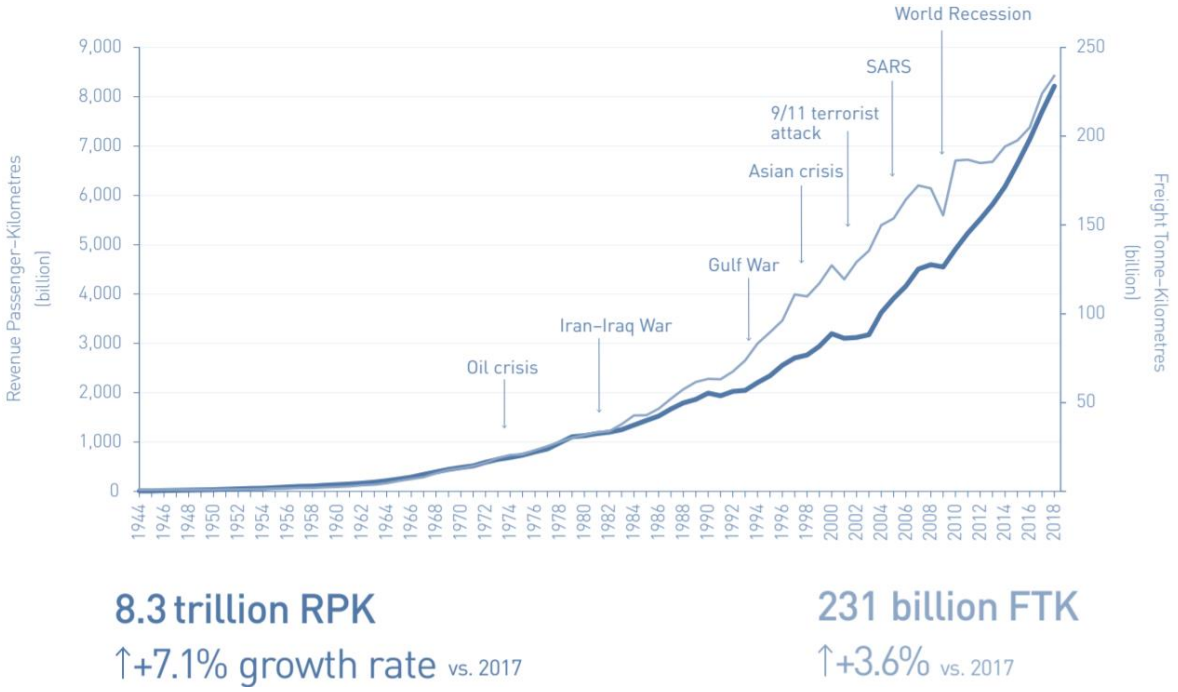

Figure 7. Air travel evolution by 2019 (ICAO 2019, 12).

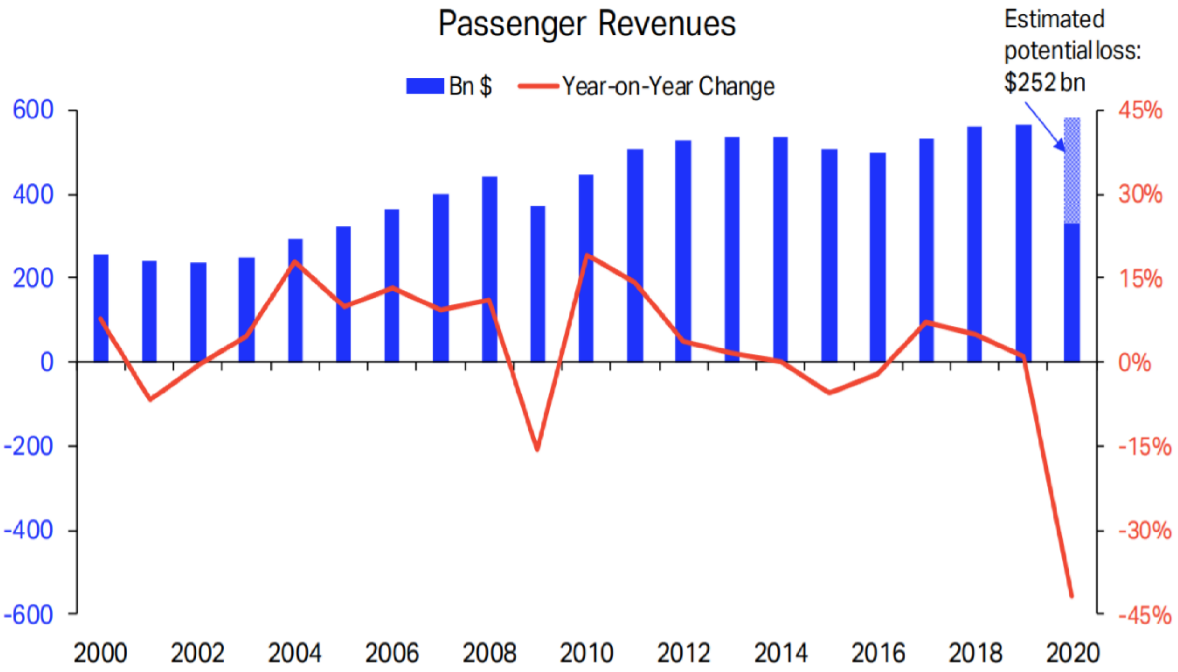

Figure 8. COVID-19 estimated effect on passenger revenues (IATA 2020).

The 9/11 event affected most directly North American market. The research by Pearce (2006) shows that after 9/11 the temporary RPK demand decreased in USA by 31.3% and temporary airline revenues decreased annually by 9.1 billion US dollars. According to analysts, COVID-19 seemed to have similar scale effects already few months after the restrictions started. During early 2020 the aviation industry was

struggling since travelling was significantly limited globally. As Figure 7 shows, the International Air Transport Association (2020) estimated that passenger revenues will be $252 billion lower in 2020 compared to previous year.

Even though the travel restrictions were in many countries partially removed by summer 2020, the recovery of the air travel has been slow, and passengers have not returned to the airports in the pre-COVID-19 amounts after a long quarantine period. The reason might be that the fear of catching the virus remains and willingness to travel to unfamiliar places and be close to others in the airplanes and other public transportation could also be a concern. Another reason might be that the restrictions had a negative impact on financial situation of the potential passengers. Some might have lost their work or have been temporarily laid off and they simply cannot afford to travel. This prolonged absence of tourists has also affected the tourism related businesses and some of them have even gone bankrupt (Tucker 2020). However, it seems that so far at least in Finland, April 2020 has been the worst month for the air travel, and it has been a slow uphill from there (Finavia [ref. 6 July 2020]).

Furthermore, other difficulties have occurred in aviation in addition to the aforementioned crises. Most memorable from recent years are the two accidents of Boeing 737 Max planes between years 2018 and 2019. These accidents resulted in the grounding of the 737 Max fleets globally until the problem causing the accidents would be solved. Rushe (2020) states in his article that according to Boeing, the estimated costs caused by the accidents and grounding of the planes was in the beginning of 2020 nearly 19 billion USD. The grounding mostly affected airlines from North America but also some Asian and European airlines such as Air China and Norwegian since their fleets consist of many 737 Max planes (Boeing 2020).

Another challenge for the industry was the emergence of so-called “flight shaming”. According to Lund (2020), the largest effects of flight shaming were seen in 2019 in Sweden when the number of passengers flying through Swedish airports decreased by 4%. Flight shaming is an environmental movement attempting to change general opinion about using airplanes to travel due to the environmental impact. So far, this movement has had visible impact in Sweden and Germany, however people are becoming increasingly conscious about environment and it is likely for this movement to spread across the world.

2.1.2 Prediction of the future in aviation industry

Many estimates about the aviation industry were promising great expansion and bright future (ICAO [ref. 14 April 2020]). For example, Rosen (2017) shows that the importance of Asia-Pacific sector in aviation led by China is estimated to increase dramatically by year 2035 mainly due to the growth of middle class. The global passenger amount was estimated to rise from 3.8 billion in 2016 to 7.2 billion in 2035. This would mean higher demand of aviation personnel. As Figure 9 (Rosen 2017) shows, new personnel required by 2035 would be over 2.1 million with Asia-Pacific region needing almost 39%. Estimated amount of aircrafts needed by 2035 was 45 240 which means 22 730 more than in 2015. In order to support a near doubling of passenger and cargo numbers withing the next 15 years, demand for pilots, engineers, air traffic controllers and other aviation-related jobs was expected to rise significantly.

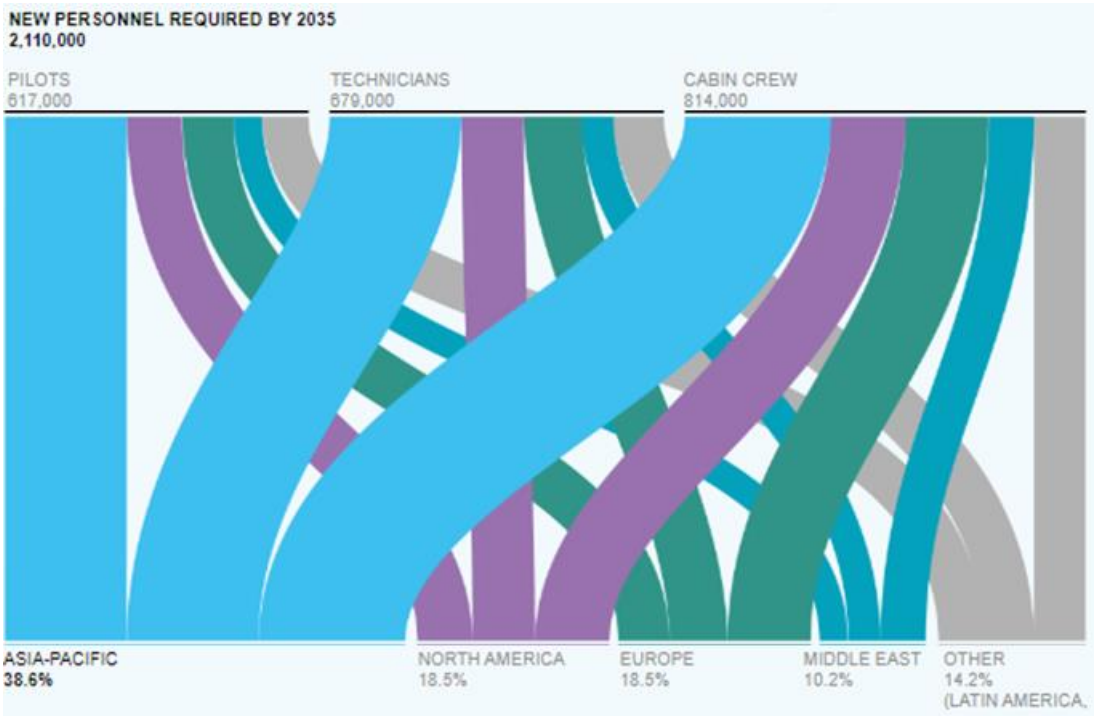

Figure 9. New Personnel Required by 2035 (Rosen 2017).

Laplace, Lenoir and Cassan (2007) state that growing demand encompasses both freight and passengers, including business as well as leisure trips. In 2002, 69% of air trips made by Europeans were for leisure meaning all travel purposes other than business. Understanding how travel choices are made and will be made in the future

can give an indication of how the traffic is likely to evolve. According to estimations by Laplace et. al., air travel demand in 2025 would increase and it would be characterized by the following aspects. There would be an increase in the level of air travel demand for the purpose of visiting friends and relatives boosted by job mobility and migration flows. The level of air travel demand from retired people and demand for customised travel would also increase. Use of travel as a way to escape from the stress of modern living would be one of the characteristics. Price would remain the main choice criterion because demand is influenced by the prices as well as the proposed destinations. Despite the environmental concerns that would shape the market, only increases in air fares or regulation measures limiting supply levels will lead to reduced demand for air travel.

Most of the data estimates about the future growth of aviation industry available for the research were conducted before the COVID-19 outbreak. With the current development, these estimates are expected to be affected on the global scale. Restrictions of flights have caused financial difficulties for the airlines and the need for temporary downsizing has been necessary to survive this crisis. Airlines are already adjusting their staff by asking employees to take vacation at reduced pay or unpaid leaves of absence. So far, the immediate effects on the airlines have been suspension of hiring, voluntary leaves for employees, implementation of cost reductions, cutting capacity, compulsory use of face masks and improving on-board cleaning of the aircrafts (Escobedo 2020). These measures can help airlines to recover in a short-term, however, suspension of hiring could hurt airlines' abilities to fill jobs that need to be filled once the crisis passes (Isidore 2020). The impact of the COVID-19 on the air cargo was of smaller scale than for passenger transportation, since there is a continuous demand for goods that need to be transported quickly (IATA 2020; International airport review 2020).

There have been several estimations of the aviation industry recovery from impact of COVID-19. Fox (2020) presents estimations based on questions asked from aviation experts. According to the results the respondents estimate 80% recovery within two or three years. Out of these experts 47% expect aviation to take six to twelve months to recover and about the same percentage expect a period of more than 12 months. These respondents were also asked about the future investments

in aviation and according to Fox, 68% said that digital transformation should get more attention and 60% wanted automation and artificial intelligence to receive greater investment. IATA (2020) presents two scenarios for the recovery, a baseline, and a pessimistic scenario. According to IATA in the baseline scenario the RPK's are not expected to exceed the levels of 2019 until 2023. IATA states that the pessimistic scenario is based on a slower opening of economies and easing of travel restrictions, with lockdowns extending into fall 2020 due to a possible second wave of the COVID-19. This would further delay the recovery of aviation industry. Donovan (2020) and Jolly (2020) make similar estimations as the previous ones based on statements by IATA and Airbus, as they estimate that it will take three to five years for the industry recover to the levels before COVID-19.

According to these estimations and forecasts an updated figure was created by using Figure 8 as a base to display these different recovery scenarios. Figure 10 shows three different estimations for the recovery of the aviation industry. The first estimate displays a steep red V-shaped curve (curve A), meaning the industry would recover to the pre-virus levels between 2022 and 2023. After that there are two dashed red lines estimating the tendency after recovery, A1 and A2. While the first line (A1) portraits a continuous industry growth with same year-on-year change increase, the second line (A2) shows a moderation to the growth. The second estimate displays a U-shaped curve (curve B) meaning the industry would recover to the pre-virus levels between 2025 and 2026.

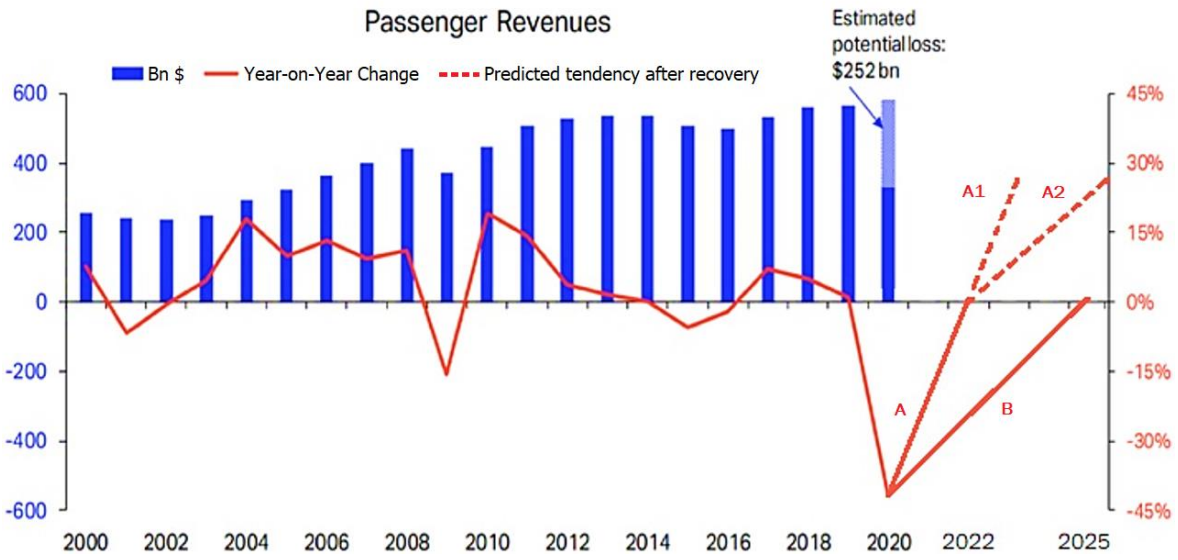

Figure 10. Prediction of the aviation industry recovery after COVID-19 based on Figure 8 estimations.

In order to help ease the impact of the outbreak, the European Commission is putting forward targeted legislation to temporarily alleviate airlines from their airport slot usage obligations under EU law. This measure will help both the European aviation industry and the environment. It releases pressure on the whole aviation industry and in particular on smaller airlines. It also decreases emissions by avoiding so-called 'ghost flights' where airlines fly almost empty aircraft to keep their slots (European Commission 2020). In addition, governments around the world are giving aid packages for airline companies to cope with the crisis. For example, Finnair, a partly government owned Finnish airline, received a promise of 600 million euros state guarantee (Harjumaa 2020).

Already for years, airports mainly in Asia-Pacific area have been conducting passenger screening for possible contagion control, such as temperature scans. Since COVID-19, these safety measures have been implemented in more global scale. Due to this situation, in the future it might be that more airports will implement safety measures to protect passengers, and airlines will enhance cleaning processes in the planes in order to control disease spreading.

In some countries the amount of new infection cases is surging meanwhile in other parts of the world numbers are beginning to decline as public health officials and governments work to slow the contagion (Ghosh 2020). Airlines, governments, and

other interested parties are working together to restore the aviation industry to earlier levels of prosperity and reach the expected growth for the future. In order to sustain a growth, innovations in technology would be needed. Goudarzi (2017) presents technologies which will impact the future of the aviation industry the most. Among others, he mentions that drones, augmented reality, and artificial intelligence will be in the center of the aviation sector development.

Artificial intelligence (AI) consists of far more than just robots. Several airlines and airports have already launched AI-powered products, such as chatbots and virtual assistants in the hopes that this technology can further revolutionize customer service and optimize efficiency (Future Travel Experience 2019).

It seems that a number of airlines see potential in augmented reality (AR) and virtual reality (VR), but it is still not clear whether these technologies will generate entirely new forms of inflight and in-lounge entertainment (Future Travel Experience 2019). AR adds digital elements to a live view often by using the camera on a smartphone whereas VR implies a complete immersion experience that shuts out the physical world (Gupton 2017). In the following Figures 11 and 12 the projected AR and VR growth until 2025 and the forecast size of different segments in 2020 and 2025 can be seen.

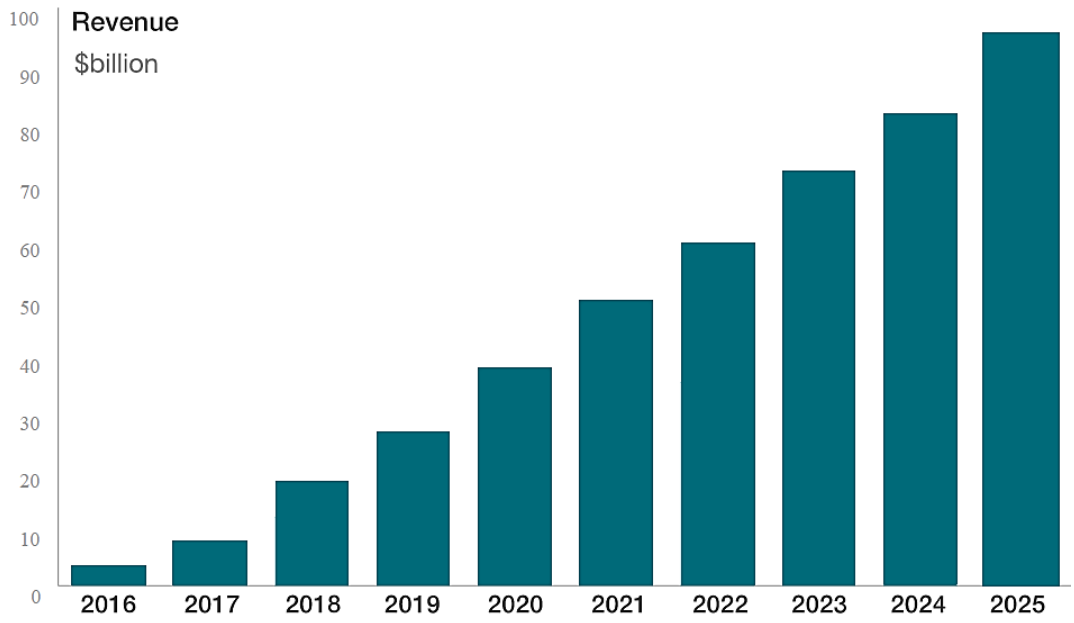

Figure 11. Projected AR and VR growth in 2016-2025 (Hall & Takahashi 2017).

