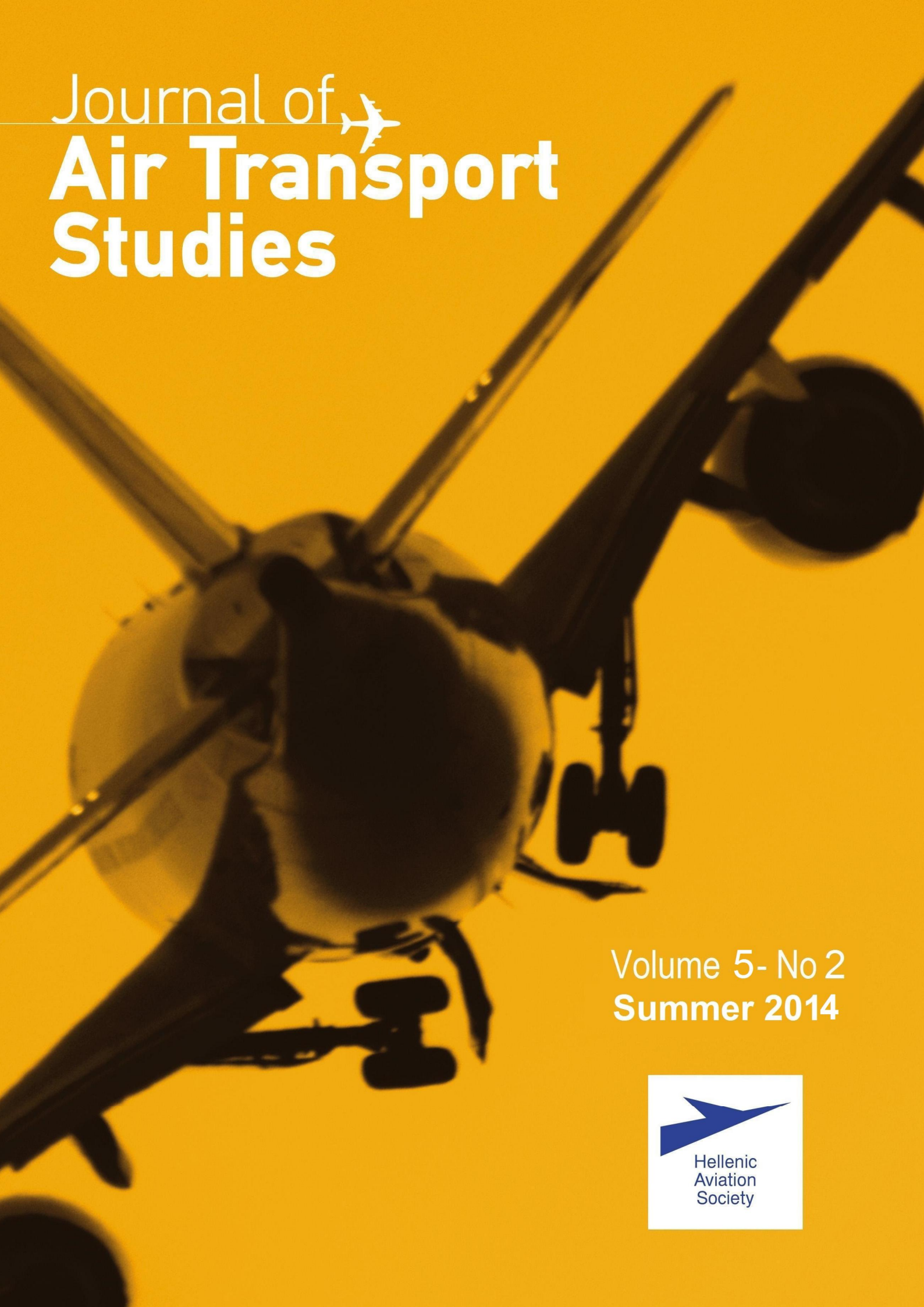
Journal of Air Transport Studies



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The *Journal of Air Transport Studies* (JATS – ISSN: 1791-6771) is a peer reviewed journal aiming at publishing high quality research related to air transport. JATS is interested in publishing papers primarily focusing on economics, geography, policymaking, management, marketing, operations, technology, logistics/supply chain management and modelling.

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- Fragoudaki, A., Keramianakis, M. and Jancovich, S. (2005) The Greek PSO Experience. *4th International Forum on Air Transport in Remoter Regions*. Stockholm, May 24-26.
- Forsyth P. (2002a), 'Privatization and Regulation of Australian and New Zealand Airports', *Journal of Air Transport Management*, 8, 19-28.
- Papatheodorou, A. (2008) The Impact of Civil Aviation Regimes on Leisure Market. In Graham, A., Papatheodorou, A. and Forsyth, P. (ed) *Aviation and Tourism: Implications for Leisure Travel*, Aldershot: Ashgate, 49-57.
- Skycontrol (2007) *easyJet welcomes European Commission's decision to limit PSO abuse in Italy*. 23rd April. Available from: http://www.skycontrol.net/airlines/easyjet-welcomes-european-commissions-decision-to-limit-pso-abuse-in-italy/ (accessed on 22/08/2008).

