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Passenger Attitudes to Flying on a Single Pilot Commercial Aircraft

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ABSTRACT

There is little specific research gathered on people's opinions of single pilot commercial airline operation and whether they are willing to fly by this means. This study examines passengers' attitudes to help determine their willingness to fly in an aircraft of this type. Part One involved four focus groups providing their views on the matter. In Part Two an online survey was developed from the output of the focus groups that gathered passenger perceptions of single pilot operations. The feedback from the focus groups highlighted distrust in technology, concerns about pilot health and workload and the need for more information on single pilot operations but also that if there were substantial savings passengers may be willing to fly on such an aircraft. The results of the survey suggested three main dimensions to passenger opinion on the subject: 'State of the pilot', 'Trust in the technology' and 'Ticket price and reputation'. Responses on these scales could determine with some certainty passengers' willingness to fly or not to fly on a single pilot airliner.

Keywords

Single pilot operations; Passenger attitudes; Intention to fly;

INTRODUCTION

Single pilot air taxi and light cargo operations have been undertaken for many years. The military also regularly operate complex, very high-performance aircraft with just one pilot. However, large, single pilot passenger carrying aircraft are specifically prohibited by regulation and by law. In Europe, any aircraft that is operated on an AOC (Air Operator's Certificate) with turbine power, cabin pressurisation and/or under Instrument Flight Rules (IFR) must be piloted with a minimum of two flight deck crew. In the US Federal Aviation Regulations state:

> ***121.385 Composition of flight crew.***
>
> *(a) No certificate holder may operate an airplane with less than the minimum flight crew in the airworthiness certificate …*
>
> *(c) The minimum pilot crew is two pilots and the certificate holder shall designate one pilot as pilot in command and the other second in command.*
>
> (Code of Federal Regulations, Title 14: Part 121 (Operating Requirements: Domestic, Flag, and Supplemental Operations)

As a result, any introduction into service of a single pilot airliner will require major changes in international rules and regulations. However, in 2018 the as part of the 'FAA Reauthorization Act of 2018' put in front of the US Congress, it was proposed that the '*Administrator shall transmit a report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate that describes… a review of FAA research and development activities in support of single-piloted cargo aircraft assisted with remote piloting and*

computer piloting'. While this only applies to cargo aircraft, such a potential change in legislation would clear the way for the introduction of large single pilot passenger aircraft. The military have flown complex, high performance single pilot aircraft for many years and for the last decade Uninhabited Air Vehicles (UAVs) have become a regular part of their operations. These technologies are now ready for application in the commercial aviation domain. However, the greatest obstacle to the operation of civil, single pilot aircraft is not the technology per se. It is developing and applying the technology in such a way as to make such an aeroplane safe to operate in a wide range of normal and non-normal situations when flown by a typical commercial pilot (Harris, 2007).

National research organisations such as NASA and major aircraft manufacturers are developing the technology to support the introduction of single pilot airliners. Embraer has stated that they are looking to provide single-pilot capability by 2020-25 (Keinrath, Vašek, & Dorneich, 2010; FlightGlobal.com, 2010; Comerford, Brandt, Lachter, Wu, Mogford, Battiste, & Johnson, 2013; Deutch & Pew, 2005). Paul Eremenko, former Chief Technology Officer at Airbus has openly stated that technologies are being developing that will allow a single pilot to fly an airliner (Bloomberg, 2017). Boeing are planning to undertake initial experimental flights in 2018 where autonomous systems will take over some of the pilot's decisions. Other programmes have investigated the feasibility of using just a single member of flight deck crew in long-haul aircraft during the cruise phase (e.g. the European ACROSS project: Advanced Cockpit for the Reduction of Stress and Workload). However, Thomas Edwards, former Director of Aeronautics at NASA Ames Research Center, has expressed the view that the single crew aircraft is only the beginning. He suggested ultimately that the issue is not about should single pilot operations be adopted, but '*is one pilot a logical stepping stone on the way to zero pilots?*' (Comerford, et al, 2013).

Originally the main driver for single pilot operations was financial, but issues relating to a potential shortage of commercial pilots in the near future now also play a major part in the impetus to develop the technology.