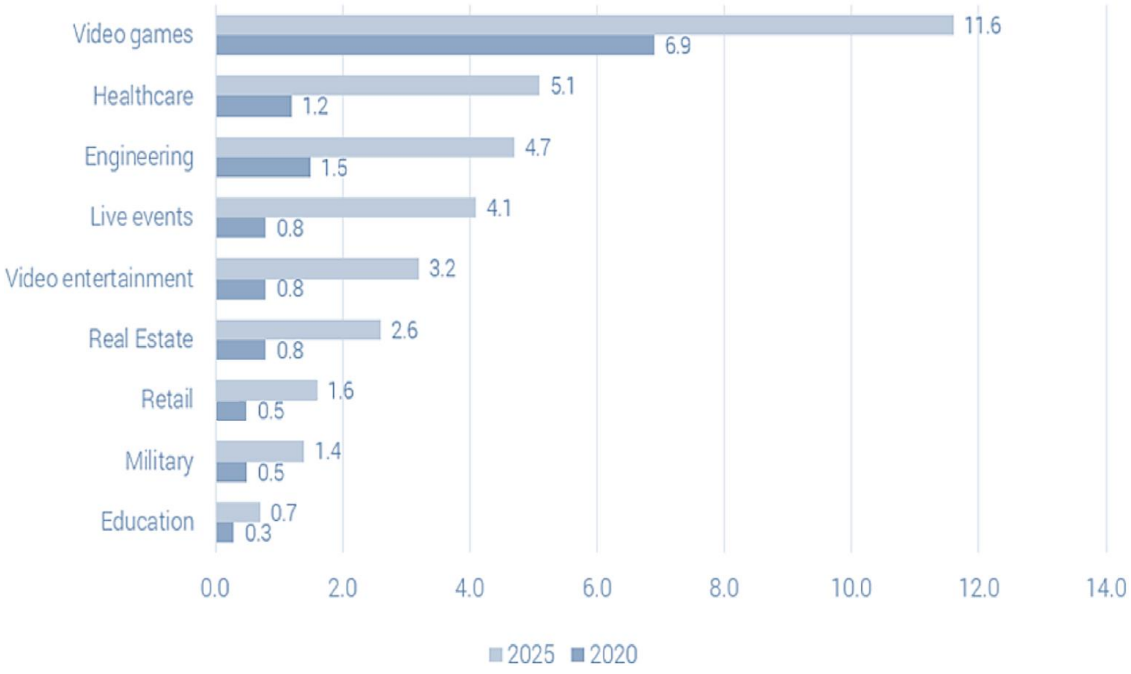

Figure 12. Forecast size of the augmented and virtual reality worldwide in 2020 and 2025 by segment (Statista Research Department 2016).

Framingham states (2019) that International Data Corporation projects the worldwide spending on augmented and virtual Reality to reach 18.8 billion USD in 2020. These figures show that the share of gaming is predicted to have the largest increase within the next years. Together with video entertainment, gaming could be integrated into aviation industry. By offering VR or AR glasses in the airports and airplanes as entertainment and means for sharing information could be potentially profitable field of business. Apart from entertaining purposes, Lufthansa also uses virtual reality to encourage passengers to purchase business class seats instead of economy class ones. Furthermore, through a VR headset, passengers have a possibility to watch a live 360-degree video from sports events. Along with a surrounding sound based on the Dolby Atmos technology, users can feel as if they are seating in the first row in a stadium or above a racetrack during a flight (Velichko [ref. 19 April 2020]).

Puiu (2019) states that VR entertainment can also help people with fear of flying. Instead of going through a traumatizing experience for hours, passengers can immerse themselves in a calm environment of their choosing. This can also help with discomfort caused by a wide number of factors like aircraft's engine noise, other people talking, crying babies, and confined space (Velichko [ref. 19 April 2020]).

Another possibility is using the VR glasses in training and according to Jasoren ([ref. 19 April 2020]) the use of virtual and augmented reality for training in aviation provides wide opportunities for increasing the effectiveness of the process while dramatically reducing costs in comparison with traditional means. The International Air Transport Association uses VR to train ground crew and flight attendants. Virtual reality can greatly simplify and speed up the airline staff training in conducting an external aircraft inspection. Wearing a head-mounted display i.e. VR glasses, employees can virtually walk around an aircraft, detect existing issues and check whether all necessary safety equipment is correctly placed. The ground crew VR training plays a significant role in ensuring passenger safety (Velichko [ref. 19 April 2020]).

Velichko also mentions that with the immersive VR technology, engineers can practice on any aircraft model and study any detail while improving their skills as long as needed. Pratt & Whitney, an American manufacturer of jet engines, uses VR to train its mechanics to repair aircraft engines. With their virtual reality experience, engineers can look inside an engine or observe it around. In addition, they can study nearly any particular detail individually using virtual reality. The immersive technology can significantly save the cost and time for training engineers to work with specific engine types and models. With virtual reality, the entire training process becomes faster and more cost-effective.

With virtual reality solutions, a cabin crew can efficiently learn the basic structure of an airplane and its appliances. The immersive virtual reality technology provides a wide set of scenarios in which flight attendants can find themselves during real flights. This makes it possible for a cabin crew to learn the necessary skills for proper behavior in dangerous or unexpected situations. Air New Zealand uses Microsoft HoloLens for cabin crew training in augmented reality. This airline considers providing its flight attendants with a HoloLens headset. With this device, a cabin crew will always have access to real-time flight information. Furthermore, through emotion tracking techniques, the headset will determine the passenger’s emotional state thus helping flight attendants to provide better service for customers (Velichko [ref. 19 April 2020]).

For pilots, the benefit of AR and VR is that training would not have to be limited by cumbersome equipment and space. Flight simulators emulate different kinds of cockpits for different kinds of aircraft training, whereas VR training is a lot more versatile and portable. This alone could save billions across the industry (Puiu 2019). The key utilization of AR in aviation is its ability to overlay information at the point of need. It aids in visualizing navigation systems, air-traffic control, weather, terrain, and airspace information in a 3D overlay, which is easy to understand and retain for long (Goel 2018).

Aerospace manufacturers are investigating the introduction of fully electric and hybrid-electric aircraft, although currently it is in the exceedingly early stages of research and development. As battery technology develops, increased energy storage may make electrically powered commercial flight a reality. Already now, several small-scale demonstrators are showing how it can be used for training flights and two-person operations. In the short-term, electric propulsion is likely to be restricted to so-called ‘air taxi’ operations which are expected to start service in a small number of cities from around 2023-2025. These will provide 2-4-person commuter flights to avoid ground traffic congestion. In the long term, several companies are developing more familiar commercial aircraft concepts. These would be regional jet sized, short-haul aircraft and could potentially be in service by around 2035, although more research is needed. The quest to maximize range and payload (passengers or freight) while reducing the weight of the batteries and increasing the energy density of stored electricity is a challenge. There is also a lot of ongoing research into hybrid options combining the performance of liquid sustainable aviation fuel with the efficiency of electric propulsion. This may be an option for mid to long-range flights in future (Aviation Benefits Beyond Borders [ref. 13. April 2020]).

As it can be seen in Figure 13, within past few years drones have gained much popularity and the drone market is forecasted to grow significantly by 2025 while rapidly becoming more and more affordable. The recent Amazon patent on the use of a flying warehouse shows where things are headed. Additionally, there have been developments of concepts such as passenger drone taxis. These drones are developed to be able to carry persons in urban areas (Marr 2018). Uber has equally ex-

pressed aspirations on the feasibility of ultra-short-haul commercial flights in the urban space. It is predicting the rise of vehicles being able to take-off and land vertically, offering on-demand flights in urban areas leveraging existing infrastructure such as parking rooftops as vertical airports. Some of the challenges posed for these developments include regulatory challenges, battery technology readiness, vehicle performance and efficiency, air traffic management, noise and emissions, vertical airport infrastructure in cities and pilot training (Goudarzi 2017).

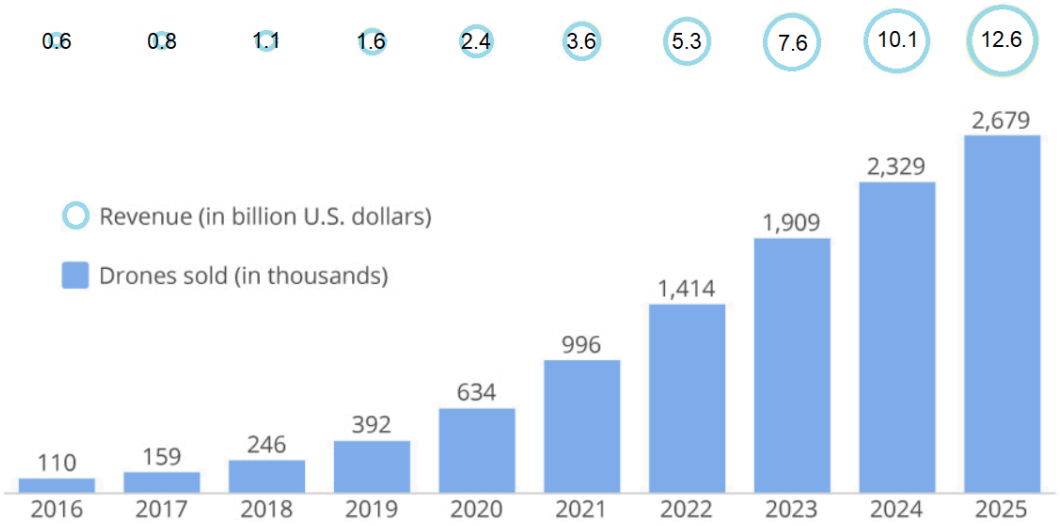

Figure 13. Projected worldwide market growth for commercial drones (Buchholz 2019).

Drones are used in various fields and Figure 14 presents the current shares of different segments of professional drone usage.

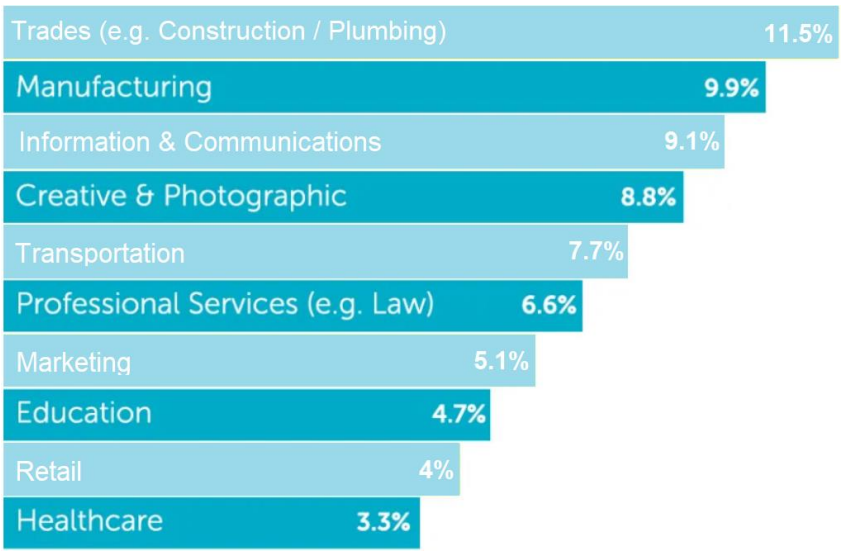

Figure 14. Level of professional drone usage (Rajendran 2017).

One of the outcomes of the pandemic outbreak can be seen in the strengthening of the market position of devices which allow interaction between people remotely. As remotely piloted devices, drones are naturally effective at minimizing human interactions, which is crucial when the officers meant to safeguard the communities can potentially become vectors for the virus to spread. Drones have become powerful tools to visualize expansive areas and communicate in complicated areas. These capabilities have been critical to oversee and communicate in dense, urban areas during the panic around COVID-19. With drones, officers can more efficiently scan an area and broadcast a message while simultaneously keeping officials away from close contact with potentially infected people.

Due to COVID-19 restrictions, people were encouraged to stay in their homes and not to be exposed to the disease. In some countries, such as the USA and the Dominican Republic, the contactless way to deliver critical medical supplies was tested and it was proven to be efficient.

Health authorities have tested out ways to utilize agriculture spraying drones to disinfect public spaces and prevent the further spread of COVID-19 more efficiently. These spraying drones are filled with disinfectants instead of pesticides and they are operated to spray the entire public area. While the effectiveness of this new disinfection process is yet to be measured in a rigorous way, the speed and area covered in the process is unparalleled. Spraying drones can cover 100 000 m^2 in an hour with a spraying tank of 16 liters.

While the process of temperature checks has proven to be beneficial overall, it has a risk point of personnel conducting the temperature checks. As the personnel traditionally measure each person with a handheld infrared thermometer, they may come into close contact with the virus and become a virus vector themselves. To limit this risk point, drones can be equipped with infrared cameras to measure body temperature. While these drones are commonly used for public safety operations or inspections, with proper calibration, they can help measure body temperature (DJI Enterprise [ref. 13 April 2020]).

2.2 Analysis of the aviation industry and market in Finland

Europe has an important share of the global revenue passenger kilometres followed by Asia/Pacific region. Figure 15 depicts the regional market shares of different countries in the world. The RPK shares of Finland are 3.5% domestic and 96.5% international. Finnair's domestic share in Finland is 100% and domestic share in Europe 0.8%. Finnair's international share in Finland is 100% and international share in Europe 3.3%. Finnair and Nordic Regional Airlines (NORRA) are the only current scheduled airline operators in Finland. NORRA is Finnair's partner company and 40% is owned by Finnair Oyj (NORRA [ref. 19 April 2020]).

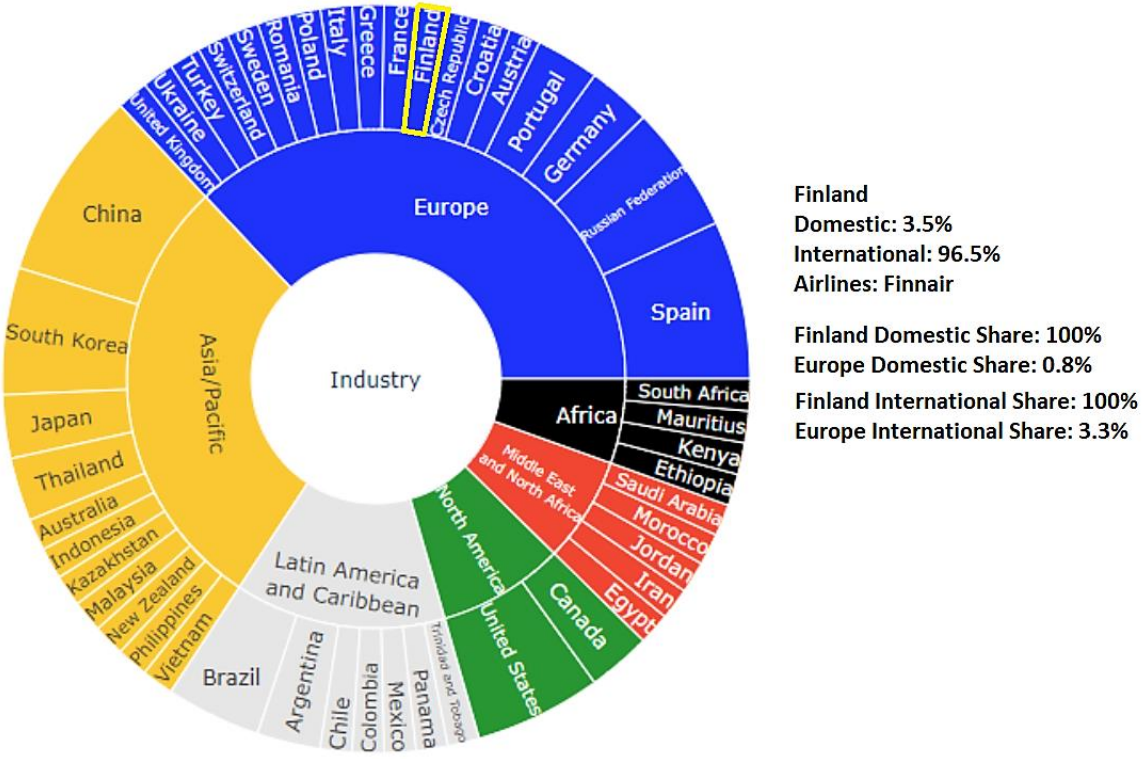

Figure 15. Overview of regional market shares of RPK's, domestic and international traffic (IATA [ref.18 April 2020]).

As Figure 16 reveals, the amount of air travelers in Finland has more than doubled within the past 15 years. This number includes both domestic and international passengers. The highest number of travelers in Finnish airports come from Europe but Asia, especially China, is increasing its numbers every year (Finavia 2018). Helsinki-Vantaa is the largest airport in Finland. For many years it provided transportation to nearly 80% of the passengers in Finland and has doubled its number of passengers

between 2004 and 2019 from a little bit over 10.7 million to nearly 21.9 million. The annual growth rate of passenger amounts from 2018 to 2019 was 4.2 percent. However, the rate of passengers transported on domestic flights dropped by 0.9 percent compared to previous year (Appendix 1, 1-2). This might be partly influenced by the rise of the “flight shaming” movement in the neighboring country Sweden, which might have also affected Finland.

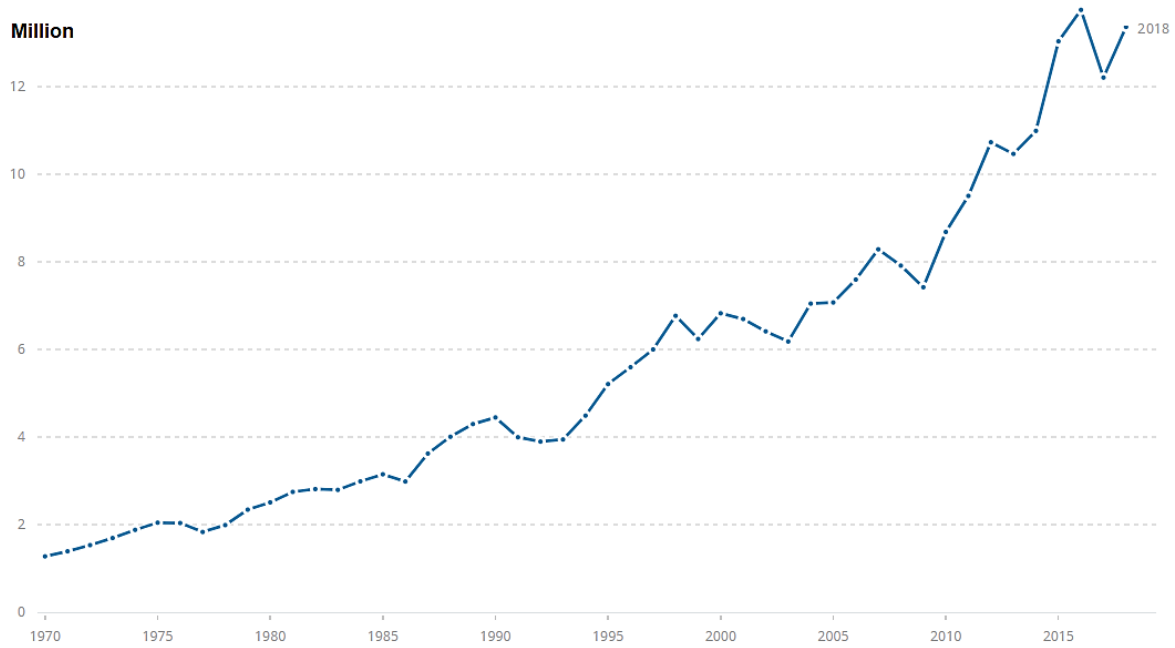

Figure 16. Air transport, number of passengers carried in Finland (The World Bank [ref. 19 April 2020]).

Also, amount of air cargo, including freight and post, has been increasing in Finland until 2019. Between 2004 and 2019 the tons transported by air have increased almost 1.8 times, however, the rate of increase has not been quite as steep as with number of passengers. Domestic cargo amounts are the main reason for lower overall cargo increase rate. In 2019 the domestic cargo transported was over 4 times less than in 2004 (Appendix 1, 3).

COVID-19 has had a huge impact for both passenger and cargo transportation only in the first three months of year 2020. Compared to the first three months in previous year, the decrease has been over 20 percent in passenger amounts and over 15 percent in cargo volumes in Finland (Appendix 1, 4-5).

2.2.1 Organizations in Finland

Finnish Aeronautical Association (FAA) is the national and central organization of recreational and sport aviation in Finland. The sphere of activities of FAA includes ten different air sport disciplines: powered flying, gliding, experimental flying, ultralight flying, hang gliding, paragliding, parachuting, ballooning, aeromodelling, and drones. FAA has over 200 member organizations and about 9 000 members (FAA [ref.16 April 2020]).