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Industry Perspectives should be up to 1,000 words and provide a practitioner's point of view on contemporary developments in the air transport industry. Contributors should explicitly specify whether their views are espoused by their organization or not.

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Editorial

This issue of the *Journal of Air Transport Studies* includes five papers.

In the first paper, Ong Su-Wuen, Robert Y. Cavana and Mondher Sahli focus on airline safety management using a systems thinking approach applied in the context of New Zealand. Their study is based on causal loop modelling; this may prove a promising tool with important implications for all stakeholders involved in the airline industry. The second paper by Jin-Long Lu investigates issues of passenger perceived value from full service carriers vis-à-vis low fare airlines. A suitable theoretical framework is applied in the context of Taiwanese travellers and the various research hypotheses are tested using among others regression analysis.

Doron Levy, Yvonne Ziegler and Susanne Koch discuss a risk assessment profiling procedure for air cargo in the third paper. Appropriate combinations of human and technological resources may substantially enhance the screening process resulting in higher efficiency and/or lower cost for the industry. In the fourth contribution, James Higgins, Kent Lovelace, Elizabeth Bjerke, Nick Lounsberry, Rebecca Lutte, Daniel Friedenzohn, Sam Pavel, Bruce Chase and Paul Craig examine issues related to airline pilot labour supply to conclude that a significant shortage of pilots is expected to emerge within the next twenty years; as a result, suitable policies should be introduced to deal with this problem. Finally, in the fifth paper, Sotiroula Liasidou highlights a number of important pillars related to holiday trips and associated consumer behaviour. Using factor analysis the author stresses the role of customer service, price sensitivity and choice and shows their implications for airline strategies.

May we take this opportunity to thank all our authors and referees for their support in publishing this tenth issue of the Journal. Our continuing partnership with Air Transport News and our new collaboration with the Laboratory for Tourism Research and Studies of the University of the Aegean, Greece facilitate the open access character of the Journal aiming at ensuring that JATS can get a significant exposure to the academic and business audience and raise its profile accordingly. Enjoy reading!

Dr Andreas Papatheodorou, Editor-in-Chief

Dr Kostas Iatrou, Associate Editor

Dr Dimitrios Stergiou, Assistant Editor

DEVELOPING A CONCEPTUAL MODEL OF AIRLINE SAFETY IN NEW ZEALAND: A SYSTEMS THINKING APPROACH

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ABSTRACT

Airline safety tends to result from a combination of many different circumstances that include technical, human, environmental and organizational factors. By using the systems thinking tools of qualitative system dynamics, this paper develops a conceptual causal loop diagram that connects possible influential factors on airline safety. This theoretical investigation constitutes a sound basis for the development of cause-effect relationships associated with accident and incident analysis in the air transport industry. Our findings suggest that causal loop modelling is a very useful tool for producing a comprehensive model of airline safety management that takes into account the multi-dimensional and complex nature of air safety mechanisms. It is hoped that the airline industry, and particularly air safety managers, will become more aware of the importance of this kind of modelling to improve their airline safety management systems.

Keywords: airline safety, system risk factors, air transport accidents, systems thinking, causal loop diagram, qualitative system dynamics

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1. INTRODUCTION

Aviation is nowadays one of the critical modes of transportation. Air traffic has doubled every 15 years in the past, and is expected to continue to grow at an average annual growth rate of 4.9% over the period 2013-2032 (Airbus, 2013). Commercial air transport development is driven by several factors. Some are economic, such as transport costs, global economic growth. Others are linked to social, technological, demographic, environmental and political drivers. As the global air transport traffic volume is expected to continue to rise, and the probability that this will bring with it an increase in the number of accidents, developing a qualitative system dynamics model that conceptualises the complex interactions of causes of air transport accidents could be of interest to managers in the airline industry.

In this paper we present a preliminary analysis of what is thought to be the key factors that exert an influence upon airline safety mechanisms using the systems thinking tools of qualitative system dynamics (e.g. see Forrester (1961), Richardson & Pugh (1981), Senge (1990), Coyle (1996), Sterman (2000) or Maani & Cavana (2007)). The purpose of this systems approach is to create new ways of examining the complex interactions of causes of air transport accidents and to help in their prevention.