The air transport industry is not a profitable one. The International Air Transport Association (2017) reported that the average return fare in 2017 (before surcharges and tax) was $351, down from $407 in 2015, and it was 68% lower than in 1995. World-wide post tax profits have declined from $9.89 (per passenger) in 2015, to $7.54. Airline personnel costs vary between about 11% of operating costs to nearly 25%, depending upon aircraft type, sector length and how much activity is outsourced: the crew themselves can represent up to 13% of operating costs (excluding fuel and propulsion). The direct operating costs attributable to pilot costs rises as aircraft size decreases. It is estimated that for an airliner with two pilots and three cabin crew, the flight deck represents 67% of crew costs; this rises to around 76% in an aircraft with fewer than 100 seats which requires only two cabin crew. If airline companies can convince passengers to travel on a single pilot aircraft, this could save airline companies up to 60 billion dollars annually (Forbes.com, 2017).

For US major inter-continental airlines each aircraft requires (on average) 12.55 pilots; US national airlines require 10.15 pilots per aircraft; regional airlines, flying smaller aircraft require 8.17 pilots on average. The annual reports from two major European low-cost operators show that they require 10-11 pilots per aircraft. It is estimated that between 2016-35, 112,000 new commercial pilots will be needed in North America: 104,000 in Europe and almost a quarter of a million in the Asia-Pacific region (Boeing, 2016). Estimates of the size of the pilot shortfall vary. Higgins, Lovelace, Bjerke, Lounsberry, Lutte, Friedenzohn, & Craig (2014) suggest that in the US alone, between 2013 and 2031, there will

be a shortage of 35,000 pilots. The majority of this will be borne by the regional carriers, as pilots migrate to job opportunities in the larger operators. Duggar, Smith & Harrison (2011) calculated a cumulative shortage of almost 40,000 FAA certificated airmen by 2035.

Addressing such shortages has traditionally seen as a recruitment and training issue. However, the single crew aircraft may provide a further option for addressing this problem. Nevertheless, it is essential that passengers accept single pilot operations, otherwise there is no case to be made for the development of such an aircraft. John Hansman, professor of Aeronautics and Astronautics at the Massachusetts Institute of Technology noted that "the issue has never been '*Could you automate an airplane and fly it autonomously?' The issue is 'Could you put paying customers in the back of that airplane?'"* (Lerner, 2017).

Air safety is an important influencer in passenger's decision to fly on current two-pilot aircraft (Anitsal, Anitsal & Anitsal, 2017) so it can be assumed that it will also be a fundamental factor in the choice to fly on a single pilot aircraft. Passengers reported that were more willing to fly on an airliner crewed by a single pilot with further support from the ground than they were on an unpiloted aircraft, however their attitudes were not as positive as they were towards a conventional two crew aircraft (Rice & Winter, 2015; Winter et al., 2015). Research has suggested that the US travelling public would be unwilling to fly in an unpiloted aircraft. MacSween-George (2003) found that only 10.5% of survey respondents would be prepared to be a passenger (although 50.5% thought such technology was acceptable for cargo and 56.5% for humanitarian/commercial uses). However, passengers' attitudes are changing. Research published 12 years later (Vance & Malik, 2015) suggested that 34.8% of people surveyed would more likely than not, be willing to fly on an unpiloted, autonomous airliner. Nevertheless, it was also noted that passengers

expected to see precursor systems, such as autonomous cargo aircraft, operating safely for a substantial time beforehand. YouTube published a 'Ted Talk' on the seventh of July in 2015 titled "Advancing Airline Single-Pilot Concept" where airline pilot James Green discussed the future and the benefits of the single pilot aircraft. From the 41 viewer comments linked to the video only three individuals were evidently "not against" the concept of the single pilot aircraft (YouTube.com: https://www.youtube.com/watch?v=etIH9PHpVyM).

This study examines passengers' attitudes within a United Kingdom based demographic to determine if this type of aircraft would be acceptable to the paying passenger. Part One involved four focus groups providing their views on the matter. These focus groups provided the structure and items for a survey of passengers to gather their opinions regarding travelling on a single pilot commercial airliner.

PART 1: FOCUS GROUPS

Method

Eighteen participants took part in one of four focus groups with the objectives of eliciting common themes toward flying on a single pilot airliner. The focus groups included a range of ages, genders, and cultural backgrounds, ensuring that wider perspectives were considered, as recommended by Krueger (2014). Overall, the focus groups comprised 14 female participants (mean age 28.3, mean number of return flights per year 3.2, approximately 40% of which were for business) and four male participants (mean age 32.5

years, mean number of return flights per year 2.75 of which approximately 10% for business).