One recently established community is AiRRhow which is a global aviation alliance combining several fields of aviation to work together. The goals of AiRRhow are offering cost-effective solutions for global training needs, providing a real-life environment for testing new concepts and building the future of aviation by bringing together top experts from different sectors. AiRRhow strives to use digital solutions to make aviation smoother, safer and more sustainable for the environment, the economy, and the future. This new kind of aviation alliance is uniting disciples such as unmanned aviation, aviation health, ICT, R&D, airspace design, airspace operations, air traffic control, architecture, training, simulations, and infrastructure. Their plan is to train top professionals who will help make a brighter future for aviation (AiRRhow [ref. 20 April 2020]).

Another online based network for pilots and air traffic controllers in simulator environment is the International Virtual Aviation Organisation (IVAO). IVAO is represented locally in 81 countries around the world and Finland is a part of Nordic Region division. Through IVAO platform the pilots and air traffic controllers can offer their services to conduct simulated flights for training purposes (IVAO [ref. 20 April 2020]).

2.2.2 Training and licenses

There exist several aviation related licenses but normally the studies for becoming an airline pilot starts with private pilot license i.e. PPL. When a person holds a PPL, an airplane can be flown for entertainment only. The next step for becoming a professional pilot is commercial pilots license - CPL, which allows a person to fly an

airplane and accept a payment for the service. The final license is airline transport pilot license - ATPL. After finishing the required theoretical studies and minimum flight time with a jet plane, one can apply for ATPL. To work as a professional pilot, one needs to fulfil requirements set by aviation authorities. In Finland this means requirements set by EASA enforced by national authority Traficom. These requirements include successfully passing aviation related theoretical and practical exams. Also, medical examination performed by a specialized licensed doctor and an English language exam are required to be passed (Traficom 2019).

The aviation authority exams for a pilot license need to be taken only once. However, in order to maintain a valid certificate, one must regularly exercise flying or take an instructor lesson demanded by aviation regulations. Furthermore, professional pilots are required to show their English language skills in an exam.

Language skill levels are rated 6, 5 and 4 from highest to lowest. Minimum acceptable level for the operational use by ICAO is level 4. Depending on the result, the exam needs to be taken only once (by reaching level 6), every 6 years (by reaching level 5) or every 4 years (by reaching level 4) (ICAO 2013).

Flying can be challenging for a human organism. In order to be certain of the required medical fitness to operate an aircraft safely, pilots must pass medical examinations. The level required for professional piloting is Medical Class 1 (EASA 2019, 42).

Aviation studies for piloting are generally carried out in universities, military academies and aviation schools and aviation clubs. The military and airlines are usually the places where the final education and focusing on specific airplane types happens. The practical part of pilot studies normally consists of two phases, simulator, and real airplane lessons. The use of simulators in the education has been steadily increasing due to lower costs and a chance to easily do over the practises (Hartzell Propeller 2018).

The most recent statistics by Statista Research Department (2020) illustrate in Figures 17, 18 and 19, that as of 2017 there were 323 licensed air traffic controllers and flight information service officers and 1 401 licensed aviation maintenance staff members in Finland. In 2017 the amount of pilot licenses in Finland was 6 570. This

number includes all levels of pilot licenses considering both airplanes and helicopters.

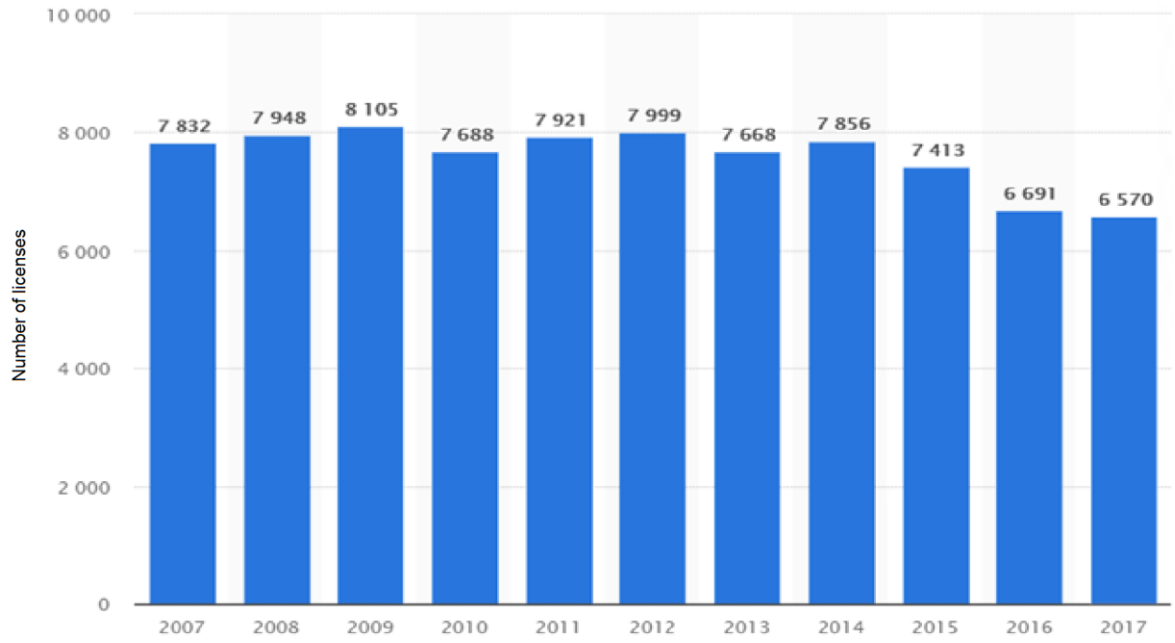

Figure 17. Number of pilot licenses in Finland from 2007 to 2017 (Statista Research Department 2020).

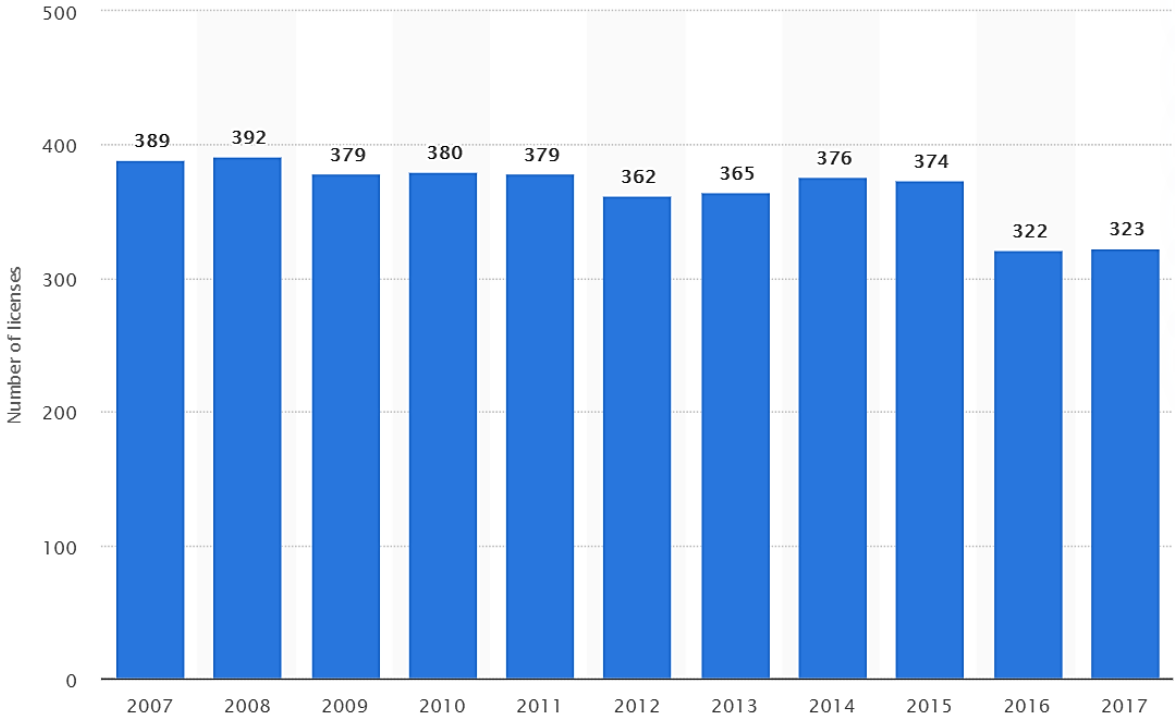

Figure 18. Number of air traffic controller and flight information service officer licenses in Finland from 2007 to 2017 (Statista Research Department 2020).

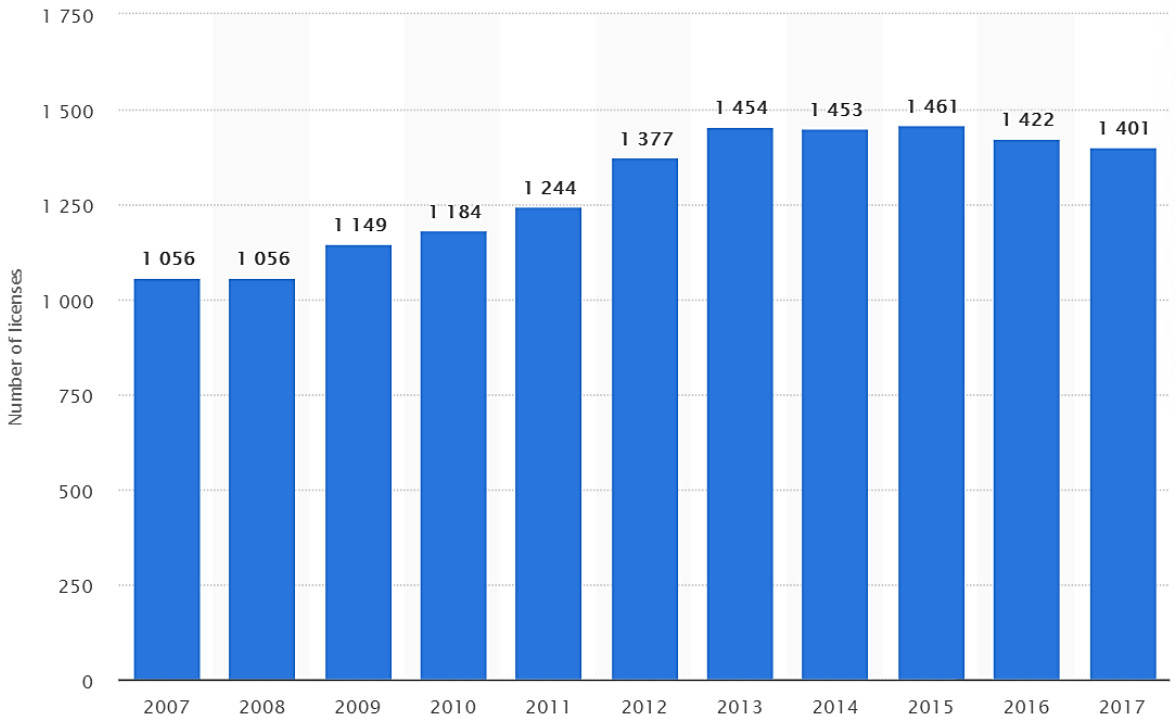

Figure 19. Number of aviation maintenance staff licenses in Finland from 2007 to 2017 (Statista Research Department 2020).

One explanation for decreasing pilot license amounts over the years could be the increased fuel prices which have led to increased costs discouraging recreational pilots to continue their hobby. Decreasing air traffic controller and flight information service officer license amounts can be partly explained by the closure of some airports and centralizing of main control center staff into one location instead of two. The amount of mechanics has remained more constant over the past years.

3 OPPORTUNITY ANALYSIS

3.1 Selected opportunities

In the following sections the selected business opportunities in aviation will be introduced, which according to several estimates, show great potential in the future. The opportunities include:

- Multidisciplinary platform for aviation education and tutoring
- Smart device application to ease fear of flying
- Use of augmented and virtual reality in aviation education
- Drone pilot training

The opportunities were selected based mainly on current situation and future predictions of aviation industry and author's own hypothesis which were grounded by AiRRhow's innovative business idea which includes many fields of aviation.

3.1.1 Multidisciplinary platform for aviation education and tutoring

Aviation is a big field to study and acquiring all knowledge takes years of practice and studying. It can be difficult to visualize some of the technical and theoretical information about airplanes and flying. However, with the help of engineers and mechanics the students could better concretely understand for example the function of a jet turbine engine and with the help of pilots and air traffic controllers the tutoring could support students to rehearse the most difficult matters for them. The purpose of teaching sessions could be just informative and refreshing or even preparation for aviation related exams.

Inviting the professionals, who have more free-time or are laid-off because of COVID-19, from different fields of aviation to come together to teach and tutor aviation enthusiasts would be a great asset for a business since some of them might want to share some of their professionalism and experiences and keep their touch to the aviation profession during these exceptional times. The professionals from

different fields gathered would include mainly mechanics, pilots, and air traffic controllers. These professionals would have a lot to give in terms of education and tutoring of aviation enthusiasts considering their vast experience.

Each lesson would be held by a professional from that particular field to reach the best outcome. The benefit for the students would be gaining in depth knowledge accompanied by concrete examples of the subject in question. Mechanics and aviation engineers would be teaching things about airplane parts and theory behind flying. Air traffic controllers would explain how things work in the three-dimensional world of aviation and why they are done in a certain way. Also, correct communication and aviation language would be practiced. Pilots would be teaching the flight procedures in theory and with the help of a flight simulator.

AiRRhow, a business located in Tampere in Finland, is a pioneer in the business of combining different aviation fields to form a multidisciplinary education platform. The advantage for a new business would be a better and more attractive location in the capital city area to reach both customers and potential employees.

3.1.2 Smart device application to ease fear of flying

Anybody can suffer from fear of flying at any time. Even the children can be afraid but mostly their fears go away after being told more about flying. Long-term fear of flying starts most often in young adulthood between the ages 20 and 30 (Harjula, Haukkamaa & Holopainen 1999, 52). According to Valleala, (2010, 25) almost one third of people are afraid of flying.

Researches state that about 10% of Finnish population suffers from disruptive fear of flying and about 70% of those people are women (Hellström & Hanell 2000, 59-61; Harjula et al. 1999, 39-40). Kinnunen (2001, 63) says that about 8% of population refuse flying completely.

The treatment of fear of flying with VR was researched by Maples-Keller et. al (2017) in a published systematic literature review in 2017 in which 17 different VR studies were compared. In ten studies VR treatment was compared to a conventional exposure therapy and to those people who did not receive treatment. According to these

studies, VR therapy has proved extremely useful as a treatment for fear of flying. The permanence of the effects was monitored, depending on a study, after a month or even after three years since the treatment ended. Even though some studies revealed the return of the fear of flying, the level of fear was lower than before VR treatment. The psychological and physical symptoms and behavioural avoidance caused by fear of flying were decreased and in most of the studies a significant and long-term easing of the fear symptoms in cognitive, behavioural and psychophysical level was observed. VR treatment was more effective than for example relaxation exercises and literature therapy and equally efficient to ordinary exposure therapy (Maples-Keller et. al. 2017). Figure 20 shows a research conducted in USA, which indicates that around one fifth of people experience some levels of fear of flying.

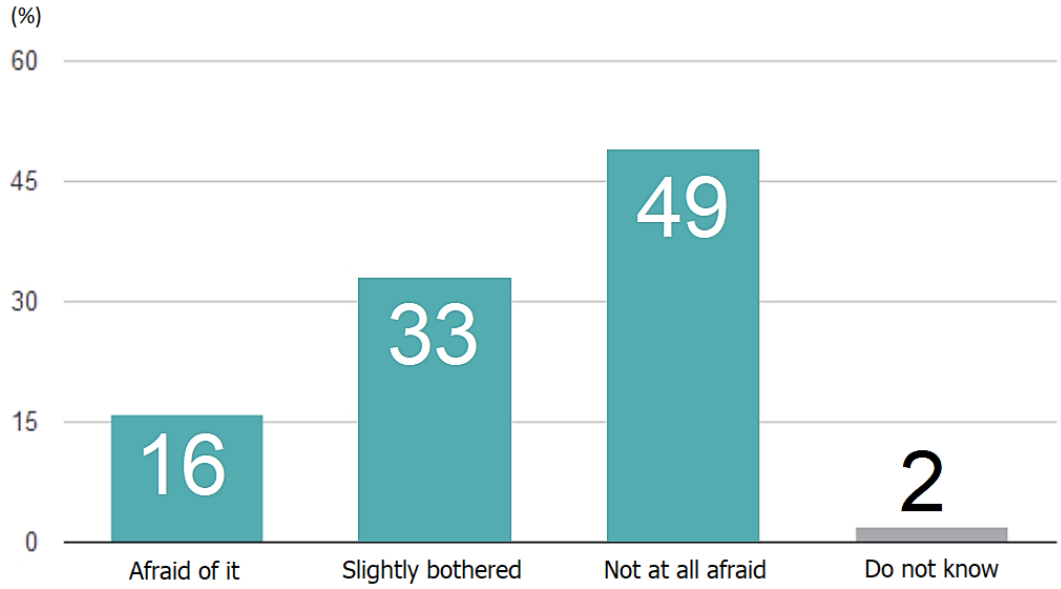

Figure 20. Relationship of passengers to flying on an airplane (Jagel 2014).

With the use of an educational and illustrational video, the aviation professionals could help to relieve the fear and stress of flying through explaining the flight operations with physical equipment and visual aids. The explanations could have a calming effect on people suffering from this fear and can help to cope better in the real plane environment.

The opportunity would be to make a video in a simulator cockpit where professional pilots would show and simultaneously explain the process of flight from start to the end. The focus would be in occurrences of strange noises and sensations in a plane. Explaining these noises and sensations and the events behind them would show

the people with fear of flying that those are common and nothing to be afraid of. The good reputation of pilots and the majority of people having confidence and trust towards this line of work, are the reasons why seeing the actual pilots on the job and showing their calm could have stress relieving effects (GfK Verein 2018, 7). This video could be made VR compliant which would allow the travellers to see everything as if they were sitting right next to the pilots. The VR would also allow the passenger to see what is happening outside the plane as it moves around. This can also help to make sense of the sounds and feelings experienced.

The video would be offered to airlines and can be customized according to their needs. The basic language in the video would be English. The airlines can then add a link to the video for the passengers while purchasing the flight ticket and the video would have a further link to a website if the passenger would like to receive more guidance in the actual simulator with the actual pilots. The income for the business would mainly come from the video views and some occasional visitors in the simulator. The price would be set according to views and based on the advertising costs in YouTube.

3.1.3 Use of augmented and virtual reality in aviation education

AR and VR could be used in flight simulator environment as an aid in aviation education as well. AR and VR are already used in different fields of business, but it has not yet made a significant impact in aviation. AR and VR could be used enhancing the teaching and learning methods. For example, by using a head mounted display, while learning the operation and location of different parts inside of a jet engine, could make the learning event more effective and time saving. In this situation the benefits are also that a real and an expensive jet engine would not be needed to be taken apart for the same purpose.

Eventually AR and VR could change the pilot training too. In the short-term AR and VR head mounted displays could be used in self training outside of school hours and lessons. With the help of these the training speed and quality can be enhanced and used as a tool instead of imaginary training which can be challenging. In the long-term the head mounted display could replace the need for a flight simulator.

With the help of AR and VR any simulated situation can be reproduced without the need to operate and maintain the expensive simulators.

3.1.4 Drone pilot training

Nowadays drones are already used for many purposes. As Figure 9 showed earlier, level of professional drone use in retail is estimated to be only 4%. It seems to be only a matter of time that retail industry will be able to use vast amounts of drones in a way that is acceptable for the authorities in terms of safety (Hayes 2016).

Especially recently with COVID-19 pandemic, it has been proved that significance of drones is increasing. Even with latest technologies allowing remote work and people to manage most of their tasks online or without contact, some tasks remain to be challenging without personal contact. Since the virus outbreak, for example receiving deliveries has got more difficult, because people try to avoid going to public places and it is challenging to be certain of a correct person receiving the delivery. Drones mounted with a camera using facial recognition could be a solution to this problem. It can be expected that more businesses would implement this kind of delivery approach. With increased air traffic, especially in urban areas, there might be need for more strict regulations and demand for professionally trained personnel.

What is still perhaps hindering the wider introduction of drones in retail industry is regulations concerning drones. In July 2020 Traficom implemented new regulations and safety recommendations to officially make drones a part of aviation. These regulations will clarify rules for commercial drone operations and make the operations of both manned and unmanned aviation safer.

Drones are already operated in a test environment in some cities in Finland (Wing [ref. 22 June 2020]; Arctic Drone Labs [ref. 22 June 2020]). These tests are about finding the best routes and practises to safely operate the drones without endangering the existing infrastructure, property, people, and other aviation operators.

It yet remains to be seen if the future of drone operations will be fully automated or will humans still be needed to operate them at least in the vicinity of people and

property. However, in the near future, before a trustworthy and fully functional automated network for drones can be established, humans are still needed to operate them. Since there does not yet exist a school or a course to become a professional or licensed drone pilot, this will be another opportunity in the aviation business field.