The remainder of this paper is outlined as follows. In the next section we provide a brief overview of the current literature on the various system risk factors that could cause air transport accidents. This is followed by a brief overview of the commercial aviation scene in New Zealand, as this provides an illustration of recent historical experience of trends in air transport activities. We then commence developing a conceptual model of airline safety, by adapting relevant aspects of Cooke's (2003) coal mine safety model, Salge and Milling's (2004) airline commercial model and Moizer's (1999) generic occupational safety model. In the rest of this paper, we develop the causal loop diagram (CLD) model for airline safety. This involves developing the causal connections, respectively, in the business operations, safety, and human resources subsystems. These subsystem diagrams are then combined to create a holistic causal loop diagram for airline safety, and a number of important feedback loops are discussed. Finally some concluding comments are provided.

2. LITERATURE REVIEW

Safety is a critical area for airline management. It is not only an obligation for airlines to maintain high safety records, but safety also influences their profitability through

brand image and social credibility. Today, airlines are required by law to implement a safety management system for their flight operation as described by the International Civil Aviation Organization (ICAO) document, Safety Management Manual (ICAO, 2013). As part of the safety management system, each airline is required to commit itself to a so-called acceptable level of safety performance (ALoSP). Aviation safety is a complex process, which depends on many interrelated contributing factors; including financial, human, technical and organizational factors. Attempts have been made in the literature to assess aviation safety risks. Nevertheless, much of the research is still partial and unsystematic and there is shortage of analytical frameworks for analysing and interpreting the complex interactions of the various subsystem risk factors.

Scholars such as Borenstein and Zimmerman (1988), Chalk (1987), Rose (1992), Noronha and Singal (2004) and Raghavan and Rhoades (2005) explored the relationship between the financial situation of carriers and airline safety. They examined whether the safety record of airlines is related to their financial health. Not all the studies come to the same conclusion, but they generally favour the notion that there is no convincing evidence of a safety-profitability link.

For instance, Rose (1992) found that for small and mid-sized airlines, a 5 percentage point increase in the operating margin implies about a 5% reduction in the total accident rate. The same profit increase also correlates with more than a 15% reduction in the fatal accident rate. The author argues that more profitable airlines have greater resources to, and actually do, invest more money in safety. Such a link is not apparent in large airlines. Rose (1992) claimed that several factors could make less variable the levels of safety investment of large firms. These airlines have probably greater ability to finance safety programmes, even whilst financially troubled. Other research has been carried out to find the relationship between deregulation and safety performance since the deregulation of airline industry. For instance, Raghavan and Rhoades (2005) examined the relationship between financial performance and air transport safety since the deregulation of the US airline industry in 1978. Using accident rates as a measure of safety, their study shows that total accidents and accident rates, when normalized over departures, have increased over the period 1978-2002, indicating the potential dominance of industry growth over air carrier safety improvements. This study is not without limitations since it relies on limited post-deregulation data. After deregulation occurred in 1978, the US airline industry has experienced several phases of expansion and retrenchment, with

significant effects on industry structure, average airfares, patterns of service and profitability. Nevertheless, most scholars agree that it has been a success, particularly in lowering airfares, providing more flights, enhancing airline efficiency, while maintaining a good safety record (Goetz and Vowles, 2009; Papatheodorou and Platis, 2007).

Aviation insurance might have also played an important risk management tool since the deregulation of the industry. Aviation risks are very complex and costly and are usually shared by several insurers with a specific aviation insurance market. Each insurer is accountable for that part of the risk that it agrees to cover. By insuring their fleet, airlines transfer the cost of their potentially daily operating risks. Although insurance does not eliminate the risk of accident, it does assist the airlines avoid the financial difficulty occasioned by airline accidents (Lane, 2005).Consequently, airlines become free to minimize their safety investment given that their risks are transferred to the insurance companies.

Other authors, such as Rhoades and Waguespack (2000) looked at the relationship between service quality and safety quality in US national and regional airlines over the period 1991-1997. Their findings suggest that for four of these seven years, service quality and safety quality were positively correlated, indicating that service quality is a good indicator of overall safety quality.

The influence of different kinds of flight operations on air crews' fatigue has also been identified as one of the factors that could cause commercial aviation accidents. Yen et al (2005) conducted an econometric study to identity the key factors affecting flight fatigue factors faced by air crews. The paper looked at responses from crew members of six Taiwanese air carriers who reported on their levels of fatigue before take-off and after landing. With their survey data, Yen et al (2005) used ordinal probit models to estimate three models for different flight operations – domestic, regional and long-haul. These serve as vehicles to investigate flight fatigue factors and identify their relative significance. The factors for long haul flights (with flight times exceeding 6 hours) are found to be problems with sleep-loss and circadian rhythm disruption. Sleep quality both at home and on board the aircraft has also been recognized as a significant factor affecting the fatigue level of long-haul crews. Air crews serving short haul flights (with flight times of less than 2 hours) tend to suffer from fatigue due to early departures, late finishes, and intensive take-off and landing procedures that are workload demanding. The age of the pilots and the

relatively poor cockpit environment are among the most significant negative fatigue factors. For regional flights (between 2 and 6 hours) the factors that cause fatigue tend to vary with the individual. For example, age, extra non-flying tasks on the ground, and experiences of fatigue during flight operations seem to be significant factors.