Prior to taking part individuals were provided with an information sheet that explained the purpose of the focus group.

The group facilitator stimulated discussion using a small number of pre-determined open and closed questions:

- How do you feel about flying on an aircraft that only has one pilot in the cockpit?
    - How do you feel about flying on an aircraft that has one pilot but increased reliance on automation?
- What would motivate you to fly on a single pilot aircraft?
- What factors would cause you to not want to fly on a single pilot aircraft?
- Do you think a one pilot aircraft is a useful investment?
    - If yes/no, why?

At the end of each focus group session, participants were simply asked a final question concerning if they would travel on a single pilot aircraft.

The views of the participants were recorded by a second experimenter by typing the conversation verbatim as the focus group members discussed the issues between themselves and with the facilitator. To protect sensitive information, all forms and notes from the focus group participants were stored on the Coventry University's OneDrive storage system on a password protected laptop. Comments were anonymised.

After each focus group the facilitator analysed text for themes. Once all four focus groups were complete the focus group outputs were aggregated, and consistent themes were identified.

Results

At the end of each focus group session, participants were asked if they would travel on a single pilot aircraft. Overall nine people indicated that they would be willing to fly in a single pilot aircraft: three indicated that they were unsure if they would be a passenger and a further six suggested that they would not fly on this type of aircraft given a choice.

Nevertheless, despite the relatively large percentage of 'yes/unsure' answers, most of the comments made in the focus groups suggested that people were wary about the concept. These concerns fell into eight categories:

Success of Technology in Other Industries

Participants from the focus groups demonstrated a distinguishable lack of trust in the *technology* to keep them safe if they were to travel on a single pilot aircraft. There was common faith in the technology currently used to operate two pilot aircrafts, nonetheless increased reliance on automation to replace the second pilot was sometimes disconcerting:

- *"I think there are issues with computer systems. I know these can have faults and go down, and I am not fully trusting of computers".*
- *"I have seen Sully [the movie], and I know how important it is for humans to make decisions and override things".*

The success of technology in other travel related industries formed participant's opinions on how they felt about single pilot travel

- *"…if they can't get that* [driverless car automation] *right, then how can they get this* [single pilot operations] *right?*

Remote Control of Operations and Cyber Security

Although there was a lack of trust in computers, participants felt more comfortable when the computer was operated by somebody on the ground, so if something happened there was human control from the ground.

- *"If they could fly the plane remotely…I may not be as concerned if they could over-ride the full system".*
- *"Maybe* [I would fly by this means] *where another pilot doesn't actually need to be on the flight, it can be from a remote location".*

Automation discussions brought up concerns about the connection between the aircraft automation and the ground, as well as 'hacking' concerns.

- *"Wi-Fi fails all the time; how would they have that connection"*
- *"I don't know if I would step on the plane without knowing how clear the connection is"*
- *"What if the autopilot was hacked?"*

Need for Information

There was general consensus that participants regarded single pilot operations as "*dangerous until proven safe*". Participants suggested that safety statistics, and particularly

flight test information, would help ease concerns to allay their perceptions of safety and security:

- *"I would like safety records and statistics on how safe the flight was or how safe their test runs had been".*
- *"If they could give me information about what the back-up plan is should something go wrong"* [then I would be more likely to travel by single pilot aircraft].

Participants' believed their apprehension toward single pilot air travel was because they were deprived of information:

- *"My knowledge on the topic is not enough to know whether or not it is a good thing or a bad thing"* [the idea of single pilot travel].

Psychological State

Events like the 2015 GermanWings pilot murder-suicide (BEA, 2016) - an example brought up at every focus group - indicated the impact that mental health and negative news stories had on passenger's view of safety:

- *"Historic events tell us one pilot doesn't work".*
- *"I don't know it helps if there is a rogue pilot, it would be beneficial if there were two".*

Concerns were also raised about the sobriety of the pilot, although were not as widely discussed as pilots suffering from depression:

- *"You always hear of drunk pilots, so they might be drunk…so he cannot keep himself in control of the 'plane".*

Pilot Health and Limitations

Many people said they would not fly on this type of aircraft as a result of health concerns, both major and minor:

- *"…in case they [the single pilot] had a heart attack";*
- *"…* [my concern would be] *if the pilot was to have a heart attack";*

One of the participants was concerned about:

- *"…what if the pilot had a headache?"*

In general, focus group members felt that two pilots were beneficial if one of the pilots was stressed or fatigued:

"*Being a pilot, it is a high stress job. There is higher level of safety with two people surely".*

However, many participants expressed fears only if it was a long-haul flight:

- *"They are going to get tired, therefore for me my opinion on flying on a single pilot aircraft would change depending on where the 'plane is going"*
- *"What would you do if something happened to that one pilot on a long-haul flight and no one else could fly the 'plane".*

Attitudes were more positive towards short-haul travel.