The education for drone piloting will be a fast-paced full course lasting one week. During the course, a vast number of theoretical topics will be taught, and drone piloting skills will be practised. After the course, the participants would receive a drone operator license which will show the potential employers their education. The course will be covering mainly theoretical topics about drone operations and it will be expected that the participants would be rehearsing their piloting skills before the start of the course. The evidence of their actual piloting experience would be displayed in their personal logbooks in the same way as all other pilots operating manned aircraft. A pilot logbook is a record of the operated flight hours containing every flight a pilot has flown. The finishing of the course and receiving the certification would only be possible with the demonstration of drone operating skills. The following topics in Table 2 would be covered in the one-week course.

Table 2. Drone pilot course topics.

UAS basics	UAS advanced	Aviation radiotelephone operator qualification
Air safety	UAS regulation	Electrical and radio systems
Airspace restrictions	UAS airspace operating principles	UA Electrical system
Aviation regulation	Airmanship and aviation safety	Equipment and its use
Human performance limitations	Human performance limitations	Requirements of radio connections and factors affecting the functions
Operational procedures	Meteorology	Most common factors of failures and interferences
UAS general knowledge	Navigation and Charts	Rules regarding radio systems and their use
Privacy and data protection	UA knowledge	Air traffic messages
Insurance	Operating procedures	Content of messages
Security		Emergency and search and rescue messages
Safety risks associated with urban operations	**Specific operations risk assessment**	ICAO terms and abbreviations, alphabet and numbers
Ground risk assessment	Specific operations risk assessment process	Practical exercise of radio communication
Flight planning	Description of organization	
Contingency procedures	Description of UAS system	
Weather	Risks on the ground	
Safe control of UA	Risks in the air	
	Requirements for risk management	
	Acceptable means of compliance	

4 METHODOLOGY

4.1 Research methods

There are two kinds of empirical research methods: quantitative and qualitative. In addition to this there is also a mixed research method combining both quantitative and qualitative research methods. Creswell (2009) states that a research using quantitative research method engages assumptions by testing theories in a non-bias environment to regulate alternative explanations to replicate the findings. Quantitative data can be analyzed through statistical measures. Qualitative research is expressed in words and data can be gathered for example through personal interviews. It is used to understand concepts, thoughts, or experiences (Streefkerk 2019). Quantitative research strives to answer the questions “what”, “where” or “how much” and “how often”. Qualitative research on the other hand strives to answer the questions “why”, “how” or “what kind of” (Creswell 2009, 32; Heikkilä 2014).

The following Table 3 will illustrate the main differences between quantitative and qualitative methods.

Table 3. Differences between quantitative and qualitative research methods.

Quantitative	Qualitative
Establish relationships between measured variables	Understanding a social situation from participants’ perspectives
Procedures are established before study begins	Flexible, changing strategies
Hypothesis is formulated before research can begin	Hypothesis is not needed to begin research
Deductive	Inductive
The researcher is ideally an objective observer	The researcher participates and becomes immersed in the research
Universal context-free generalizations	Detailed context-based generalizations
Instrument based questions	Open-ended questions
Performance / attitude / observational and census data	Interview / observation / document / audio-visual data
Statistical analysis	Text and image analysis
Statistical interpretation	Themes, patterns interpretation

4.1.1 Advantages and disadvantages of research methods

Strengths of quantitative method are precision, control, ability to produce causality statements, sophisticated analyses, and replicability (Goundar 2012). However, quantitative method requires substantial number of participants, which can be a considerable issue in research projects. In addition, the data gathered does not provide in-depth views on the studied matter (Choy 2014) and it can lead to the assumption that facts are true and the same for all people all of the time (Goundar 2012). Also, according to Goundar, quantitative method is not totally objective because the researcher is subjectively involved in the choice of a problem under investigation and in the interpretation of the results. Another disadvantage of quantitative research is that the participant might answer according to what is socially acceptable or according to the expectations of the survey maker (Taanila 2019, 23-24).

The positive aspects of qualitative research method include comprehensive results and a high response rate (Whorton 2016). Negative aspects include the fact that people might not always tell the truth. It also might be difficult to generalize the findings. According to Whorton, the possibility of observer bias is always present in qualitative research.

The methodology must best suit the project and meet the goals of the research (Quinlan 2011, 108-110). For this reason, it was also not practicable considering the time and data available to combine quantitative and qualitative research in this thesis. Considering the nature, advantages and disadvantages of both methods, quantitative research method was chosen to best suit this thesis, because the research needed to be independent of personal interpretations and statistical analysis and generalizability was necessary to be able to expand the business outside of Finland in the future. Using qualitative methods, e.g. interviews, would not give satisfactory nor reliable results of a larger group and would take considerable amount of time to conduct. Therefore, the questionnaire is regarded as the most time-efficient way to get information (Hirsjärvi & al. 2007, 190). In addition, according to Hirsjärvi et. al., the timetable regarding the questionnaire and the accessibility of the target group is easiest with the questionnaire.

4.1.2 Quantitative research

Quantitative research is typically collected through forms, surveys, structured interviews, phone interviews, systematic observation, and experimental studies. The research method can be used to observe interdependencies between objects or changes in the phenomenon (Heikkilä 2014). In this thesis the quantitative data was gathered via online survey and analyzed to find out the potential of business opportunities. Online survey is a quantitative research method and seeks answers to questions like “What”, “How many” and “How often”. The results of an online survey are represented in numerical data form and supported visually by bar charts.

Surveys are a common way to execute a quantitative research. A typical way to conduct a survey is in the form of a questionnaire which a person in a target group fills out (Balnaves and Caputi 2001, 76) utilizing a standardized data collection in which the questions are asked in the exact same way from all participants (Hirsjärvi et al. 2009, 188). Research question should be well defined and concrete enough in order to utilize the collected data (Heikkilä 2014; Taanila 2019, 3). Typical evaluation practices in quantitative research are ready-made alternative scales. Open-ended questions are hard to analyze as the answers can vary and their reliability is questionable (Hirsjärvi & al. 2009, 196).

When planning the questionnaire for a survey, it is essential to get familiar with theoretical literature, set research questions, choose the research frame, draft indicators, and design the sampling. In order to construct a valid and purpose-built survey, the questions are structured from and based on the theoretical framework. To answer research questions, a quantitative questionnaire needs large amount of numerical representative material. According to Heikkilä (2014), the amount of the needed respondents depends on the aim of the research.

This thesis employs a deductive approach and quantitative research method was chosen as primary data was collected through survey. The secondary data was mainly gathered from published books, articles, journals, and trusted e–resources.

Lean Canvas was used as a method to help deconstruct the business idea into its key assumptions and it was used to closer examine and evaluate the opportunities.

After choosing the best opportunity with the help of Lean Canvas and calculations, an online survey was conducted to receive quantitative research data. This data would be used to identify the general publics' opinions and feelings about the opportunity. These results could be used later to create a business model first in Finland and afterwards in other countries.

4.2 Lean Canvas and calculations

The Lean Canvas consists of nine parts which are separately analyzed.

According to instructions by Leanstack ([ref. 6 July 2020]), in general for creating a Lean Canvas it is recommended to sketch a canvas in one sitting. While a business plan can take weeks or months to write, initial canvas should be sketched quickly. It is fine to leave sections blank and rather than trying to research or debate the supposedly right answers and it is recommendable to write something down quickly or leave it blank and come back to it later since some elements such as Unfair Advantage might take time to find out. The Lean Canvas is meant to be an organic document that evolves over time and it is acceptable to state: I do not know.

While there exist several alternative approaches for sketching an initial Lean Canvas, it is recommended by Leanstack to use a customer-centric approach. Figure 21 illustrates the division of Lean Canvas into nine different parts, the contents of the topics and a recommended order of creating the Lean Canvas from one to seven.

Lean Canvas was chosen as a tool to create an overview and find out the potential of the different business opportunities. Lean Canvas is a one-page business plan template created by Ash Maurya that helps to deconstruct a business idea into its key assumptions. Lean Canvas is adapted from Alex Osterwalder's Business Model Canvas. It replaces elaborate business plans with a single page business model (Leanstack [ref. 13 April 2020]). The aim of making a Lean Canvas of all opportunities was to choose the best option to pursue.

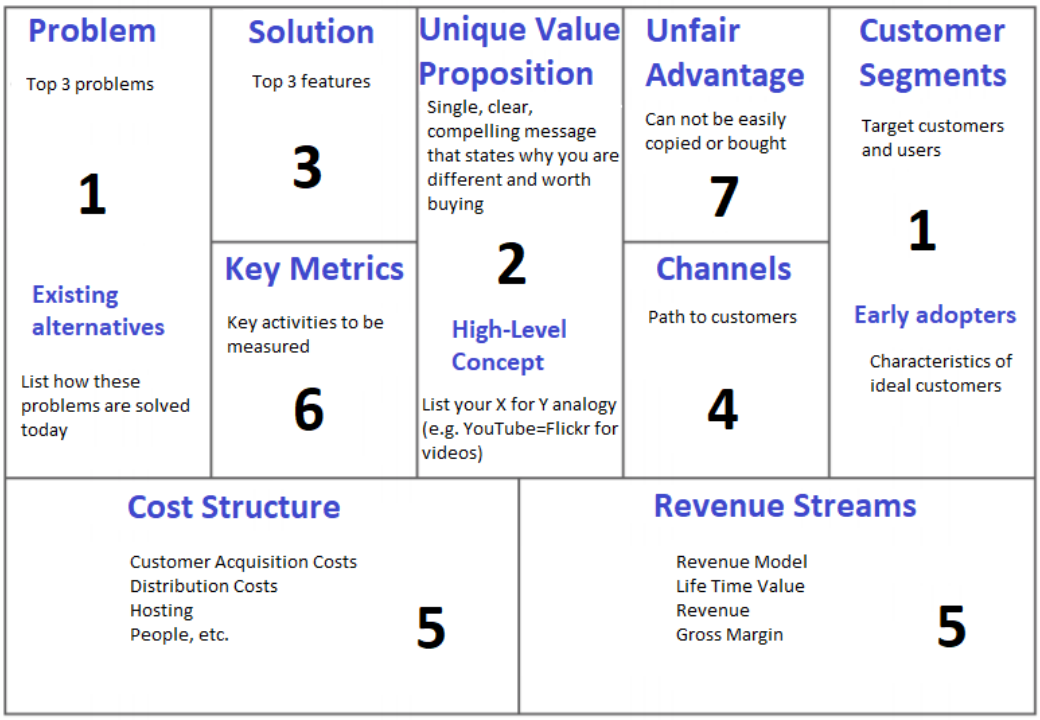

Figure 21. Lean Canvas structure model (Leanstack [ref. 6 July 2020]).

The cost-revenue calculations were created to complement and expand the information in the Lean Canvases and help to better visualize the profitability of the opportunities.

The 1st year profitability was calculated to require an initial investment of € 400 000 for all opportunities to rapidly start the business in the first country, Finland, because new equipment and advertising would be required in the beginning. Additionally, the expected number of customers per year was reduced by 50% due to unfamiliarity of the business to the public. Revenues per customer, fixed and variable costs, and workforce costs were set according to Lean Canvas estimations.

The 5th year profitability was calculated with the intention of reaching international markets in 2nd year and no new investments would be needed after 1st year. The business would be expanded to 50 countries around the world and the amount of the customers, fixed and variable costs, and workforce costs would be tripled in every country. The number of customers for fear of flying application in the 5th year was based on the estimation of reaching 10% of the global air passengers, which was in 2019 4.5 billion, based on Figure 3.

In the calculations the 10th year 20% CAGR was chosen to portray the potential of a drone related business. According to Schroth (2019), the drone markets were expected to triple from 2019 to 2024 and the expected CAGR would be 20.5%. The 10th year 77% CAGR was chosen to represent a possible and more optimistic growth, because according to Framingham (2019), AR and VR products and services were expected to grow with a CAGR of 77% from 2019 to 2023. Both of these 10th year CAGR predictions were calculated starting from year five after the peak growth rate would have already been established.

4.3 Reliability, validity, and confidentiality

This thesis was created by examining several online resources such as academic articles, case studies and literature, it allows the researcher to gather awareness of the current situation (Malhotra (2012, 73). Up-to-date real-time data is readily accessible online to understand current trends and determine where a focal point is situated. Nonetheless, to minimize the use of unreliable resources, which can hinder the overall research purpose, the data was gathered through the following sources: HH Finna to gain access to journals, academic articles and loan text-books from professional authors; national and international regulator websites such as ICAO, IATA, EASA and Trafi; media such as Forbes and The Guardian; and subject matter expert websites.

The survey included only one open-ended question to eliminate the inaccurate analysis. However, the questions related with opinions, attitudes, beliefs, and behaviors are especially vulnerable to reliability and validity problems. The opinion might vary depending on the mood, environment, and time. To avoid this, the questions were carefully planned with the aim of getting information about how likely it is that drone pilots will be needed and the potential of utilizing AR and VR technology in aviation training.

The research can be considered confidential since it was anonymously conducted online. The online survey, which was used to collect the research data, can be found in Appendix 2.

5 LEAN CANVAS MODELS AND CALCULATIONS

5.1 Results based on Lean canvas

In this study four Lean Canvas models were created, one for each business opportunity. Each opportunity was then analyzed based on different criteria and aspects to better visualize the realistic potential as can be seen in following Figures 22, 23, 24 and 25.

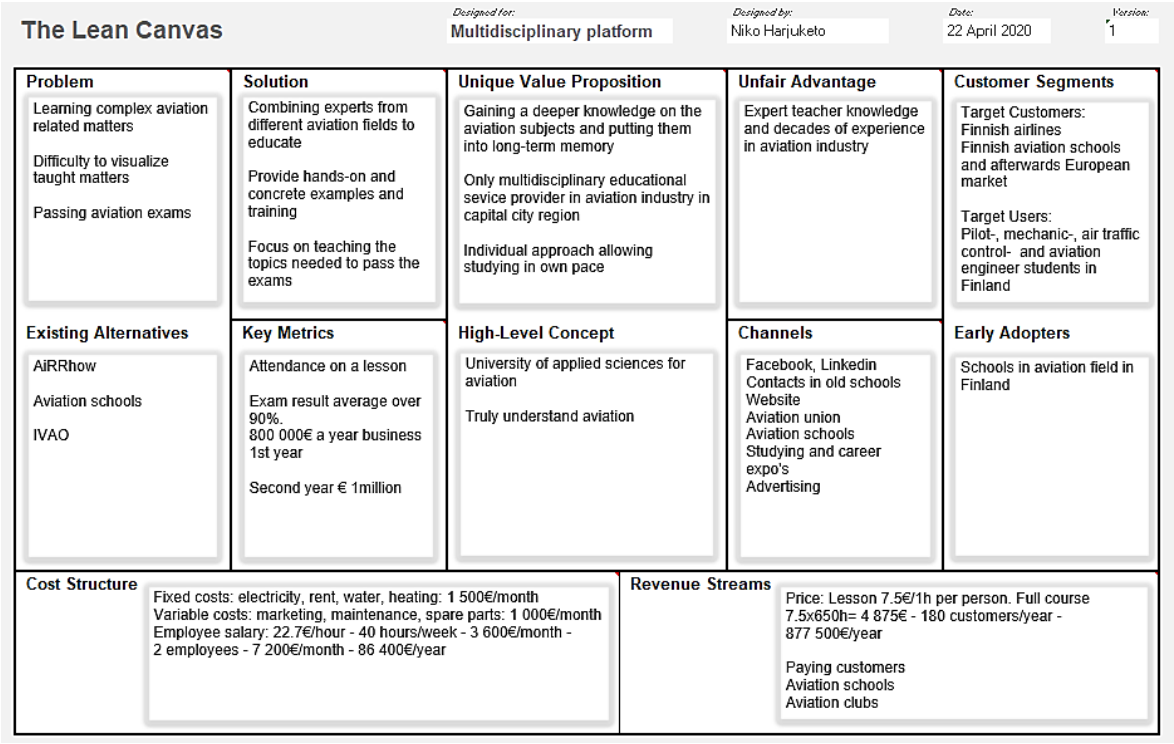

Figure 22. Lean Canvas: Multidisciplinary platform for aviation education and tutoring.

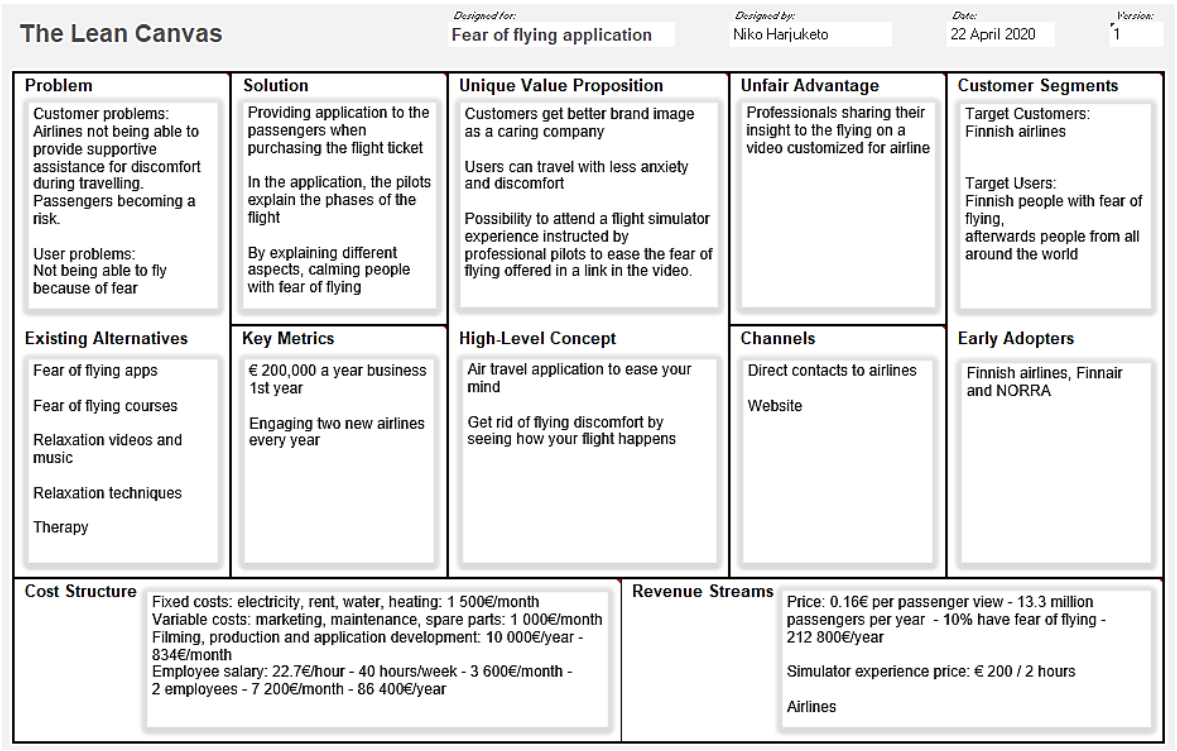

Figure 23. Lean Canvas: Smart device application to ease fear of flying.

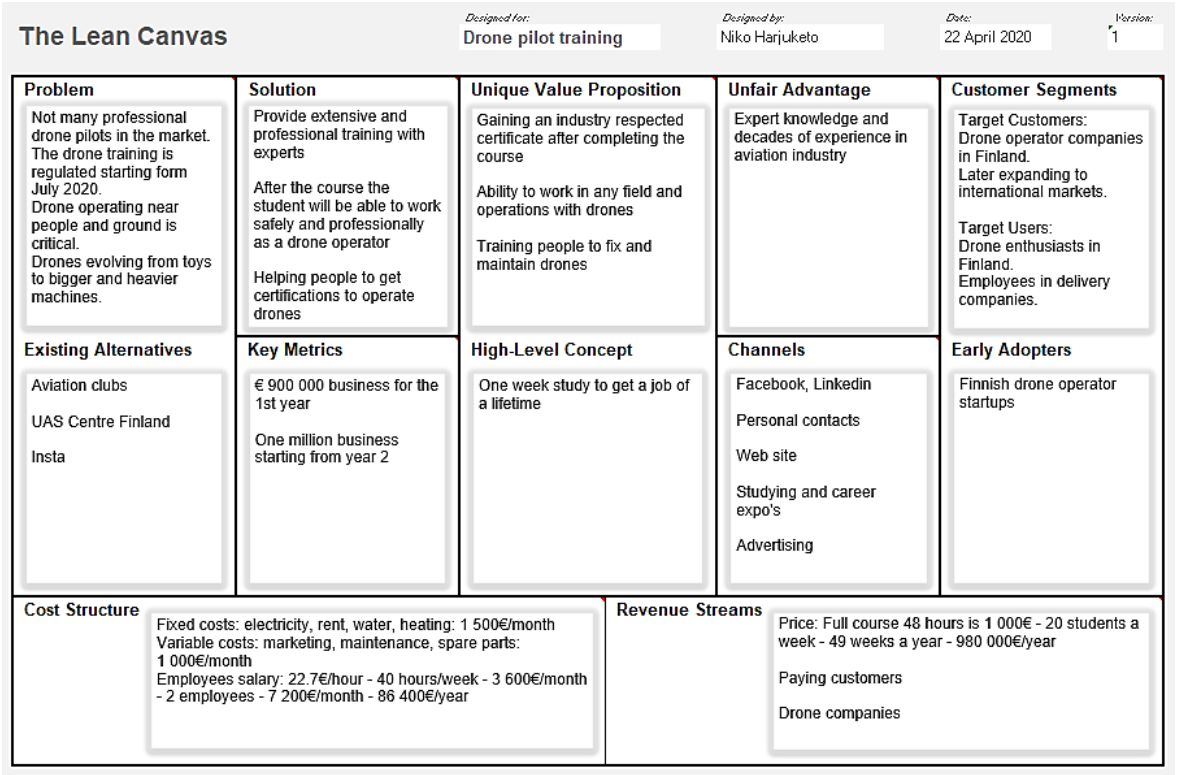

Figure 24. Lean Canvas: Drone pilot training.