Maintenance quality is also a key contributing factor of airline safety. Rhoades et al (2005) argue that airline deregulation could tempt financially troubled carriers to lower line maintenance spending. This would lead to lowering maintenance quality and decreasing the overall safety of the carrier. This paper examines the quality of airline line maintenance activity and examines the impact of maintenance spending on maintenance quality and overall safety. Rhoades et al (2005) correlated the maintenance spending of 10 major airlines in the US with their "incident" reporting rates. The results show only a modest level of correlation. Curiously the authors appear not to have tried lagging the maintenance spend and the rates of incident reporting. One would have expected a lagged effect taking place. Nevertheless, this contribution is interesting for two reasons. First, it gives a very detailed account of how airlines schedule their fleet maintenance. Second, the paper explicitly says where future research should head towards: the influence of the fleet mix and the age of the aircraft on maintenance spending, the effect of aircraft utilization and maintenance training, and extend the study to national and regional carriers.

McDonald et al (2000) investigated four aircraft maintenance firms to examine how each organisation manages safety. The emphasis was on the human and organisational aspects. Their investigation shows that, as a group, aircraft technicians have a strong culture of professionalism. However, the authors detected differences in safety attitudes between other occupational groups. The authors suggested that these differences are related to the organisational structure of these companies.

Taking into account the complexity of measuring safety management in the aviation sector, Gill and Shergill (2004) conducted a study to assess employees' perceptions of safety management and safety culture in the aviation sector in New Zealand. The findings show that aircraft maintenance engineers seem to be committed to standards and operating procedures and effective organizational processes in making the maintenance system work. Furthermore, the findings suggest that pilots perceive luck to be a significant contributing factor in safety. Another interesting finding from this study is that employers are not perceived to be giving much importance to safety

management systems, and safety culture in the aviation industry. As a consequence, the complex and dynamic environment of this industry requires that aviation regulators, airlines and service providers cooperate to maintain a safe air transport system.

Van Fenema (2002) pointed out another contributing factor likely to have influenced the safety outcome was the nature of ownership. The author believes that state ownership of the national airline is justified because of the lack of certainty that the new owner would abide by existing safety standards. Such views are probably changing, as evidenced by ICAO's statistics on the gradual decline of state ownership. Chang et al (2004) asserted that the primary global concern today is safety. And that, irrespective of who owns the airline, governments and the public will continue to insist on appropriate airline safety standards.

While the above studies provide key feedback mechanisms that help to understand the causes of aviation accident across the world, there is still a lack of an analytical framework that allows those responsible for regulation and safety management to understand the multi-dimensional context of air safety mechanisms. The causal loop modelling framework that we are suggesting in this paper combines many of the contributing factors that we discussed above. The next section briefly outlines the commercial airline safety situation in New Zealand, as the context for developing the conceptual airline safety model.

3. THE NEW ZEALAND COMMERCIAL AVIATION SAFETY SCENE

As at 17 November 2012, the New Zealand safety regulator, the Civil Aviation Authority (CAA) had 1982 fixed wing and 792 helicopters on its registry (CAA, 2012a). There were 180 organisations licensed to carry fee-paying passengers or freight, called Part 119 operators. There were also 30 "adventure aviation operators" and 102 agricultural aircraft operators.

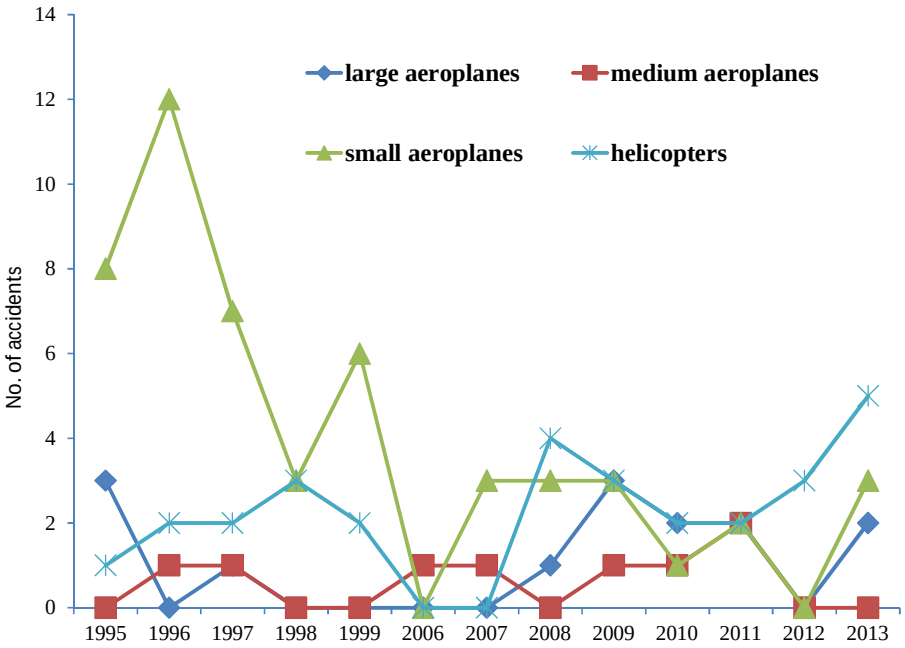
Many of the 180 "Air Operators" probably do not perform many passenger carrying flights. For the calendar year 2004, four operators only flew one such flight. At the other end of the scale, three operators each flew over 50,000 passenger flights each.