Workload and Sense-Checking

In the focus groups there was a belief that without the second pilot, the single pilot was at risk of making a mistake as there wasn't an additional pilot to undertake sense-checking and share the decision-making load:

- *"To me it's sense checking, when you have two people there that know how to fly a 'plane".*
- *"If you only had one pilot there is less decision-making power in the cockpit to recover* [a negative] *situation".*

One deliberation was that the pilot would not be able to attend to all the crucial information needed to successfully fly the aeroplane:

- *"It is a long time for one person to be concentrating" .*
- *"With one pilot there is heavy reliance on that pilot if something goes wrong* [to perform the correction actions]*".*

Airfare

Focus Group participants expressed that ticket price would influence their attitude towards flying on a single pilot aircraft:

- *"[I'd fly by this means] if it was cheaper".*
- *"Cost would have a big impact".*

One of the reasons proffered was that it may allow passengers who do not find air tickets easily affordable the opportunity to visit places or people not previously possible:

- *"*[SPO can allow a person] *to go somewhere to see someone you wanted".*

However, cheap tickets did not motivate all individuals:

- *"I'd rather pay more and be super safe".*

Trust in Airlines

Several participants mentioned that their trust levels in an airline would impact whether they would fly with this company or not:

- *"Trust in certain companies would play a factor – flying with an airline your trust makes a big impact".*

Some individuals were more persuaded to fly on a single pilot aircraft if the airline company had a good safety record. Some potential passengers felt low cost airline pilots would not be as well trained as pilots from other more luxurious carriers. However, this concern was not shared by everyone:

- *"…even if it is a* [less highly rated] *airline, the pilot should still be the same and trained the same".*

Participants also discussed luxury as a motivator to flying on a single pilot aircraft:

- *"If the flight was ultra-luxurious, good meals, reclining chair, then genuinely my safety concerns would not be as high".*

Discussion

Within the focus groups participants expressed mixed views however eight key themes were elicited. Most of these were concerned with the implications for safety if a second pilot was removed and there was increased reliance on automation. Participants did, however, believe that single pilot operations should be further researched and were willing postpone any final decision until they had further information about the concept.

However, while focus groups are a suitable means of gathering information and eliciting potential areas of concern, they cannot provide quantitative data on the breadth with which these attitudes and opinions are held. As a result, they are unsuitable as a sole method for gathering passengers' perceptions on the concept of single pilot airline operations. Therefore, a survey was developed from the outputs and administered to a wider audience to compliment the focus group findings.

PART 2: SURVEY

Introduction

The purpose of the survey was to ascertain the prevalence of the opinions elicited in the focus groups. Questionnaire items were derived from the focus group outputs. There were two major objectives:

- Identify the underlying dimensions of passenger attitudes toward flying on a single pilot airliner
- Establish if passenger attitudes can distinguish between potential passengers that would and would not be prepared to fly in a single pilot airliner.

Survey Design and Data Gathering

A short survey was designed for online completion. The questionnaire consisted of three main sections.

Section 1 contained a participant information sheet and was concerned with obtaining the respondent's informed consent to complete the survey and for their data to be used in the manner described in the survey introduction.

Section 2 collected basic demographic data (age; gender; number of return trips as a passenger per year; ascertaining their understanding of the number of pilots on a current airliner flight deck and establishing if they considered themselves to be a nervous flyer).

Section 3 contained the survey items derived from the output of the focus groups. This comprised 14 questions (see Table 1 in the Results section for the survey items) all of which required a response using a seven-point Likert scale (running from 'strongly disagree' to 'strongly agree' with a mid-scale neutral point). Once the questions were created, they were reviewed by three individuals to ensure the wording was appropriate, and that they would be easily understood.

The main dependent variable was also presented as a seven-point Likert scale using the same format: 'I would be willing to fly on a single pilot aircraft on a short haul journey'.