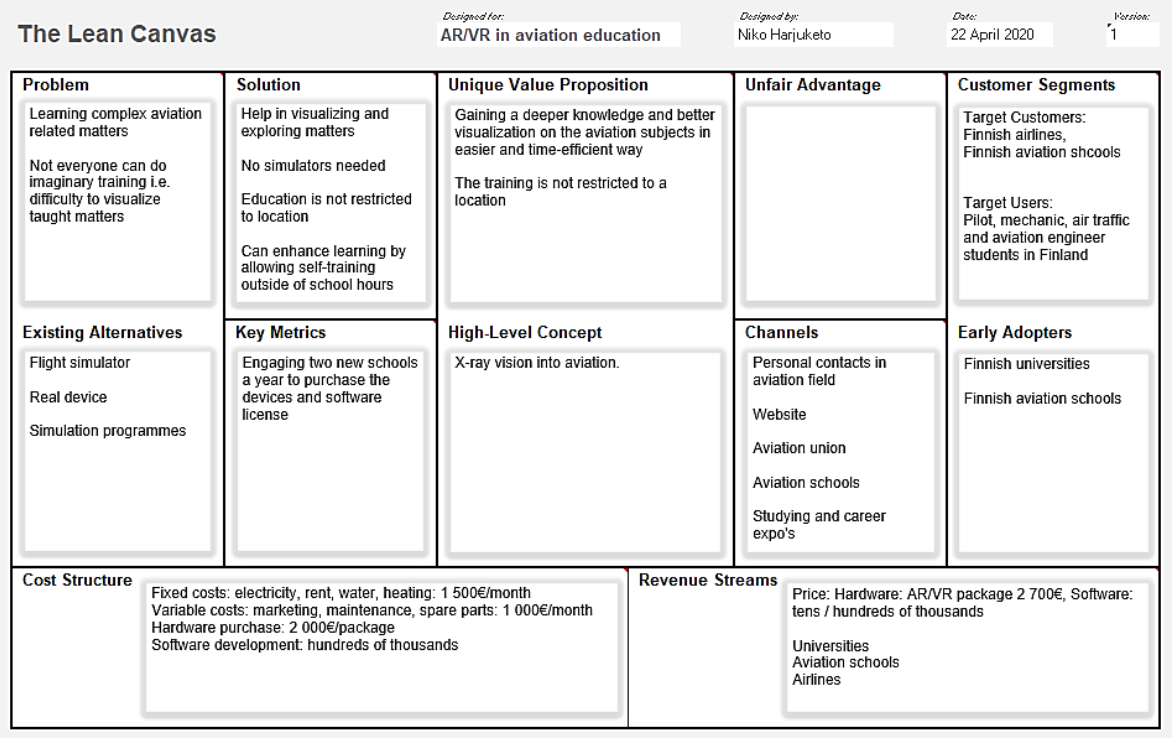

Figure 25. Lean Canvas: Use of augmented and virtual reality in aviation education.

In the beginning the expectation was that the most potential business opportunity would be Multidisciplinary platform for aviation education and tutoring followed by the Smart device application to ease fear of flying. This expectation was based on the knowledge that these two opportunities would be reasonably easy to implement in reality and show concrete results rather quickly. Use of AR and VR in aviation education and Drone pilot training first seemed equally interesting opportunities, however, not practically as potential as the two first ones due to the lack of feasible technological developments available.

The costs and revenues were estimated according to online research of similar businesses in Finland. Since there does not exist data for hourly salary of an aviation theory teacher in Finland, an average salary of a flight instructor and a class teacher was used according to a website Palkkavertailu.com ([ref. 22 June 2020]). The working hours per week were selected to be 40 hours and variable and fixed costs were roughly estimated.

The market price for a customer for Multidisciplinary platform was researched to be € 5 290 (Aeropole [ref.22 June 2020]). Since the course would last 650 hours the

average price per hour was a little bit over € 8. Thus, a price of € 7.5 per hour totaling € 4 875 was chosen to stand out from the competition. The price for Smart device application for fear of flying was connected to online media advertisement prices. The average price that an advertiser pays for their ad in a video in channel such as YouTube was 0.18 USD accounting to € 0.16 (Geyser 2020). The market price for drone pilot training offering separate courses lasting altogether 48 hours had a total price of approximately € 1 400 (UAS Centre Finland [ref. 15 June 2020]). Thus, the price for the course was selected to be € 1 000 to stand out from the competition. According to ThinkMobiles ([ref. 22 June 2020]), the VR application development could take 3 to 24 months and cost between 5 000 USD and 300 000 USD depending on the complexity. Since the price is relatively difficult to estimate, it was only stated that it would be in hundreds of thousands because the software would need to be high end quality for the training purposes.

After completing the Lean Canvas, it was found out that the originally considered best two opportunities did not seem as profitable or viable as the two latter ones combined. The Multidisciplinary platform for aviation education was found out to have newly established strong competition and Smart device application to ease fear of flying would initially bring the lowest profit until growth outside of Finnish markets would be possible.

The Drone pilot training was the most profitable opportunity and a good feature of it was the immediate implementation potential into a business. The Use of AR and VR in aviation education would also provide a high financial potential since the software would be enormously profitable. The downside to the software development is that is takes exceptionally long time and a lot of money before it can be released to markets and it would need to be continuously updated.

5.2 Calculations

Too many variables exist to be able to precisely estimate the revenues of use of AR and VR in aviation education and that is why no numbers were approximated for the profit. In the following Tables 4, 5, 6 and 7 the profitability of different opportunities

is displayed in terms of 1st year profit, 5th year profit, 10th year profit with compound annual growth rate of 20% and 10th year profit with CAGR of 77%.

Table 4. Profitability of year 1.

	1st year			
Opportunity	Multidisciplinary platform	Fear of flying application	**Drone pilot training**	AR/VR in aviation education
Customers (pcs)	90	665 000	**490**	N/A
Revenues per customer (€)	4 875	0,16	**1 000**	N/A
Investment (€)	400 000	400 000	**400 000**	400 000
Fixed and variable costs (€)	30 000	40 000	**30 000**	N/A
Workforce (€)	86 400	86 400	**86 400**	N/A
Total revenues (€)	438 750	106 400	**490 000**	N/A
Total costs (€)	116 400	126 400	**116 400**	N/A
Profit (€)	-77 650	-420 000	**-26 400**	Negative tens of thousands

Table 5. Profitability of year 5.

	5th year			
Opportunity	Multidisciplinary platform	Fear of flying application	**Drone pilot training**	AR/VR in aviation education
Customers (pcs)	27 000	450 000 000	**147 000**	N/A
Revenues per customer (€)	4 875	0,16	**1 000**	N/A
Investment (€)	0	0	**0**	0
Fixed and variable costs (€)	4 500 000	6 000 000	**4 500 000**	N/A
Workforce (€)	12 960 000	12 960 000	**12 960 000**	N/A
Total revenues (€)	131 625 000	72 000 000	**147 000 000**	N/A
Total costs (€)	17 460 000	18 960 000	**17 460 000**	N/A
Profit (€)	114 165 000	53 040 000	**129 540 000**	Tens of millions

Table 6. Profitability of year 10 with 20% CAGR.

	10th year (20% CAGR)			
Opportunity	Multidisciplinary platform	Fear of flying application	**Drone pilot training**	AR/VR in aviation education
Total revenues (€)	327 525 120	179 159 040	**365 783 040**	N/A
Total costs (€)	43 446 067	47 178 547	**43 446 067**	N/A
Profit (€)	284 079 053	131 980 493	**322 336 973**	Hundreds of millions

Table 7. Profitability of year 10 with 77% CAGR.

	10th year (77% CAGR)			
Opportunity	Multidisciplinary platform	Fear of flying application	**Drone pilot training**	AR/VR in aviation education
Total revenues (€)	2 286 676 434	1 250 831 554	**2 553 781 088**	N/A
Total costs (€)	303 326 652	329 385 642	**303 326 652**	N/A
Profit (€)	1 983 349 782	921 445 911	**2 250 454 437**	Billions

The most promising opportunity, Drone pilot training, was highlighted with bold letters. Combining drones and AR and VR technology into a busines could bring increased benefits, since both fields have strong growth predictions, but the integration of these technologies is not yet comprehensively researched. For this reason, the Drone pilot training and AR and VR in aviation education were chosen to be studied jointly and idea developed further to bring out the one best opportunity.

6 QUANTITATIVE RESEARCH — SURVEY

6.1 Objectives of the survey

The objectives of this survey were to analyze how people perceive the present situation and the future of drone and augmented and virtual reality use. The results from this survey were used to help to identify the potential for a new business in aviation industry consisting of drones and use of augmented and virtual reality in education.

6.2 Research method

The research was executed by conducting an online survey. For the research it was important to receive as many answers as possible from the target group in order to have more reliable results. With an online survey it was possible to gather data quickly and efficiently. Most of the questions in the online survey were multiple choices to make survey attractive for the participants and easy to analyze. The survey also included one open-ended question and one scale question.

Overall, the survey was designed with a goal to minimize alternative explanations and interpretations for findings in order to maximize validity in answering research questions according to the guidelines which McKibben and Silvia (2015) state are defined by Heppner et. al. (2008).

6.3 Target group

To gain a better understanding of professionally interested participants' opinions on questions related to proposed business opportunities, the target group was selected according to free-time activities or profession related to aviation, drones or AR and VR. The target group was chosen to be international in order to receive data from foreign markets which could be useful when the business opportunity would expand to international markets. Age and sex of the respondents were not a defining factor for the study, which is why the survey did not include questions considering them.

6.4 Questionnaire — Conducting the research

Ramshaw ([ref. 14 May 2020]) states that the importance of surveys is to collect feedback, opinions, criticism and suggestions from the general public and customers. Ramshaw also says that it has been a common practice in the past that surveys were conducted in printed form. With the introduction of online surveys collecting feedback has become easier since the manual collection process was eliminated.

The questionnaire was shared via the SurveyMonkey.com, a widely used and well-known website survey creating platform (Ramshaw [ref. 14 May 2020]). In this website it was possible to create a graphically attractive and functionally user-friendly survey for free and share the link to the respondents. In the survey it was decided to include mainly multiple-choice questions to minimize the amount of missed answers and make it quick to answer and in this way to maximize the engagement of the respondent. With SurveyMonkey.com it was easy to create the survey, gather responses, and automatically analyze the results and make graphical representations of the responses. Website also allows to export the analysis to pdf and excel files for further processing or presentation.

The link to the survey was sent to each respondent privately by e-mail. The name of the survey was titled as Use of Commercial Drones and Augmented and Virtual Reality in Aviation. The survey was divided into two parts. The first part was asking questions about how respondents perceive the use of drones in the present and the future. The second part of the survey was focused on respondent’s opinion about augmented and virtual reality. The survey consisted of 13 questions: 11 multiple-choice, 1 open-ended question and 1 scale question. The questions were planned with the aim to receive the insights of the aviation industry professionals to the most critical and up-to-date questions regarding the two business opportunities in order to find out their potential.

6.5 Results

The survey was sent to 23 selected respondents and 13 of them answered the survey, which means that the response rate was 56%. There was a total of 12 respondents who answered all the questions and 1 respondent skipped one question from the survey. All the respondents belonged to the target group and had experience in the aviation industry. From them 7.7% had experience more than 25 years, 30.8% had experience between 4 to 10 years and 61.5% of the respondents less than 3 years in the industry. 15.4% of respondents related their field of expertise with economics and business. The rest of the group stated that their field of expertise was in aviation and 76.9% of respondents were pilots.

When asked about the free time activities, none of the respondents had activities related to augmented and virtual reality. 7.7% of the respondents participated in education or training, 15.4% took part in activities including drones and 76.9% were involved in activities in aviation in their free time. These first questions of the survey reveal that the majority of the respondents were pilots with aviation related free-time activities, over 50% of whom had experience less than 3 years in aviation industry.

When asked about the biggest benefits of drones bringing to the society, over 69% chose rescue operations as one of the biggest benefits and next chosen options were military and industry. Delivery was chosen as the fourth most beneficial option. Personal transportation was regarded as the least beneficial option since none of the respondents chose it. This might be because the concept of personal drone transportation is still in development and not yet widely known, however, this might change in the future. Drones used for measurements of environmental and climate change and in various entertainment related matters gained also minimal interest within the group. The results from this question show us that the respondents find the biggest benefits of the drones to the society in the fields that are closely related to the basic human wellbeing and safety. The non-essential fields like personal transportation by drones and entertainment were shown minimal interest.

As Figure 26 shows, over 61% of the respondents considered that air safety was the most worrying factor about drones. Overall security was not of any concern to them and 7.7% stated that there were no worries about drones at all. Safety for

people on the ground, property safety and privacy together worried 30% of the respondents. It seems that perhaps because the majority of respondents were working as pilots, that naturally the most worrying factor would be air safety since there has been recorded increased frequency of drone related incidents in aviation. According to results drones are seen mainly as a benefit rather than a threat to the security, however there were some concerns about invasion of privacy.

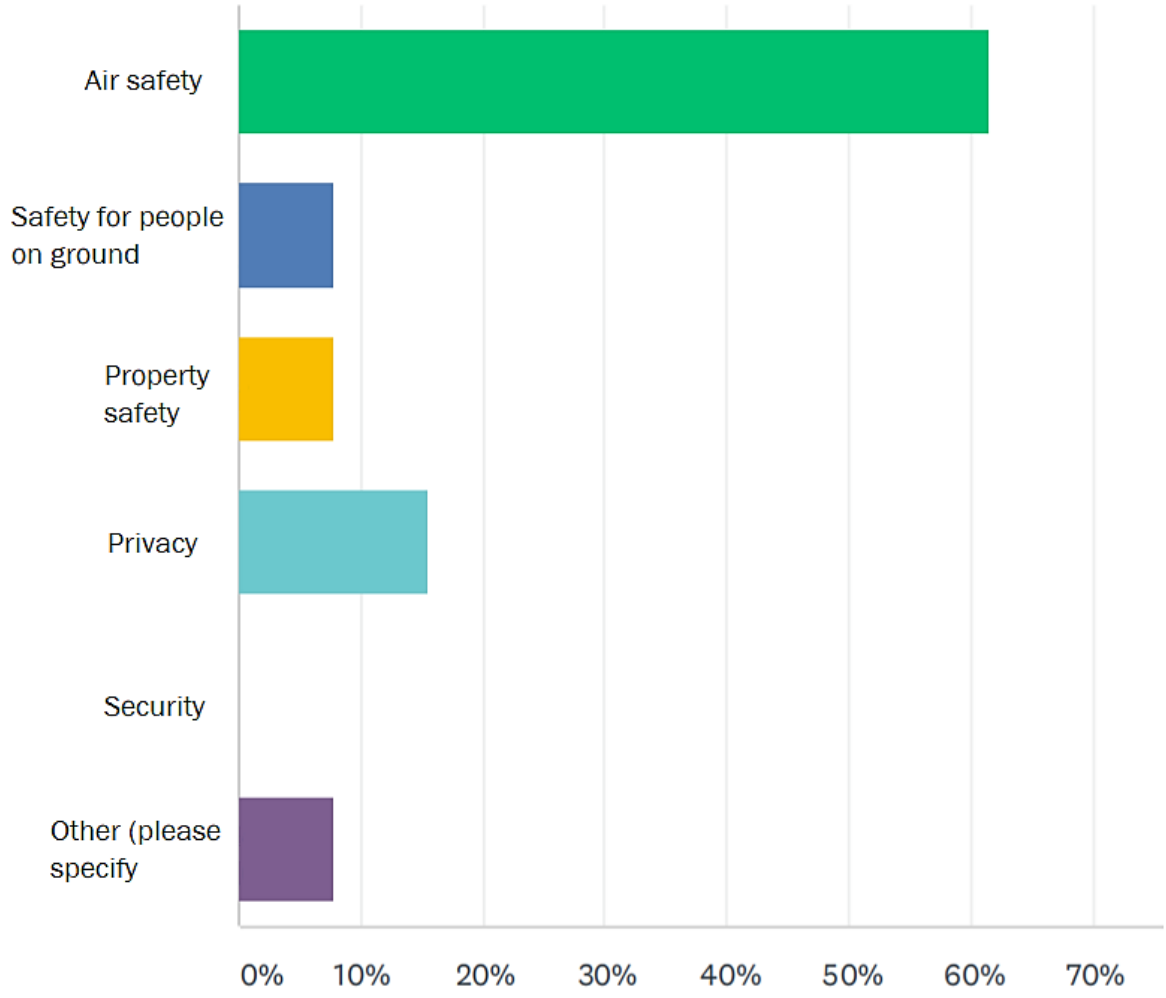

Figure 26. Which of the following worries are most important concerning drones?

Figure 27 reveals, that considering the risks related to drone operation safety, all the respondents saw that drone pilots, in some extent, should complete a certification course. Majority thought that every drone pilot operating a drone heavier than 3 kilograms should complete a certification course and 7.7% thought the same should be required from drones heavier than 400 grams. The reason for these weight limits is the European Union drone regulations (Droneinfo [ref.15 July 2020]). Over 38% thought that every drone pilot should complete a course and 7.7% had

an opinion that only operators using drones professionally should complete a course. From these results it can be derived that drone operating certification course is considered necessary. Perhaps not for all drone operators, but at least for heavier than 3-kilogram drones. The reasons behind the answers seem to be related to more serious damage caused by heavier drones. The caused damages could be prevented with training and the safety of the drone operations could be improved with the help of education.

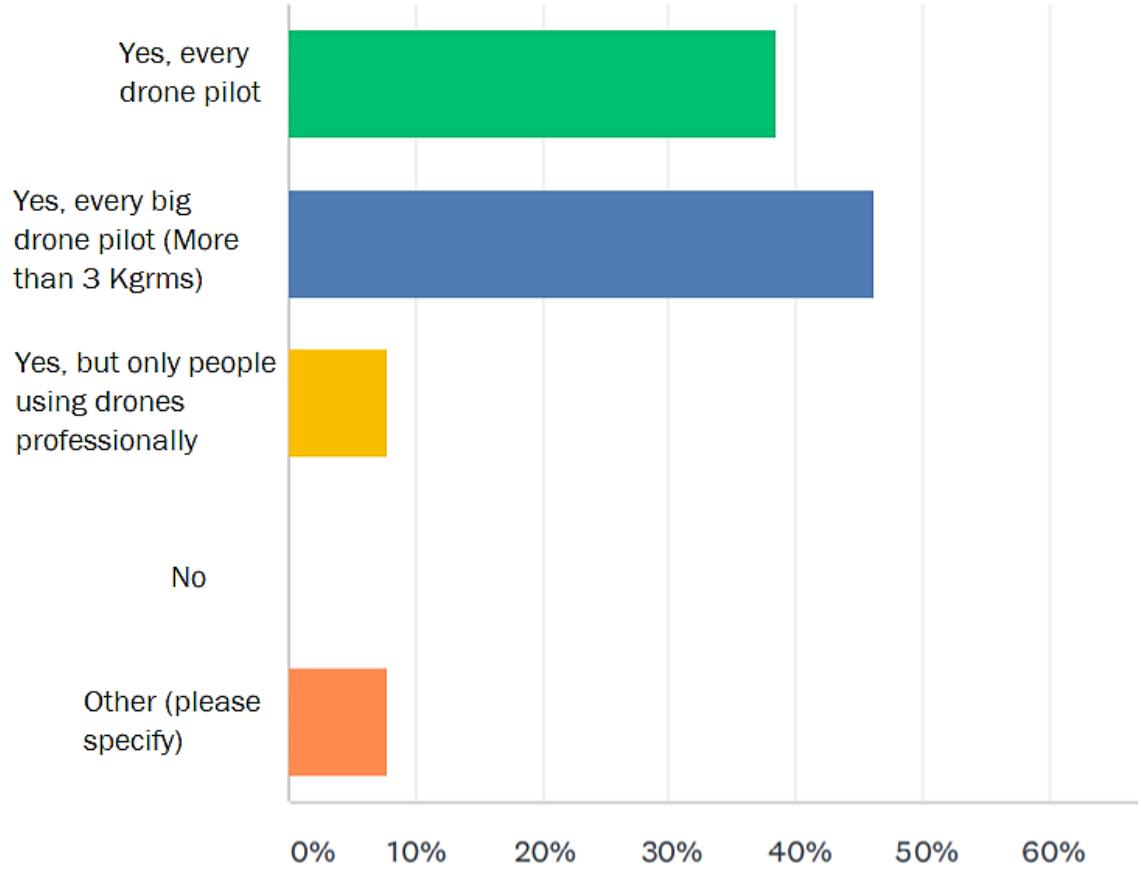

Figure 27. Considering the risks mentioned previously, do you think drone pilots should complete a certification course when operating a drone?