The CAA keeps counts of two measures that are directly safety-related. The first is a count of accidents. These are aircraft-related occurrences where the aircraft was damaged, gone missing or humans were seriously injured. The second is a count of

'incidents'. These are occurrences where safety was, or could have been, affected.

The reporting of both accidents and incidents is mandatory in New Zealand. The definition of accidents is very clear, so there is little leeway for not reporting an accident. However, the definition of an incident is relatively loose and open to interpretation. It is possible that the database does not capture the vast majority of incidents. Figure 1 shows the number of commercial flight accidents between 1995 and 2013 (Large aeroplanes greater than 13,608 kg; medium aeroplanes between 5,670 and 13,608 kg; small aeroplanes less than 5,670 kg).

Figure 1: New Zealand commercial flight accidents, 1995-2013

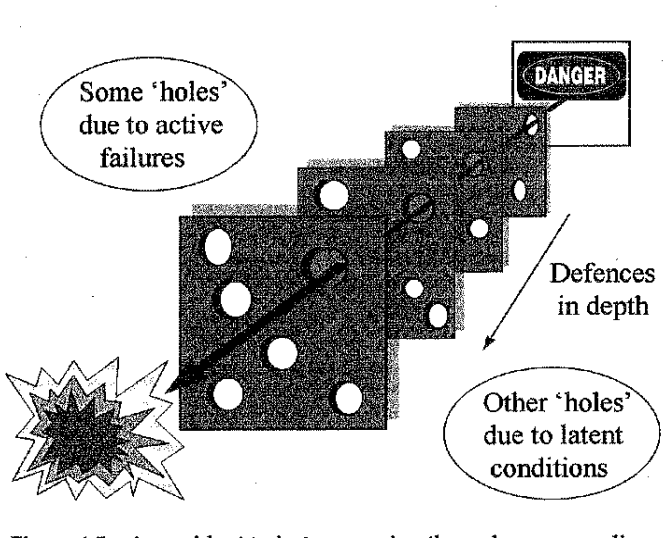


Source: From New Zealand CAA website, 21 Aug 2014

4. DEVELOPING A CONCEPTUAL MODEL OF AIRLINE SAFETY

At an organisational level, safety is a dynamic issue with a tension between profitability and safety. The temptation to increase profitability by reducing spending on safety is an avenue many firms have taken. Such reductions could, though not always, lead to accidents and crashes. Reason (1997) illustrates the problem with his famous "Swiss cheese" model of organisational safety. See Figure 2 below. According to Reason (1997), an incident or accident happens when various 'holes' in the defence barrier line-up. If any of the holes were smaller, or the organisation re-oriented, the accident may have been prevented.

Figure 2: Reason's "Swiss Cheese Model" of Accidents



Source: Reason, 1997, Fig 1.5, p12

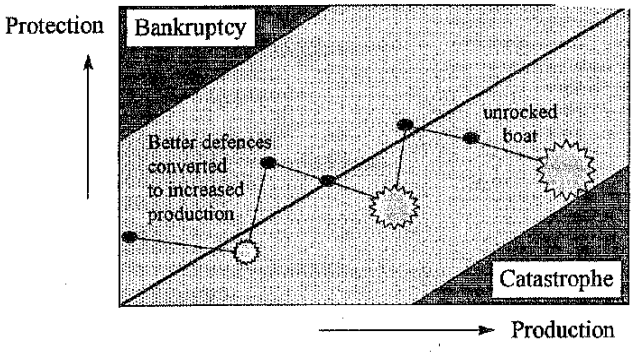
In the aviation context, each slice might represent a different component of the aviation matrix: the airplane manufacturer, the airline, pilots and their training, air traffic control and so on. Each acts in a defensive way to prevent incidents, yet each of these have vulnerabilities where things can go wrong.