The survey was delivered questions using the web-based Online Surveys platform (previously Bristol Online Surveys) at www.onlinesurveys.ac.uk. The survey was open to everyone excluding those under the age of 18 and was accessed via a public link. The survey was live for one month and one week.

Results

A total of 117 individuals responded to the survey: 71 (60.7%) were female and 46 (39.3%) males. Of these 19 (16.2%) were aged 18-25; 36 (30.8%) were 26-35; 17 (14.5%) were 36-45; 25 (21.4%) were 45-55 and there were 20 over 55s (17.1% of respondents). Only one individual had never flown on an aircraft before and of the remainder, 17 (14.5%) travelled less than once per year; 35 (29.9%) made two or three round trips per year; 29 (24.8%)

travelled three or four times per year and 36 (30.8%) flew five or more times per year. One hundred and ten (94%) participants believed there to be two pilots on current flight decks. Three respondents (2.6%) believing there to be just one pilot currently; four (3.4%) were unsure.

To elicit the underlying latent structures in the data set, a Maximum Likelihood Factor Analysis was undertaken. The Kaiser-Meyer-Olkin measure of sampling adequacy for the data set was exceptionally good, (KMO = 0.940); Bartlett's test of sphericity was also highly significant (χ^2 =1,460.057; df=91; p<0.0001). Measures of sampling adequacy for each variable ranged from 0.901-0.966 suggesting the data set was appropriate for Factor Analysis (Cerny & Kaiser, 1977; Dziuban & Shirkey, 1974). Three identifiable factors were extracted and subjected to Varimax rotation with Kaiser normalisation. Overall, the three factors accounted for just under 70% of the variance (see Table 1). The variances attributable to the individual factors extracted can be found in Table 2.

Only two items failed to load significantly on one of the three factors, and only two items did not load cleanly onto just a single factor.

The survey items comprising the first factor were almost all related to the state of the pilot (e.g. fatigue and workload). Items in the second factor were almost exclusively related to passengers' trust in the technology to be employed. The final factor was composed of responses to questions relating to the airline ticket price and reputation.

Regression-based factor scores were computed for each case for use as summary variables to be used in the following analysis to predict intention to fly on a single pilot airliner. Intention to fly on a single pilot aircraft was derived from responses to the variable 'I would be willing to fly on a single pilot aircraft on a short haul journey'. A trichotomous

categorical variable was computed with responses re-coded into 'willing to fly'; 'maybe' and 'not willing to fly on a single pilot aircraft'. These were then subject to a discriminant function analysis with the regression-based factor scores used as the predictor variables. As a result of missing data, 109 cases were used in the analysis, giving a variable: subjects ratio of 36.33:1, which was well in excess of the recommended 20:1 for a stable, generalisable solution (Tabachanick & Fidell 2007).

A highly significant discriminant function analysis result was produced with high correct classification rates to predict intention to fly on a single pilot airliner based upon the canonical discriminant functions derived (see tables 3 – 6). The two canonical discriminant functions accounted for 65% of the variance in the predictor variables with the first discriminant function derived accounted for the vast majority of the variance in the analysis (table 4). Overall, 86.2% of the cases were correctly classified (table 6).

INSERT TABLES 1 – 6 ABOUT HERE

Discussion

Factor analysis of the questionnaire items produced three coherent factors: State of the pilot, Trust in the technology and Ticket Price and Reputation. All of these concepts were recognisable from the issues elicited in the focus groups in the initial stage of the research.

The factor labelled 'State of the Pilot' was related to issues identified in focus groups such as 'Pilot Health and Limitations', 'Psychological State' and 'Workload and Sense-

Checking'. Survey respondents who expressed fewer concerns about pilot health and workload issues were more likely to opt to fly on a single pilot airliner. Vance & Malik (2015) stated that it is important for humans to have faith in their pilot, to recognise that the pilot will operate professionally and in accordance to how a pilot should be expected to operate. In their study they found this to be a better predictor of passenger's willingness to fly than their trust in technology, safety statistics and airfare. Passengers currently put their trust into two pilots to make them feel at ease with flying, and so reducing the number of pilots in the flight deck may potentially cause passengers to have less faith that they are in safe hands.