76.9% of the respondents considered the price between 500 and 999 euros appropriate for a one-week certification course for drone operating certification confirming theoretical knowledge and practical skills enabling to apply for drone related work globally. 15.4% of the respondents were willing to pay between 1 000 and 1 499 euros and 7.7% between 1 500 and 2 499 euros. The results show that the course price around € 1 000 reflects the expectations of the respondents.

Figure 28 reveals that over 61% of respondents would not be willing to pay extra for a pilot operated drone delivery and they prefer automated drones. In addition, only around one third would be willing to pay for specialized deliveries. Interesting about these results is that respondents who wanted to have licensed drone operators would not be willing to pay extra for a pilot operated drone delivery and majority would like to have automated drone deliveries. This shows the contradiction between the need and requirement for drone safety and willingness to pay for it. Currently automated drone tests are limited to less populated areas due to technological solutions still being under development.

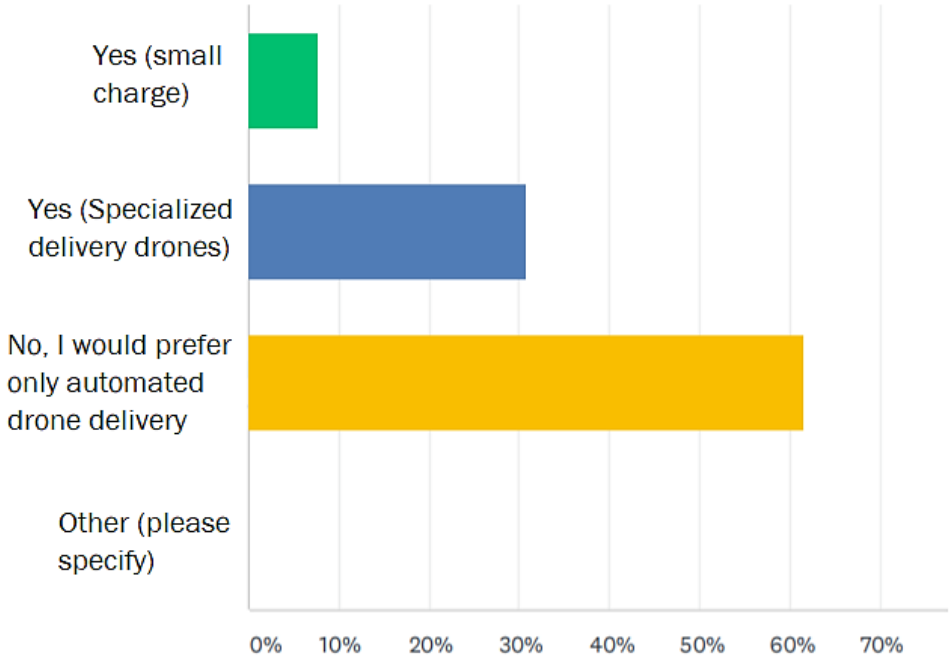

Figure 28. Hypothetically, in the future, when the drone deliveries would be common, would you be willing to pay extra for a pilot operated drone delivery?

When asked about opportunity to use Augmented Reality and Virtual Reality in aviation and drone industry, all respondents felt that there would be at least some opportunities. As Figure 29 shows, 30.8% of the respondents felt that there is great deal of opportunities, same percentage answered a lot, same percentage said a moderate amount and 7.7% felt that there is a little opportunity. It seems that the benefits of combining AR and VR technology with drones would be appreciated.

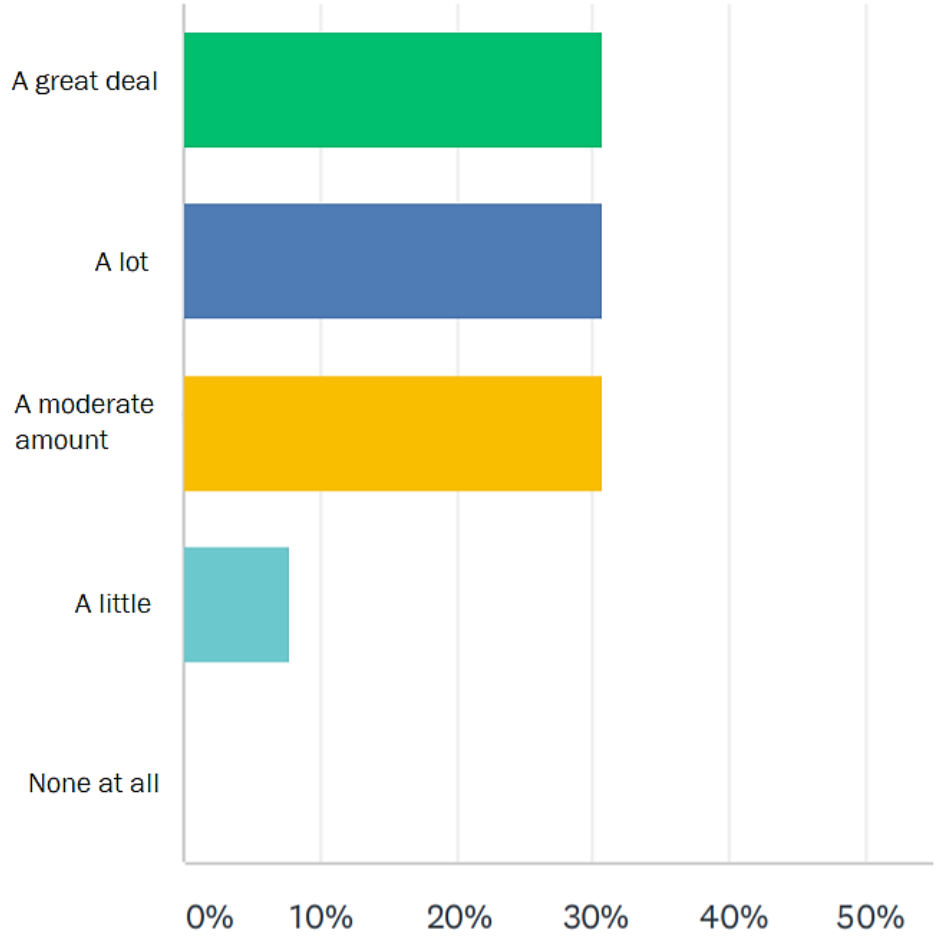

Figure 29. Do you think there is opportunity to use augmented reality (AR) and virtual reality (VR) in aviation and drone industries?

The biggest drawback for utilizing AR and VR in aviation industry training according to 50% of the respondents would be false learning due to lack of physical and psychological real-world sensations. Endangering safety received 25%, high costs around 16.7% and privacy and data security received 8.3% of the answers. Many respondents, perhaps because of their field of expertise, were worried about the true learning achieved by using AR and VR in training. This kind of training is mostly related to pilot training where the sensations of events are essential for learning. If the training would be drone pilot training, the factor of no sensations remains even without the introduction of AR and VR. It also seems that health risks were not regarded as a drawback in using AR and VR in training.

As Figure 30 presents, none of the respondents saw it very likely for AR and VR replacing simulators in aviation education and 46.1% felt that it was unlikely. The responses show that people do not see AR and VR overtaking simulators in aviation

training probable since only 15.4% saw it likely. This shows that there exists high trust in simulators in aviation field. One reason for this might be the previously mentioned loss of sensations with AR and VR, while simulators accommodate this feature well.

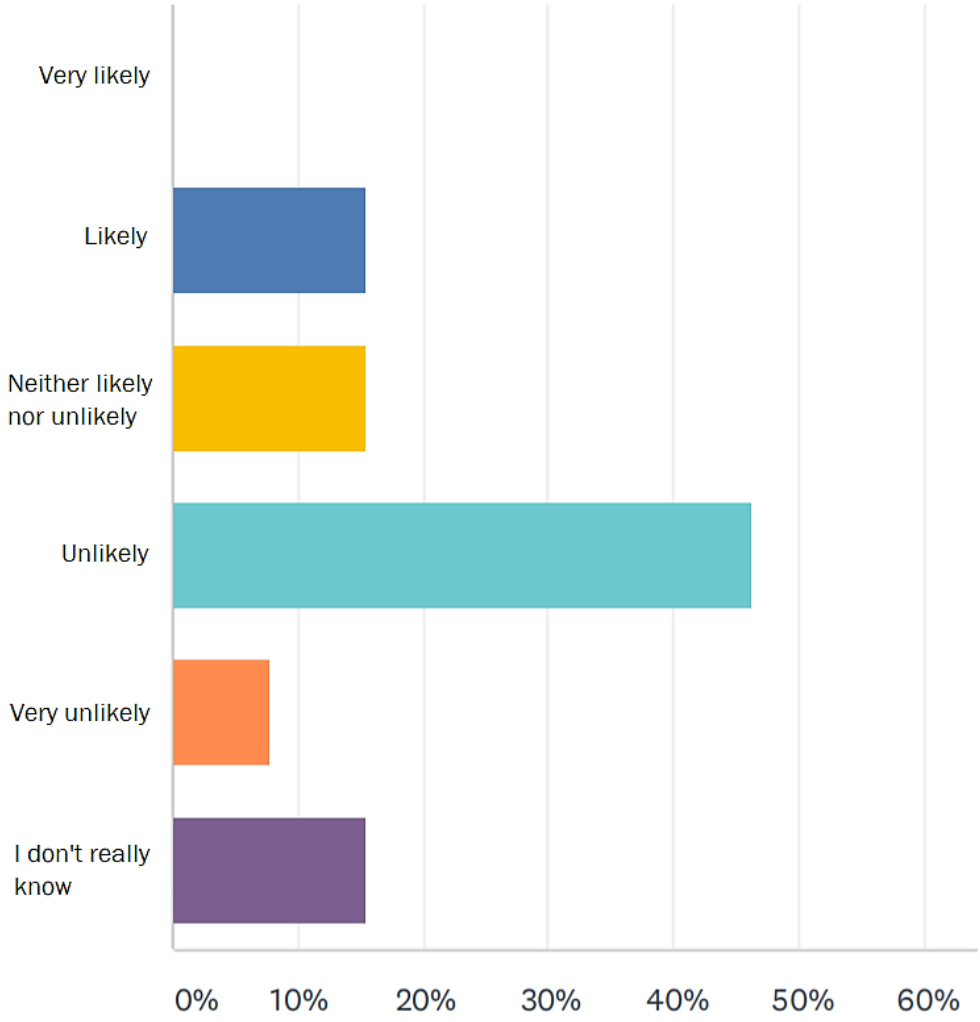

Figure 30. Do you think augmented reality and virtual reality will replace simulators in aviation education?

When asked how good a training platform would an augmented and virtual reality environment provide for aviation education, the answers varied significantly. The evaluation scale was from 1 to 100, one being the worst and one hundred being the best imaginable platform. The average rating was 61. 7.7% of the respondents gave a rating of 100 and 7.7% gave rating of 18. The other answers were within the range of these two values. It is hard to find a reasoning for such a varied data but considering the average result it can be determined that the training platform including AR

and VR in aviation shows a moderate interest and potential. Perhaps the respondents would like to see AR and VR platform in aviation education, but according to previous answers they feel skeptical towards the introduction taking place.

Figure 31 shows that in the period of the next 10 years, the respondents estimated that pilots would be needed for commercial drone operations. Majority, 46.1%, said that some pilots would be needed and only 7.7% thought that only very few pilots would be needed. Almost 30.8% thought that many pilots with specific additional skills such as background in security, health or logistics would be needed and about 15.4% thought that a lot of pilots would be needed for commercial drone operations. These answers reveal that, in the short term, drone pilots especially in specified fields are expected to be needed for the commercial drone operations.

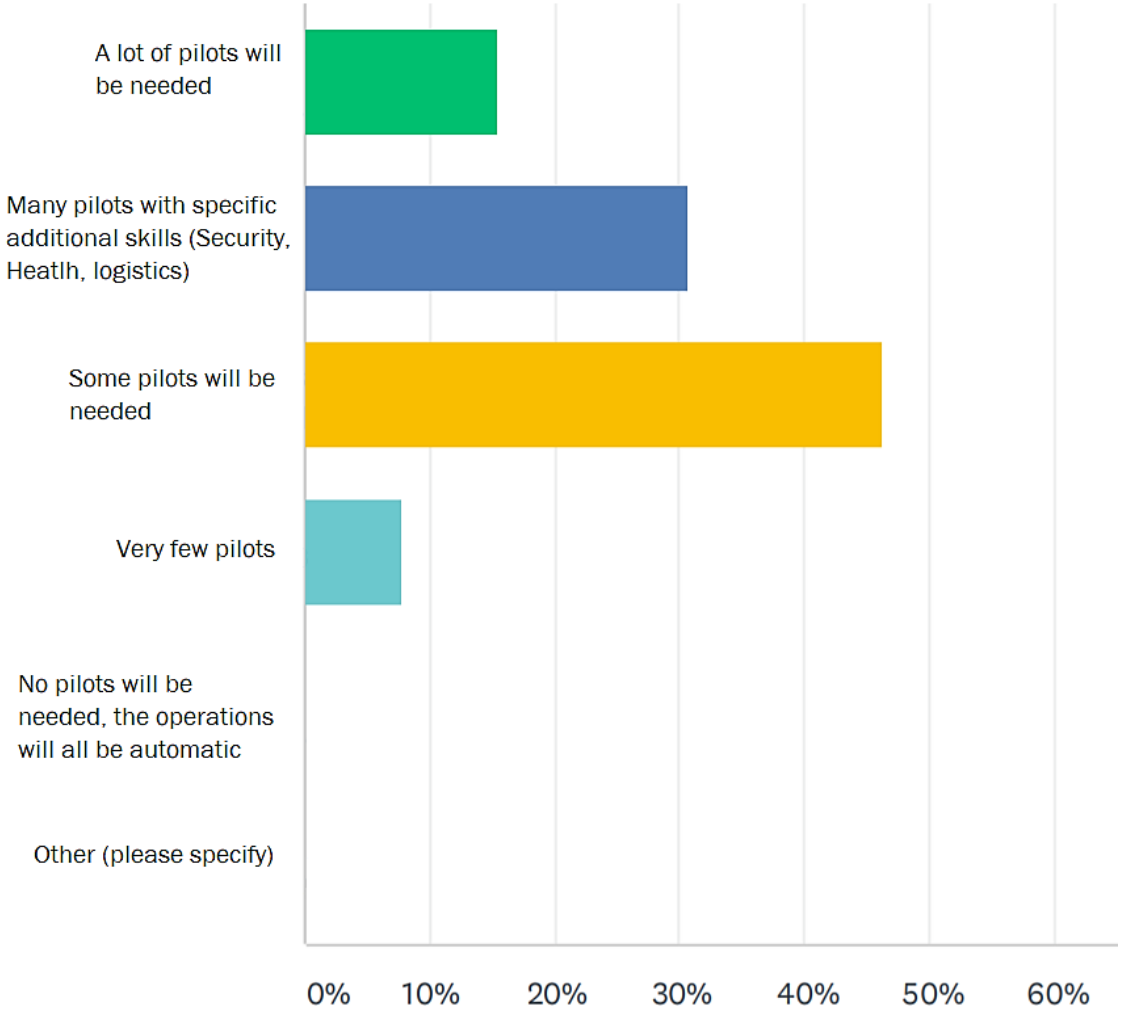

Figure 31. Within the next 10 years, do you think pilots will be needed for commercial drone operations or do you think they will be automatically operated?

6.6 Summary of the survey

Analyzing the whole survey results, a conflict between the need for pilot operated drones and willingness to pay additional fee for pilot operated deliveries exists. Automation is seen as a definite trend for future, but it will not dominate within the next 10 years since at the moment the automated drone operations are still under development. The biggest benefits of drones for the society are seen in rescue operations, military, industries such as mining and construction followed by delivery. Here lies the potential for drone pilot training. Majority of the respondents would be willing to pay between € 500 and € 999 for a one-week drone pilot certification course and 23% would pay even more.

7 CONCLUSIONS

7.1 Potential business opportunity

Aviation industry's overall effect on global economy in 2016 was 2.7 trillion USD. Until the end of year 2019 all forecasts about the aviation industry agreed that there would be a continuous global growth for the foreseeable future. Some regional markets, such as Asia-Pacific sector, were projected to grow almost exponentially due to the middle class becoming wealthier and larger in these regions. Also, a near doubling of passenger airplanes and crew to operate them was predicted within next 15 years and similar trend was estimated for RPK's and RTK's for the industry.

Currently the whole world is facing difficulties posed by COVID-19 and it is evident that especially aviation industry and fields combined with tourism have taken a steep turn downwards considering the development of the markets. The next couple of years will be crucial for the survival of many businesses and it is estimated that it will take three to five years for the industry to recover. Despite these challenges, this will be an interesting and important time to start searching for new business opportunities in the aviation industry.

The objectives of the thesis were to research the market potential for a new business opportunity in the aviation field in Finland. The research focused on targeting new business opportunities and finding ways to merge them with most suitable operations by defining general overview of the business models. This thesis has pointed out some possibly potential business propositions and created a rough version of a new business opportunity in aviation industry in Finland.

Four potential opportunities in the aviation industry were recognized and given a closer examination. These opportunities included Multidisciplinary platform for aviation education and tutoring, Smart device application to ease fear of flying, Use of augmented and virtual reality in aviation education, and Drone pilot training. Lean Canvas was chosen as a tool to create an overview and find out the potential of these opportunities.

After conducting a Lean Canvas study, it became evident that Smart device application to ease fear of flying would not have as big potential as the other opportunities mainly due to lower profitability. Multidisciplinary platform for aviation education and tutoring was analyzed to be very profitable concept, however, a newly established strong competition in Finland affected the decision not to develop the idea further. Drone pilot training displayed the largest profit and the opportunity would be further developed to train drone pilots. Use of augmented and virtual reality in aviation education showed a lot of promise since the technological innovations are still rather new and remain to be somewhat unexplored. The profitability of AR and VR model was difficult to state since there would be many variables affecting the calculation and it was decided to only state that it shows a great promise for a business.

Cost-revenue calculations and an illustration of the business ten years in the future were performed to clarify the financial potential of the opportunities. Eventually Drone pilot training and Use of augmented and virtual reality in aviation education were chosen to be jointly studied further since these two concepts could complement each other and possibly form a unique and viable business opportunity.

Outcomes of the Lean Canvas results were later validated, and cross checked with the online survey and it can be determined that there exists interest towards drones and AR and VR technologies. Combining AR and VR into aviation education by replacing flight simulators in general does not show as much promise as integrating them into the drone pilot training. According to the online survey, drones could bring the biggest benefit to the society in matters concerning rescue operations, military, industries such as mining and construction, and delivery. Even though, the survey showed that people expect to see pilot operated drones during the next decade, it was also evident that majority would like to rather have automated drone deliveries and not pay extra for pilot operated deliveries.

Based on the survey analysis, most people would want the drone pilots to go through a certification training. This shows that people require more strict control over drone pilots but eventually they would not be willing to pay extra for the pilot operated drone deliveries. In the future this might pose a challenge in terms of pricing for commercial drone operator businesses.

Looking at the business opportunity after conducting different analyses it is obvious that drone pilots will be needed at least in the next decade and even later until automation technology reaches a safe and reliable status. Safety of drone operations is clearly an important matter for people, and they would want most of the drone pilots to go through a certification training confirming theoretical knowledge and practical skills for operating drones. Furthermore, the effects of COVID-19 might cause wider demand and faster developments facilitating drone operations to avoid unnecessary contact between people and possible spread of the virus.

Since the course would be lasting one week, the participants would have to train their drone piloting skills also privately due to limited time available. Specific practical instructing would be carried out during this week. In the end of the course a theoretical and practical drone operating exam would be required to pass in order to receive a certification enabling to apply for drone related work globally.

After conducting the research and analyzing the markets in Finland it was found out that market price for drone pilot training offering separate comprehensive courses lasting altogether 5 days (48 hours) had a total price of approximately € 1 400 (UAS Centre Finland [ref. 15 June 2020]). The € 1 000 price for the one-week drone pilot certification course met the expectations of the survey respondents and it was also below the current market price. This means that people would be most willing to join the course in the price range of € 1 000 and the business would be viable and profitable.