Equally, the diagrammatic gaps could be gaps created, knowingly or inadvertently, during maintenance when something is incorrectly performed. Or they could be gaps created by the deliberate disabling of an engineered safety system feature. Or it could be the violation of a safety operating procedure.

Reason (1997) pointedly says that his Swiss cheese model is supposed to represent a dynamic system. Thus the protection and the gaps are never static. Gaps appear when a procedure is mistakenly stopped, disappear when it is reinstated and then appear again when it is 'cut' by order. They could also shrink then expand. They can also represent spatial differences with the holes moving around a layer.

Being a dynamic system, one could try to visualise the 'Swiss cheese' model as a time-series graph, such as Figure 1 above. Reason (1997) presents the graph as a way of illustrating how 'real' companies tend to bounce between levels of safety and commercial aggression. This is shown in Figure 3 below.

Figure 3: How 'catastrophes' occur in companies



Source: Reason, 1997, Fig 1.3, p5

On the vertical axis is increasing safety. On the horizontal axis is increasing production or profit. For all firms including airlines, it is not tenable to be in:

- the top left hand corner (total safety, zero profit – outcome bankruptcy!) or
- the bottom right hand corner (total profit, zero safety – outcome major airline accidents).

Time is represented as the line within the graph i.e. starting at the left 'dot' and ending at the 'explosion'. All airlines will start somewhere near the bottom left hand corner and strive to reach perfection – total profit and total safety. But perfection is usually unreachable, so they 'meander' in some zone in between. The trick is to try to avoid both the 'catastrophe' and 'bankruptcy' zones shown. Although they are portrayed as 'corners', in reality the 'safe' zone outside these danger areas is a band along the diagonal. It is up to an airline's management system to steer the company within this diagonal band.

Although there are a number of published studies dealing with causal models of airline safety (eg see Ale et al (2006, 2009a & b), Chen & Chen (2012), Hsu et al (2010), Roelen et al (2011), and Leveson (2011)), we still believe that there is room for further systems thinking related studies of airline safety. In fact Leveson (2011, p63) reaches the following conclusion:

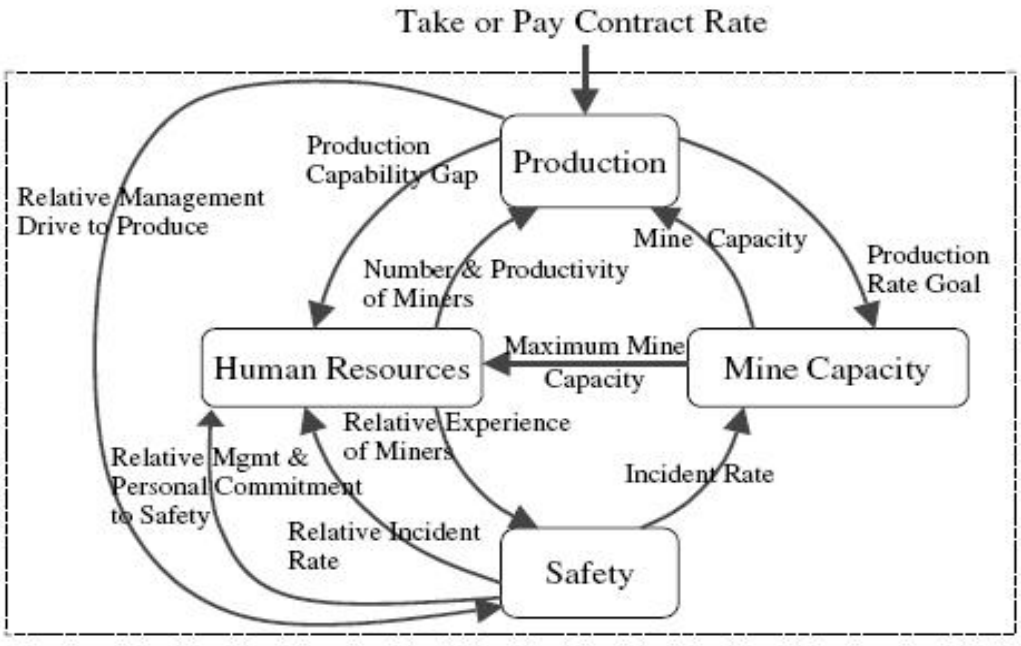
"An argument has been presented that sophisticated models of causality (not more notations for the basic chain-of-events model) based on systems thinking and systems theory presents an opportunity to perform more powerful accident analysis and hence learning from events."

Hence, in this paper, we focus on developing a conceptual 'systems thinking' model of airline safety based on the causal loop diagramming tools of qualitative system dynamics.