In the focus groups there was a belief that without the second pilot, a single pilot is at risk of making a mistake. Some individuals believed the workload of flying an aircraft is a too demanding for just one pilot. Deutsch & Pew (2005) reported by removing the second pilot the ability is lost to have one pilot focus on a problem where it may be presented, and the other pilot focussing on the task of flying the plane. Focus group outputs suggest that passengers thought that the pilot won't be able to attend to all the crucial information they need to successfully fly the aircraft. However, as technology has developed the output from the questionnaire survey would seem to suggest that this is becoming less of an issue.

The factor 'Trust in the Technology' was related to focus group outputs related to 'Success of Technology in Other Industries', 'Success of Technology in Other Industries' and 'Remote Control of Operations and Cyber Security'. Survey respondents who had a more positive attitude toward the technology required to develop a single crew aircraft were more likely to fly on it. However, attitudes are beginning to change and are becoming more positive toward non-traditional crew configurations (Rice & Winter, 2015; Winter et al.,

2015; Vance & Malik, 2015). Nearly half the respondents indicated that they would be willing to fly on a single pilot aircraft.

Respondents who scored more highly on the final factor 'Ticket Price and Reputation' were more likely to fly on a single crew airliner. Lower price was a major determining factor in determining the likelihood to fly. Akamavi, Mohamed & Pellmann (2015) also found that satisfaction with air carrier was a factor in someone's attitude towards flying as well as the ticket cost. Both the output from the factor analysis and the results from the discriminant function analysis would suggest that there is more confidence in full-service carriers to operate a single crew airliner which influences positively potential passengers' attitudes to fly by this means. This was also reflected in the results from the focus groups where the opinion was expressed by some people that pilots from low cost airline pilots would not be as well trained as those from more luxurious carriers.

It was noted in the Introduction that irrespective of the safety and reliability of the technology, the major issue that will determine the viability of a single crew aircraft is the passenger perception of safety. Confidence in the safety of a radical aircraft design is essential if passengers will be willing to fly on it (Anitsal, Anitsal & Anitsal, 2017). As a result, airlines and aircraft manufacturers must take steps to assure the public in this respect. The FAA has taken steps to manage incrementally the introduction of single crew operations by first proposing the use of such an aircraft in cargo operations, hence potentially demonstrating its safety record before introducing it into passenger operations.

This study identified three key areas of concern about single crew aircraft from the travelling public, two of which are directly related to safety: 'Trust in the Technology' and 'State of the Pilot'. From the focus groups it was noted that 'Trust in the Technology' was

influenced strongly by autonomous technologies developed in other domains, particularly driverless cars. It may be wise in any public relations campaigns associated with promoting this category of aircraft to distance the technology from that used in motor vehicles and also to emphasise the high level of training of airline pilots. Similarly, concerns about single pilot operations were also highly influenced by the GermanWings murder/suicide. This was a relatively recent event to the conduct of the focus groups and will fade with time (the introduction of any single crew operations is likely to be a minimum of a decade from the time of writing). However, the technology associated with single crew operations has the potential to avoid such events. The technology can take over which could be portrayed as a benefit of such a configuration.

Finally, intent to fly was related to the potential reduction in the price of a ticket. Price reductions must be obvious to potential passengers flying on such an aircraft to encourage its utilisation.

CONCLUSIONS

It was noted in the Introduction by John Hansman that the main issue in the introduction of single pilot operations was '*Could you put paying customers in the back of that airplane?*'. The results of this study would suggest that the answer to this question is '*possibly*'. Just about 50% of respondents indicated that they would maybe be willing to fly on a single pilot airliner (5.5%) or would be willing to fly in such an aircraft (45.9%). Three main areas of concern were identified which determines the likelihood of flying on such an aircraft: the state of the pilot; trust in the technology; and ticket Price and airline reputation.

Single pilot operations have been identified as a manner to increase profits within the industry and address the upcoming pilot shortage, however at the moment passengers' attitudes may not be positive enough to be confident that this type of travel would be well received. Presently, single pilot operations are only being considered for short-haul routes, cargo operations and for periods during the cruise of long-haul flights (two crew will still be on the flight deck for take-off and landing). In the present study, only attitudes toward short-haul flights were considered. Passenger feelings toward the implementation of single crew operations for long-haul flights may be completely different. The survey sample comprised an accidental sample of UK passengers. Before more definitive conclusions can be drawn a larger, representative world-wide sample of potential passengers needs to be surveyed. The current study provides the basis for questions in such a survey. Passenger attitudes to such an aircraft need to be tracked over time, as the technology is developed.