7.2 Recommendations for further research

The survey response rate was relatively good considering that 56% from the target group answered the survey. However, another research reaching more respondents would be recommendable to receive more reliable results. In the future researches it would be desirable to find out the concrete ways to adapt AR and VR technologies to drone pilot training, since this study only pointed out some options. For example, a company called Spherie, located in Germany, has reached an interesting integration of these technologies (Spherie [ref. 17 June 2020]). Another recommendation

for further research would be the integration of AR and VR into simulators. According to the survey there is some potential with this opportunity, however it would need to be comprehensively researched to be able to bring to light the real benefits and risks in order to convince the aviation community of its usability in simulator training.

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APPENDICES

Appendix 1. Data of passenger and cargo transport in Finland

Appendix 2. Online survey: Use of Commercial Drones and Augmented and Virtual Reality in Aviation

Appendix 1. Data of passenger and cargo transport in Finland

Passengers by Finnish airports 2018-2019

	2018						2019					
	Domestic		International		Total		Domestic		International		Total	
	Passengers	Change-%	Passengers	Change-%	Passengers	Change-%	Passengers	Change-%	Passengers	Change-%	Passengers	Change-%
Helsinki	2 955 100	8,2	17 893 649	10,7	20 848 749	10,4	2 929 779	-0,9	18 931 303	5,8	21 861 082	4,9
Oulu	991 161	16,4	105 756	47,5	1 096 917	18,8	950 699	-4,1	106 656	0,9	1 057 355	-3,6
Rovaniemi	512 033	12,4	132 111	6,6	644 144	11,2	540 467	5,6	120 657	-8,7	661 124	2,6
Turku	105 746	-0,3	263 686	15,9	369 432	10,7	106 825	1,0	346 102	31,3	452 927	22,6
Kittilä	208 835	13,5	145 726	3,3	354 561	9,1	214 357	2,6	148 804	2,1	363 161	2,4
Vaasa	166 195	2,4	149 705	8,7	315 900	5,3	165 125	-0,6	138 786	-7,3	303 911	-3,8
Kuopio	213 856	3,2	31 826	13,1	245 682	4,4	204 597	-4,3	38 932	22,3	243 529	-0,9
Ivalo	182 934	13,7	59 523	19,9	242 457	15,1	183 122	0,1	56 631	-4,9	239 753	-1,1
Tampere	81 705	-4,8	146 391	1,5	228 096	-0,8	87 006	6,5	135 384	-7,5	222 390	-2,5
Joensuu	111 144	0,4	10 410	15,1	121 554	1,5	112 564	1,3	14 049	35,0	126 613	4,2
Kuusamo	79 515	18,4	34 054	65,6	113 569	29,4	78 103	-1,8	35 900	5,4	114 003	0,4
Kajaani	85 286	0,7	3 529	29,2	88 815	1,6	84 316	-1,1	2 991	-15,2	87 307	-1,7
Jyväskylä	59 516	4,8	12 567	12,7	72 083	6,1	57 027	-4,2	9 545	-24,0	66 572	-7,6
Kemi-Tornio	65 004	-32,0	1 796	-79,7	66 800	-36,1	62 516	-3,8	1 063	-40,8	63 579	-4,8
Kokkola-	57 286	-5,6	11 350	-40,7	68 636	-14,0	51 316	-10,4	4 797	-57,7	56 113	-18,2
Mariehamn	41 377	-2,6	13 263	-30,5	54 640	-11,3	37 273	-9,9	14 324	8,0	51 597	-5,6
Enontekiö	595	-24,2	25 468	2,9	26 063	2,1	16	-97,3	27 963	9,8	27 979	7,4
Pori	5 789	-40,0	11 836	-12,6	17 625	-24,0	6 817	17,8	7 598	-35,8	14 415	-18,2
Savonlinna	7 628	-20,1	3 129	9,4	10 757	-13,3	7 130	-6,5	3 365	7,5	10 495	-2,4
Halli	15	15,4	0	-100,0	15	-40,0	0	-100,0	0	/0	0	-100,0
Utti	7	133,3	0	-100,0	7	16,7	0	-100,0	0	/0	0	-100,0
TOTAL	**5 930 727**	**8,2**	**19 055 775**	**10,7**	**24 986 502**	**10,1**	**5 879 055**	**-0,9**	**20 144 850**	**5,7**	**26 023 905**	**4,2**

Arrival, departure, and transfer passengers in domestic and in international flights in Helsinki Airport 1998-2019

HELSINKI AIRPORT PASSENGERS 1998-2019

Passengers	Domestic				International				GRAND TOTAL			
	Arrival passengers	Departure passengers	Transfer passengers	Total	Arrival passengers	Departure passengers	Transfer passengers	Total	Arrival passengers	Departure passengers	Transfer passengers	Total
1998	1 456 108	1 123 557	320 480	2 900 145	3 224 146	2 627 498	603 391	6 455 035	4 680 254	3 751 055	923 871	*9 355 180*
1999	1 408 403	1 066 651	328 073	2 803 127	3 349 174	2 784 964	629 423	6 763 561	4 757 577	3 851 615	957 496	*9 566 688*
2000	1 526 521	1 177 639	338 771	3 042 931	3 443 903	2 875 106	648 014	6 967 023	4 970 424	4 052 745	986 785	*10 009 954*
2001	1 503 504	1 144 497	351 671	2 999 672	3 496 334	2 897 584	637 328	7 031 246	4 999 838	4 042 081	988 999	*10 030 918*
2002	1 377 683	1 018 679	351 500	2 747 862	3 378 228	2 799 241	684 556	6 862 025	4 755 911	3 817 920	1 036 056	*9 609 887*
2003	1 347 755	1 000 030	336 833	2 684 618	3 479 250	2 858 562	688 490	7 026 302	4 827 005	3 858 592	1 025 323	*9 710 920*
2004	1 427 620	1 055 904	353 328	2 836 852	3 918 357	3 110 974	863 763	7 893 094	5 345 977	4 166 878	1 217 091	*10 729 946*
2005	1 407 192	1 036 092	361 020	2 804 304	4 157 212	3 228 850	942 829	8 328 891	5 564 404	4 264 942	1 303 849	*11 133 195*
2006	1 474 137	1 061 749	391 741	2 927 627	4 578 600	3 533 799	1 107 755	9 220 154	6 052 737	4 595 548	1 499 496	*12 147 781*
2007	1 445 258	1 030 566	399 472	2 875 296	5 118 611	3 787 847	1 359 868	10 266 326	6 563 869	4 818 413	1 759 340	*13 141 622*
2008	1 359 456	971 079	369 834	2 700 369	5 342 563	3 916 469	1 485 039	10 744 071	6 702 019	4 887 548	1 854 873	*13 444 440*
2009	1 188 756	843 194	340 935	2 372 885	5 116 132	3 737 701	1 384 469	10 238 302	6 304 888	4 580 895	1 725 404	*12 611 187*
2010	1 106 291	754 852	346 495	2 207 638	5 302 073	3 843 156	1 519 755	10 664 984	6 408 364	4 598 008	1 866 250	*12 872 622*
2011	1 356 485	926 723	423 836	2 707 044	6 066 264	4 270 885	1 821 878	12 159 027	7 422 749	5 197 608	2 245 714	*14 866 071*
2012	1 347 600	975 025	370 526	2 693 151	6 078 704	4 220 869	1 865 365	12 164 938	7 426 304	5 195 894	2 235 891	*14 858 089*
2013	1 212 379	858 700	360 553	2 431 632	6 415 166	4 425 738	2 006 458	12 847 362	7 627 545	5 284 438	2 367 011	*15 278 994*
2014	1 252 917	874 358	379 848	2 507 123	6 719 540	4 609 778	2 112 397	13 441 715	7 972 457	5 484 136	2 492 245	*15 948 838*
2015	1 296 179	878 900	416 645	2 591 724	6 910 106	4 767 663	2 152 773	13 830 542	8 206 285	5 646 563	2 569 418	*16 422 266*
2016	1 340 595	843 665	495 625	2 679 885	7 236 008	5 101 116	2 167 418	14 504 542	8 576 603	5 944 781	2 663 043	*17 184 427*
2017	1 365 773	848 398	517 283	2 731 454	8 063 135	5 548 772	2 549 025	16 160 932	9 428 908	6 397 170	3 066 308	*18 892 386*
2018	1 479 644	882 085	593 371	2 955 100	8 929 667	5 847 559	3 116 423	17 893 649	10 409 311	6 729 644	3 709 794	*20 848 749*
2019	1 471 681	843 761	614 337	2 929 779	9 444 724	5 914 677	3 571 902	18 931 303	10 916 405	6 758 438	4 186 239	*21 861 082*

Domestic and international air transport cargo and postal volumes in tonnes 1998-2019

FREIGHT AND MAIL 1998-2019

Tons	Domestic			International			TOTAL	
	Freight	Post	Total	Freight	Post	Total	Tons	Change-%
1998	9 958	8 837	18 795	81 515	12 819	94 333	113 129	/0
1999	10 679	7 530	18 209	76 398	13 107	89 504	107 714	-4,8
2000	12 676	7 444	20 120	79 486	12 595	92 081	112 201	4,2
2001	7 869	6 524	14 393	71 093	11 788	82 881	97 274	-13,3
2002	7 492	6 434	13 927	70 817	11 514	82 331	96 257	-1,0
2003	6 324	5 576	11 900	99 641	10 625	110 266	122 166	26,9
2004	5 363	5 222	10 585	112 270	9 861	122 132	132 717	8,6
2005	4 692	5 251	9 942	115 734	9 627	125 361	135 303	1,9
2006	4 145	5 469	9 614	126 332	9 098	135 430	145 044	7,2
2007	3 171	5 676	8 847	136 669	9 285	145 954	154 801	6,7
2008	2 980	4 549	7 529	142 106	9 533	151 639	159 168	2,8
2009	2 600	4 828	7 428	118 056	8 250	126 307	133 735	-16,0
2010	1 971	3 966	5 937	154 432	7 800	162 232	168 169	25,7
2011	1 329	5 133	6 461	165 651	9 974	175 625	182 086	8,3
2012	3 528	4 035	7 564	188 782	8 108	196 890	204 453	12,3
2013	2 200	3 524	5 724	185 274	7 714	192 988	198 711	-2,8
2014	1 671	3 247	4 918	179 028	10 986	190 013	194 932	-1,9
2015	1 413	3 009	4 422	170 508	9 185	179 693	184 115	-5,5
2016	1 796	2 966	4 762	174 678	8 987	183 665	188 427	2,3
2017	2 111	1 454	3 565	187 797	9 133	196 929	200 494	6,4
2018	2 166	327	2 493	197 127	7 741	204 868	207 361	3,4
2019	2 334	127	2 461	223 986	8 015	232 001	234 461	13,1

Passengers on domestic and in international scheduled flights March 2020

Passengers on domestic and in international scheduled flights

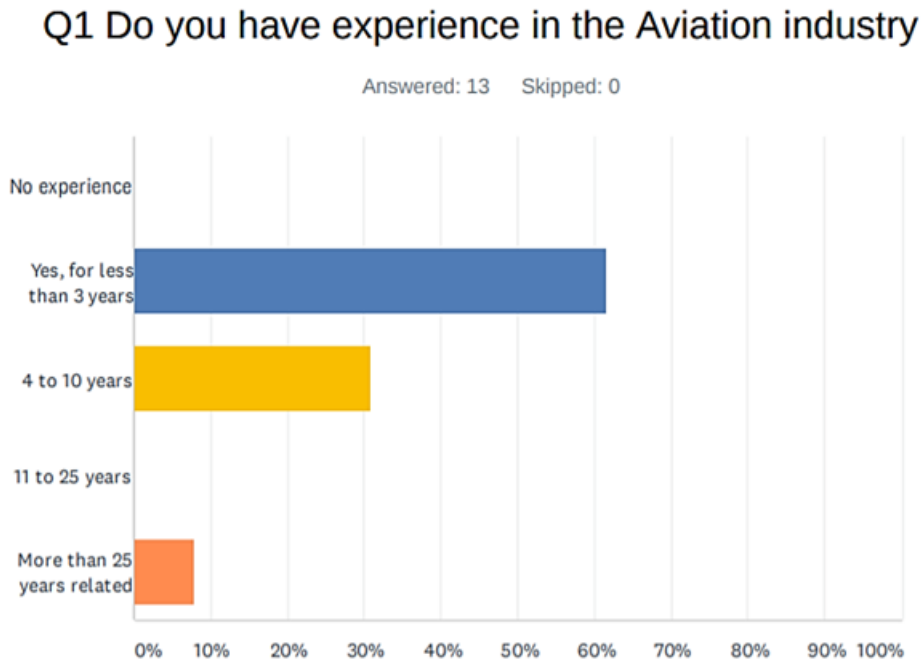
				01/20	02/20	03/20	Year to date
Domestic		Scheduled	Passengers	549 034	573 664	297 737	1 420 435
			Change-%	-0,3	-2,2	-55,1	-21,1
		Total	Passengers	549 376	574 102	298 003	1 421 481
			Change-%	-0,4	-2,2	-55,2	-21,2
International	EU	Scheduled	Passengers	839 288	813 472	393 726	2 046 486
			Change-%	-1,5	-2,5	-60,4	-23,7
		Total	Passengers	923 949	903 747	436 491	2 264 187
			Change-%	-1,0	-1,4	-58,9	-22,2
	Non-EU Europe	Scheduled	Passengers	160 432	147 491	70 545	378 468
			Change-%	15,4	13,8	-50,6	-8,0
		Total	Passengers	169 075	150 639	72 076	391 790
			Change-%	13,1	10,5	-51,1	-9,5
	Long haul	Scheduled	Passengers	334 994	260 280	130 592	725 866
			Change-%	11,4	-6,9	-55,1	-16,7
		Total	Passengers	355 747	283 749	146 731	786 227
			Change-%	10,9	-5,8	-53,4	-16,1
	Total	Scheduled	Passengers	1 334 714	1 221 243	594 863	3 150 820
			Change-%	3,3	-1,8	-58,3	-20,5
		Total	Passengers	1 448 771	1 338 135	655 298	3 442 204
			Change-%	3,3	-1,2	-57,0	-19,6
TOTAL		Scheduled	Passengers	1 883 748	1 794 907	892 600	4 571 255
			Change-%	2,2	-1,9	-57,3	-20,7
		Total	Passengers	1 998 147	1 912 237	953 301	4 863 685
			Change-%	2,2	-1,5	-56,4	-20,1

Domestic and international air transport cargo and postal volumes in tonnes March 2020

Domestic and international air transport cargo and postal volumes in tonnes

			01/20	02/20	03/20	Year to date
Domestic	Freight	Tons	175	177	66	418
		Last year's	219	173	195	587
		Chg-% (month)	-20,1	2,1	-66,4	-28,9
		Chg-% (Cum.)	-20,1	-10,3	-28,9	-28,9
	Post	Tons	8	6	6	20
		Last year's	11	11	13	35
		Chg-% (month)	-31,1	-40,2	-53,2	-42,0
		Chg-% (Cum.)	-31,1	-35,5	-42,0	-42,0
	Total	Tons	183	183	72	438
		Last year's	231	184	208	623
		Chg-% (month)	-20,7	-0,4	-65,5	-29,7
		Chg-% (Cum.)	-20,7	-11,7	-29,7	-29,7
International	Freight	Tons	16 257	14 607	12 136	42 999
		Last year's	16 235	15 404	18 245	49 884
		Chg-% (month)	0,1	-5,2	-33,5	-13,8
		Chg-% (Cum.)	0,1	-2,5	-13,8	-13,8
	Post	Tons	568	375	232	1 174
		Last year's	669	639	726	2 034
		Chg-% (month)	-15,2	-41,3	-68,1	-42,3
		Chg-% (Cum.)	-15,2	-27,9	-42,3	-42,3
	Total	Tons	16 824	14 982	12 367	44 174
		Last year's	16 904	16 043	18 971	51 918
		Chg-% (month)	-0,5	-6,6	-34,8	-14,9
		Chg-% (Cum.)	-0,5	-3,5	-14,9	-14,9
TOTAL		Tons	17 007	15 165	12 439	44 612
		Last year's	17 135	16 227	19 179	52 541
		Chg-% (month)	-0,7	-6,5	-35,1	-15,1
		Chg-% (Cum.)	-0,7	-3,6	-15,1	-15,1

Appendix 2. Online survey: Use of Commercial Drones and Augmented and Virtual Reality in Aviation



ANSWER CHOICES	RESPONSES	
No experience	0.00%	0
Yes, for less than 3 years	61.54%	8
4 to 10 years	30.77%	4
11 to 25 years	0.00%	0
More than 25 years related	7.69%	1
TOTAL		13

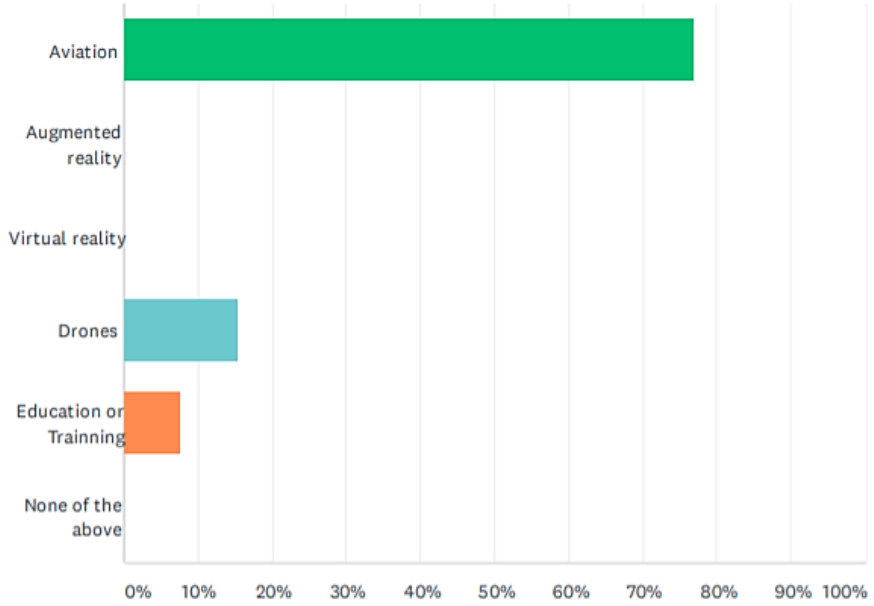
Online survey: Question 1

Q2 What is your field of expertise?
Open-Ended Response
Business
Economics
Pilot
Commercial aviation
Pilot
Airbus 32s series co-pilot
Pilot
Pilot
Airline pilot
Pilot
Airline pilot, A320
Pilot
Director Academia de Ciencias Aeronáuticas Universidad Técnica Federico Santa Maria. Ex Comandante en Jefe de la Fuerza Aérea de Chile. Piloto

Online survey: Question 2

Q3 Are any of your work or free time activities related to one the following topics?