4.1 Overview of the Conceptual Model

There have been a numerous papers where system dynamic techniques have been used to consider organisational safety eg Marais et al (2006). However, none of these specifically address the field of airline safety. As there are very limited system dynamics publications involving airline safety, we looked to models involving safety in other fields as examples. Cooke (2003) published a system dynamics coal mine safety model which was based on Sterman's (2000) inventory control and order fulfilment archetype. Cooke's (2003) framework has 4 distinct sub-systems –Human Resources, Production, Mine Capacity, and Safety (see Figure 4). We used this framework as our primary source when building our model. The other main models we used as a source of ideas and inspiration were the ones elaborated by Salge and Milling (2004) and Moizer (1999).

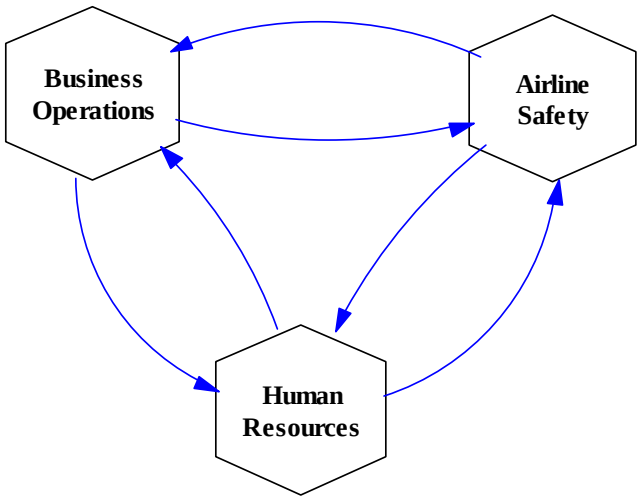
Figure 4: Subsystems of the Westray Mine Safety Model



Source: Cooke, 2003, Fig. 1, p144

We combined the Production and Mine Capacity sub-systems of Cooke's model into a 'Business Operations' sub-system. This would be the part of the model that simulates the commercial operations side of an airline or air operator. The modified subsystem view of the model is shown in Figure 5. We will now build up the causal connections in each subsystem separately: Business operations, human resources and airline safety.

Figure 5: Overview of the Airline Safety model



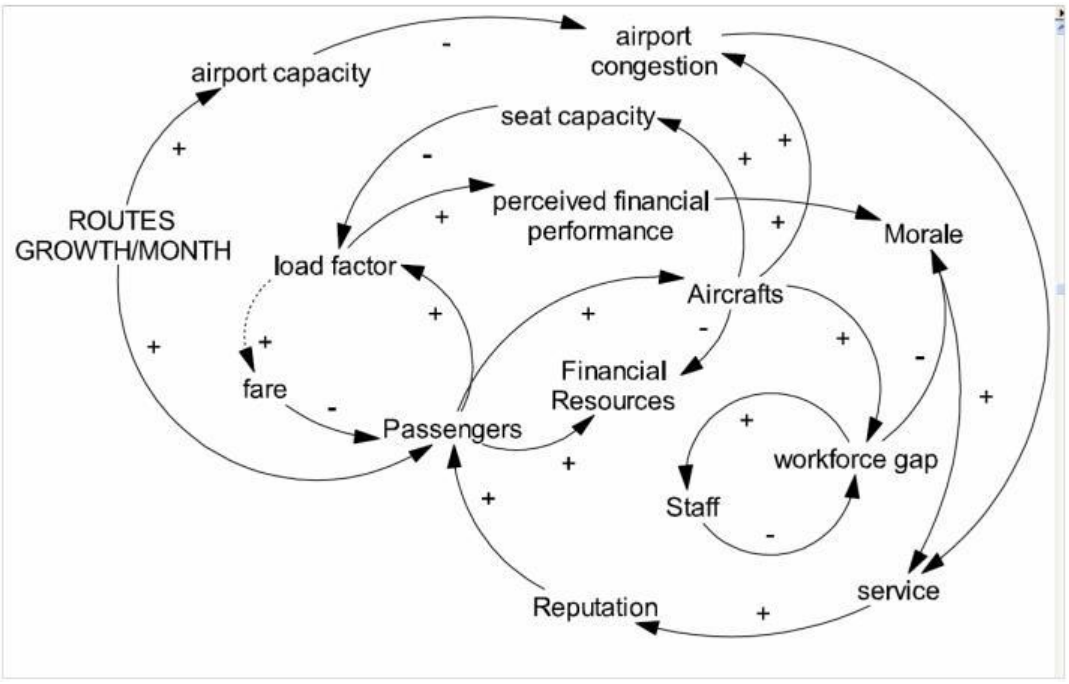
4.2 Causal Connections in the Business Operations subsystem

We began constructing the causal loop diagram (CLD) by starting at the Business Operations subsystem. The causal loop diagram of Salge and Milling's (2004) model of airline business, in Figure 6, has been a good starting point in building our CLD. The connections between the variables are reflected by an arrow with a positive (+) or negative (-) sign. A '+' sign indicates that an increase in a variable at the base of an arrow adds to or changes a variable at the head of the arrow in the same direction. Conversely a '-' sign indicates that the variable at the base of the link causes a reduction in the variable at the head of an arrow or a change in the opposite direction (Sterman, 2000; Maani & Cavana, 2007).