However, the trend in the literature and from the present study would suggest that the idea is becoming more acceptable. As well as developing the necessary technology and ensuring its safety, public perception of the safety of such aircraft is essential to make them viable. If the three areas identified are also addressed, then it is likely that attitudes towards flying on a single pilot aircraft will become more positive.

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Table 1. **Loadings and factors (post Varimax rotation using Kaiser normalisation) based on the maximum likelihood extraction; for clarity, loadings less than 0.50 have been omitted.**

	Factor		
Survey Item	**1**	**2**	**3**
If it could be guaranteed that the pilot on the single pilot aircraft would be well rested and alert at all times during the flight, I would be willing to fly by this means	.852		
If it could be guaranteed that the pilot on a single pilot aircraft would be able to manage their workload levels effectively, I would be willing to fly by this means	.765		
If it could be guaranteed that the pilot on a single pilot aircraft would be healthy and well, I would be willing to fly by this means	.733		
I would be comfortable flying on a single pilot aircraft if I had information on how safe the flight tests were	.586	.543	
I would trust in technology taking the place of a second pilot within the flight deck on a short-haul journey		.688	
Based on the knowledge I have, current advancements in technology are sophisticated enough to replace a pilot in the flight deck on short haul journeys		.641	
If automation was successful in other industries e.g. driverless cars, I would be willing to fly on a single pilot aircraft		.583	
In my opinion, single pilot operations will not increase the chances of an error being made		.555	
In many industries, technology can now be seen in place of human workers. I trust in technology that replaces humans within industries that are high hazard		.523	
It is unlikely the technology used in single pilot aircraft could be at risk of hacking			
If the airfare of a single pilot aircraft was 50% cheaper than the typical cost of the same flight on a multi pilot aircraft, I would be willing to fly by this means			.824
If the airfare of a single pilot aircraft was 20% cheaper than the typical cost of the same flight on a multi pilot aircraft, I would be willing to fly by this means			.716
If the single pilot aircraft was operated by a luxury airline I would be willing to fly by this means	.517		.534
If the single pilot aircraft was operated by a low budget airline I would be willing to fly by this means			

Table 2. Variances related to the factors extracted.

	Rotation Sums of Squared Loadings		
	Total	**% of Variance**	**Cumulative %**
Factor 1	3.514	25.099	25.099
Factor 2	3.506	25.043	50.142
Factor 3	2.720	19.432	69.574

Table 3 **Mean and standard deviation of regression-based factors, broken down by intention to fly in on a single pilot airliner.**

Intention to fly on a single pilot aircraft		Mean	SD	N
Not Willing to fly on a single pilot aircraft	State of the pilot	-.565	.879	53
	Trust in the technology	-.387	.662	53
	Ticket Price and Reputation	-.360	.745	53
Maybe	State of the pilot	.633	.816	6
	Trust in the technology	-.434	.587	6
	Ticket Price and Reputation	-.251	1.143	6
Willing to fly on a single pilot aircraft	State of the pilot	.552	.648	50
	Trust in the technology	.481	.844	50
	Ticket Price and Reputation	.392	.929	50
Total	**State of the pilot**	**.014**	**.956**	**109**
	Trust in the technology	**.009**	**.861**	**109**
	Ticket Price and Reputation	**-.009**	**.926**	**109**

Table 4 **Summary statistics for the canonical discriminant functions classifying participants by intention to fly on a single pilot airliner.**

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.728	97.3	97.3	.796
2	.048	2.7	100.0	.215

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.350	110.321	6	.000
2	.954	4.965	2	.084

Table 5 **Standardized Canonical Discriminant Function Coefficients**

	Function	
	1	**2**
State of the pilot	.889	-.612
Trust in the technology	.722	.576
Ticket Price and Reputation	.630	.250

Table 6 **Classification of intention to fly on a single pilot airliner based upon the discriminant functions derived.**

			Predicted Group Membership		
	Intention to fly on a single pilot aircraft	**Prior Probability**	**Not Willing to fly on a single pilot aircraft**	**Maybe**	**Willing to fly on a single pilot aircraft**
Actual Group Membership	Not Willing to fly on a single pilot aircraft	.486	92.5	.0	7.5
	Maybe	.055	33.3	.0	66.7
	Willing to fly on a single pilot aircraft	.459	8.0	2.0	90.0