Answered: 13 Skipped: 0

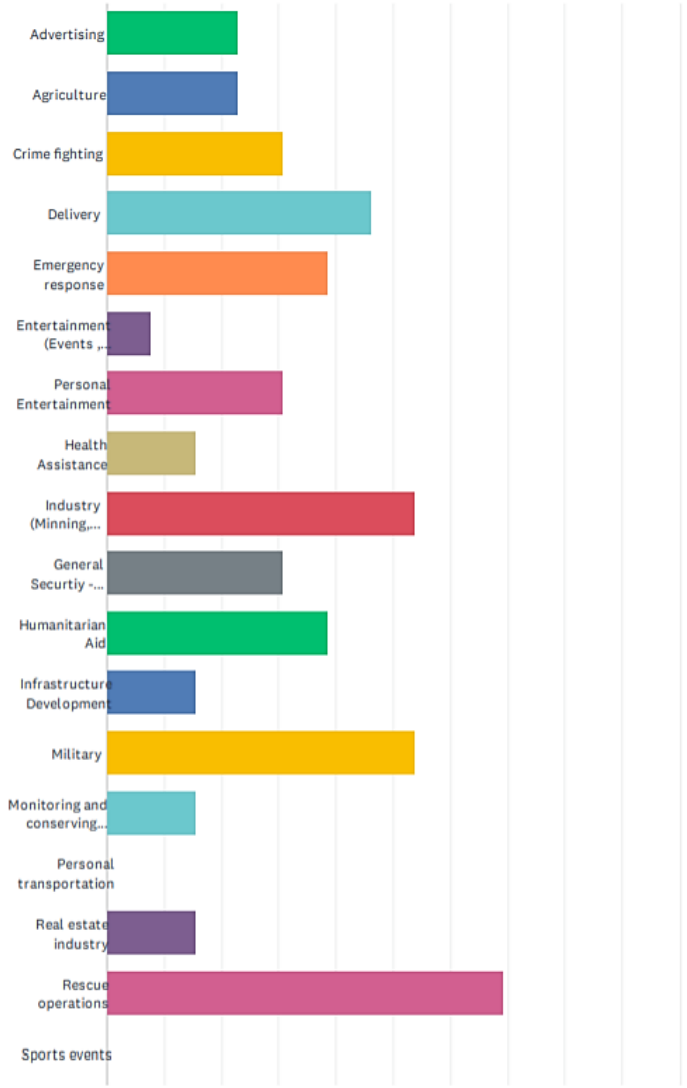


ANSWER CHOICES	RESPONSES	
Aviation	76.92%	10
Augmented reality	0.00%	0
Virtual reality	0.00%	0
Drones	15.38%	2
Education or Trainning	7.69%	1
None of the above	0.00%	0
TOTAL		13

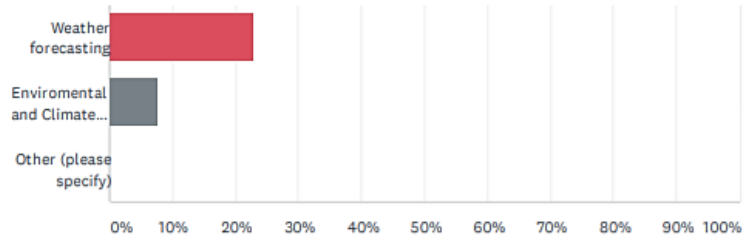
Online survey: Question 3

Q4 In your opinion, to which of the following fields drones could bring the biggest benefit in the society? Choose maximum 5 options

Answered: 13 Skipped: 0



Online survey: Question 4 (part 1)

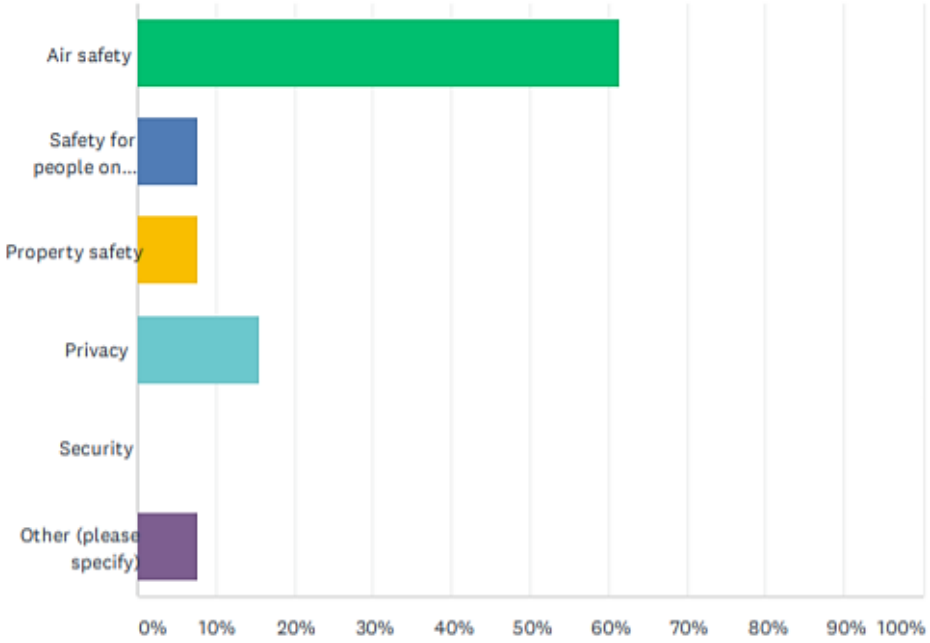


ANSWER CHOICES	RESPONSES	
Advertising	23.08%	3
Agriculture	23.08%	3
Crime fighting	30.77%	4
Delivery	46.15%	6
Emergency response	38.46%	5
Entertainment (Events , others)	7.69%	1
Personal Entertainment	30.77%	4
Health Assistance	15.38%	2
Industry (Minning, exploring, construction, others)	53.85%	7
General Securtiv - Survilance	30.77%	4
Humanitarian Aid	38.46%	5
Infrastructure Development	15.38%	2
Military	53.85%	7
Monitoring and conserving wildlife	15.38%	2
Personal transportation	0.00%	0
Real estate industry	15.38%	2
Rescue operations	69.23%	9
Sports events	0.00%	0
Weather forecasting	23.08%	3
Enviromental and Climate change	7.69%	1
Other (please specify)	0.00%	0
Total Respondents: 13		

Online survey: Question 4 (part 2)

Q5 Which of the following worries are more important concerning drones?

Answered: 13 Skipped: 0

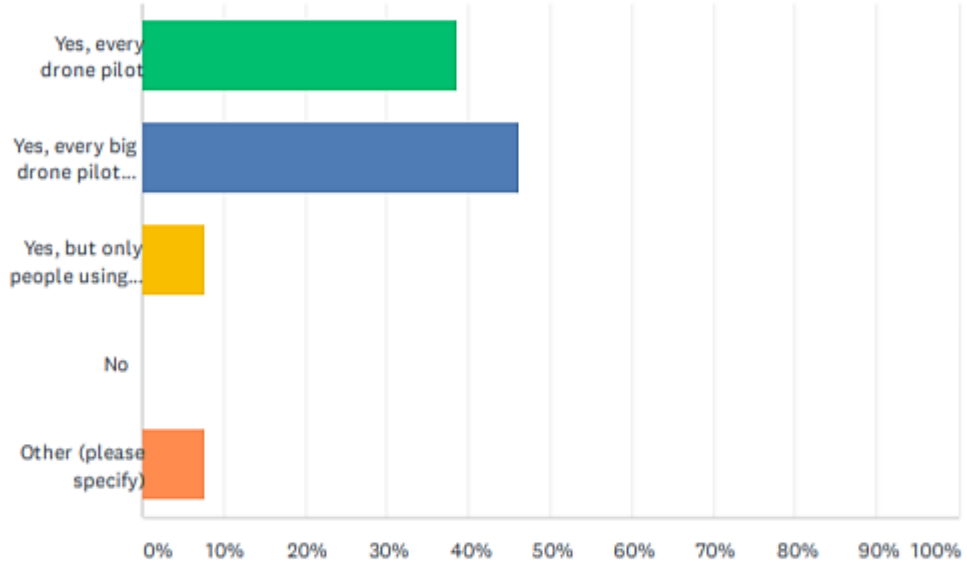


ANSWER CHOICES	RESPONSES	
Air safety	61.54%	8
Safety for people on ground	7.69%	1
Property safety	7.69%	1
Privacy	15.38%	2
Security	0.00%	0
Other (please specify)	7.69%	1
TOTAL		13

Online survey: Question 5

Q6 Considering the risks mentioned previously, do you think drone pilots should complete a certification course when operating a drone?

Answered: 13 Skipped: 0

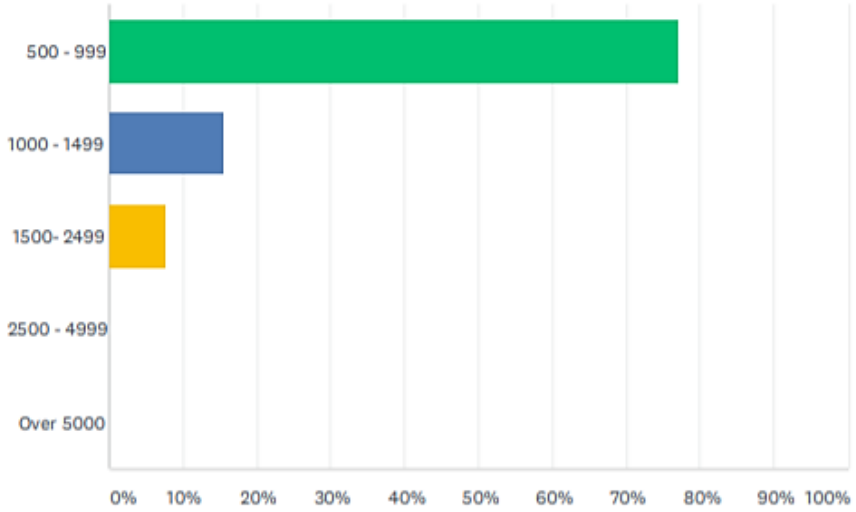


ANSWER CHOICES	RESPONSES	
Yes, every drone pilot	38.46%	5
Yes, every big drone pilot (More than 3 Kgrms)	46.15%	6
Yes, but only people using drones professionally	7.69%	1
No	0.00%	0
Other (please specify)	7.69%	1
TOTAL		13

Online survey: Question 6

Q7 Let us say you wanted to take part in the certification course for drone operations lasting for one week. After passing the course you would receive a certification confirming your theoretical knowledge and practical skills enabling you to apply for drone related work globally. What is the maximum amount you would be willing to pay for this course in US dollars?

Answered: 13 Skipped: 0

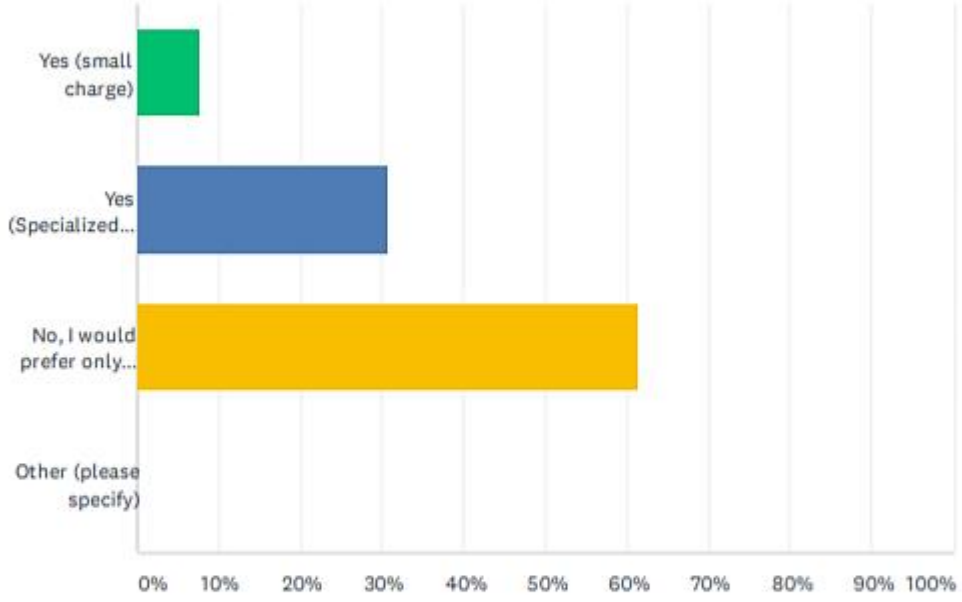


ANSWER CHOICES	RESPONSES	
500 - 999	76.92%	10
1000 - 1499	15.38%	2
1500- 2499	7.69%	1
2500 - 4999	0.00%	0
Over 5000	0.00%	0
TOTAL		13

Online survey: Question 7

Q8 Hypothetically, in the future, when the drone deliveries would be common, would you be willing to pay extra for a pilot operated drone delivery?

Answered: 13 Skipped: 0

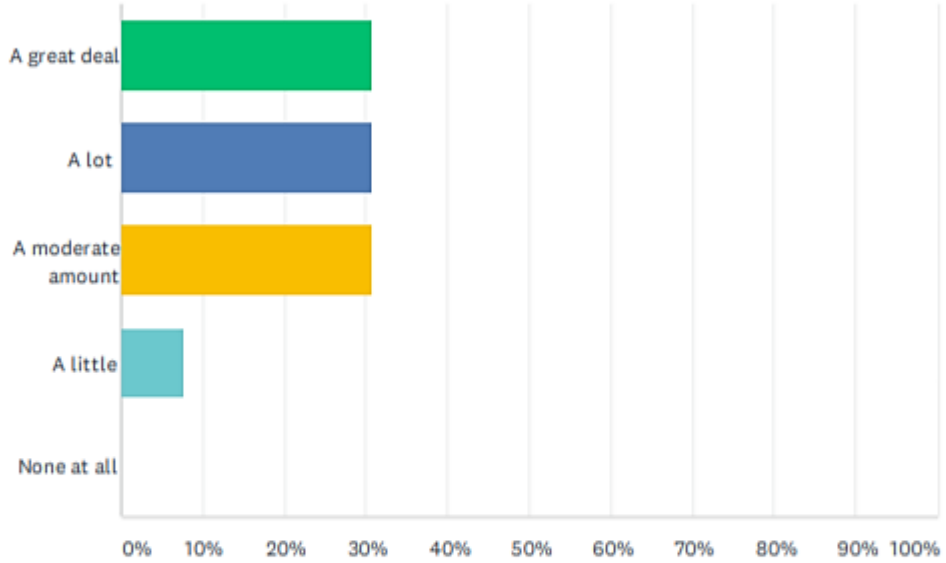


ANSWER CHOICES	RESPONSES	
Yes (small charge)	7.69%	1
Yes (Specialized delivery drones)	30.77%	4
No, I would prefer only automated drone delivery	61.54%	8
Other (please specify)	0.00%	0
TOTAL		13

Online survey: Question 8

Q9 Do you think there is opportunity to use Augmented Reality (AR) and Virtual Reality (VR) in Aviation and Drones industries

Answered: 13 Skipped: 0

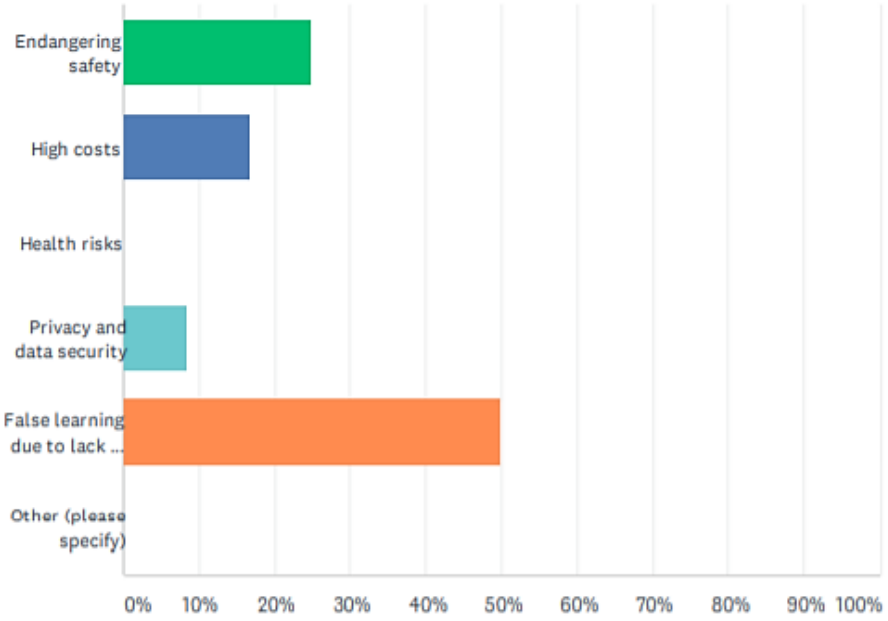


ANSWER CHOICES	RESPONSES	
A great deal	30.77%	4
A lot	30.77%	4
A moderate amount	30.77%	4
A little	7.69%	1
None at all	0.00%	0
TOTAL		13

Online survey: Question 9

Q10 What would be the biggest drawback of utilizing AR and VR in aviation industry trainning ?

Answered: 12 Skipped: 1

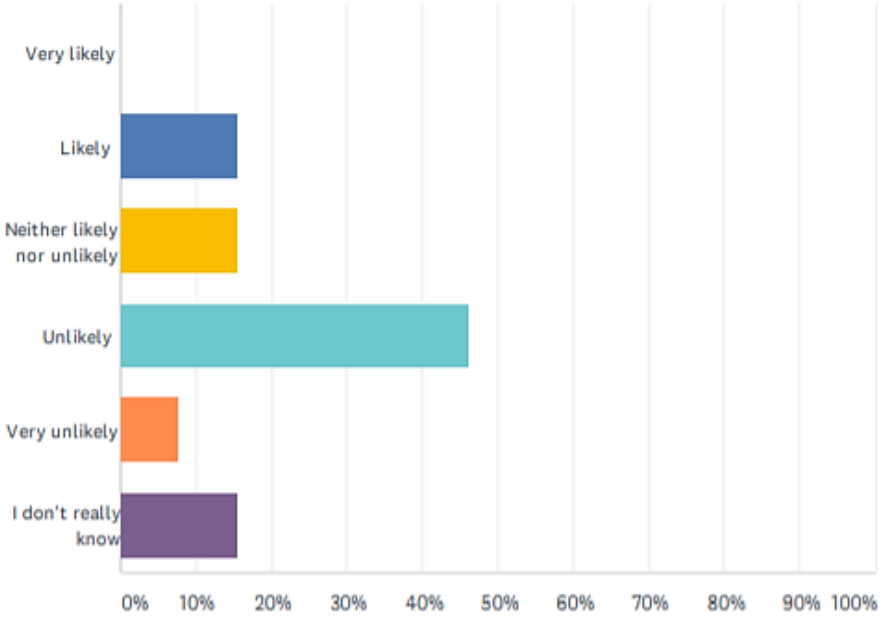


ANSWER CHOICES	RESPONSES	
Endangering safety	25.00%	3
High costs	16.67%	2
Health risks	0.00%	0
Privacy and data security	8.33%	1
False learning due to lack of physical and psychological real-world sensations	50.00%	6
Other (please specify)	0.00%	0
TOTAL		12

Online survey: Question 10

Q11 Do you think augmented reality and virtual reality will replace simulators in aviation education?

Answered: 13 Skipped: 0

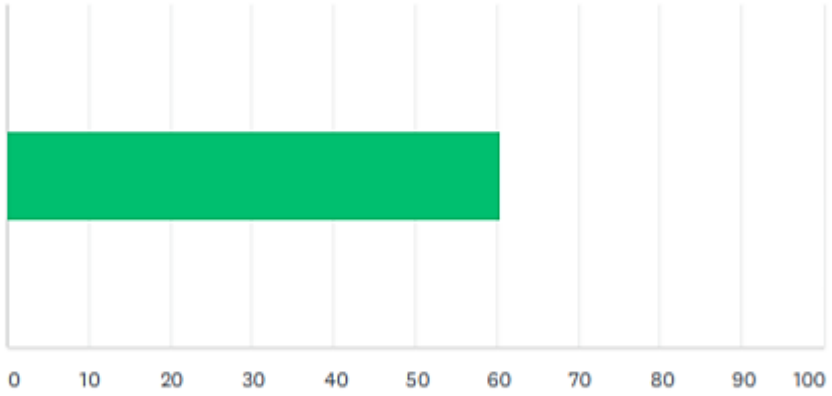


ANSWER CHOICES	RESPONSES	
Very likely	0.00%	0
Likely	15.38%	2
Neither likely nor unlikely	15.38%	2
Unlikely	46.15%	6
Very unlikely	7.69%	1
I don't really know	15.38%	2
TOTAL		13

Online survey: Question 11

Q12 How good a training platform would augmented and virtual reality environment provide for aviation education? Rate from 1 to 10 with 1 being the worst and 10 being the best imaginable platform.

Answered: 13 Skipped: 0

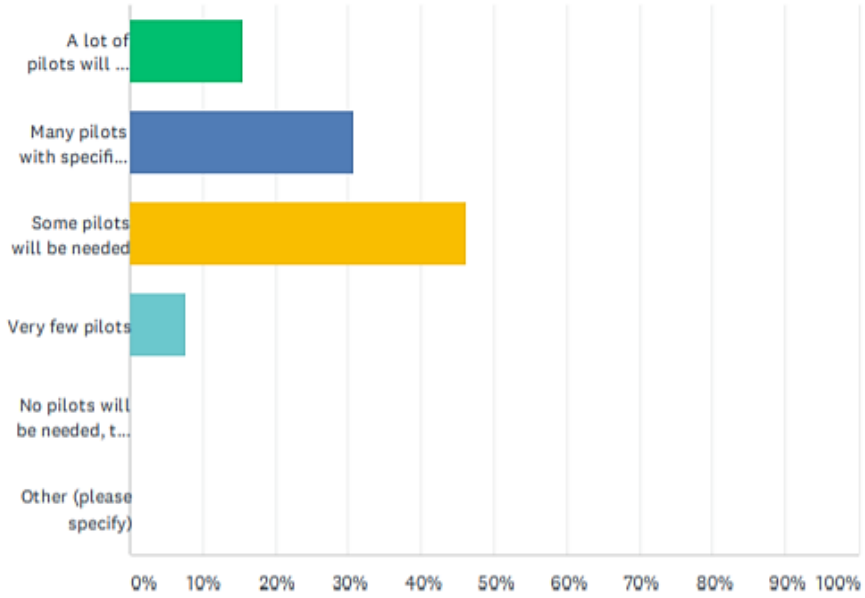


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	61	787	13
Total Respondents: 13			

Online survey: Question 12

Q13 Within the next 10 years, do you think pilots will be needed for commercial drone operations or do you think they will be automatically operated?

Answered: 13 Skipped: 0



ANSWER CHOICES	RESPONSES	
A lot of pilots will be needed	15.38%	2
Many pilots with specific additional skills (Security, Heatlh, logistics)	30.77%	4
Some pilots will be needed	46.15%	6
Very few pilots	7.69%	1
No pilots will be needed, the operations will all be automatic.	0.00%	0
Other (please specify)	0.00%	0
TOTAL		13

Online survey: Question 13