Starting with 'aircrafts', Salge and Milling (2004) show 'aircrafts' affecting 'financial resources'. We retain that idea but introduce 'maintenance expenditure' to highlight how aircraft influence an airline's cash balance (ie their 'financial resources'). Similarly in Figure 6, Salge and Milling (2004) include 'passengers' affecting 'financial resources'. Again we introduce an intermediate variable of 'revenue' as a clarification to increase 'airline cash balance'. We also change 'passengers' to 'customers' to emphasise the business relationship.

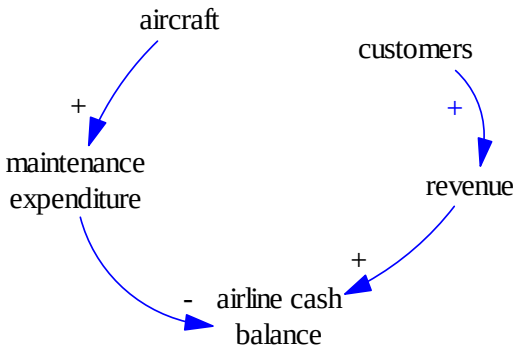
Figure 7 shows these connections, which form the basis of the business operations subsystem.

Figure 6: Salge and Milling's airline operations causal loop diagram



Source: Salge & Milling, 2004, Fig 3, p7

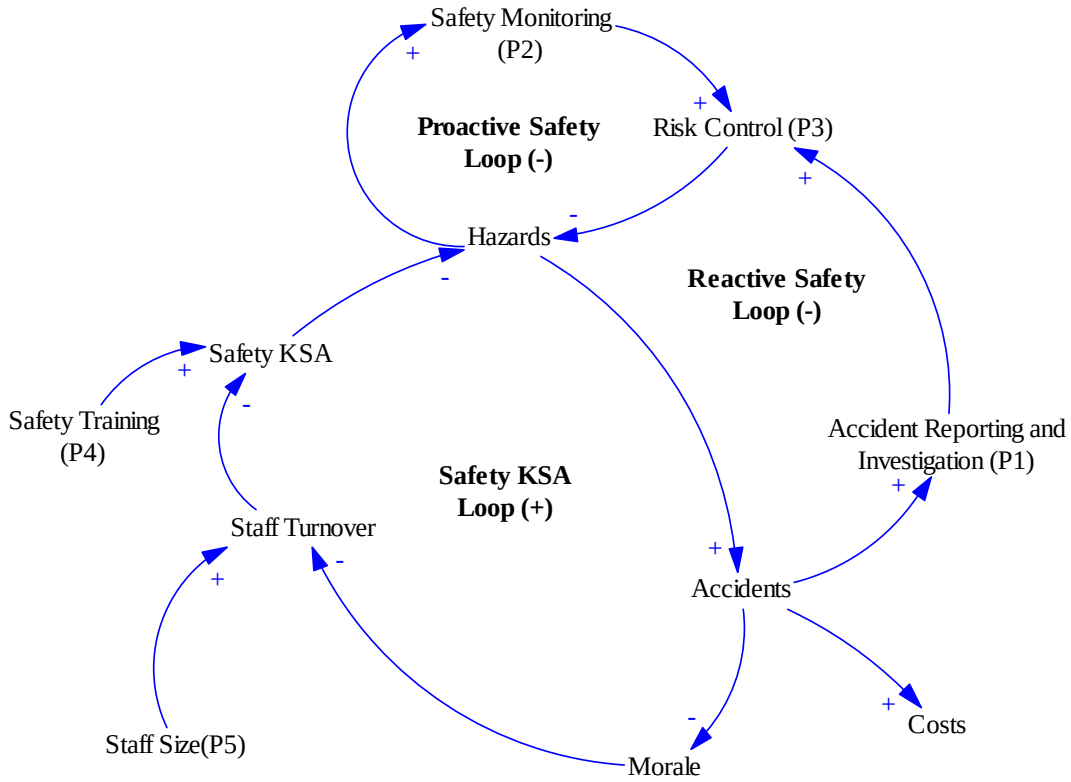
Figure 7: Initial causal connections in Business Operations subsystem



4.3 Causal Connections in the Safety Subsystem

We began by adapting Moizer's (1999) model into an airline safety model (see Figure 8). Moizer (1999) makes a positive connection between 'accidents' and 'costs'. Direct cost of a crash is mostly covered by insurance, according to Reason (1997) and Rose (1992). So we introduced 'insurance' as an intermediate step (in Figure 9).

Figure 8: Mozier's Safety causal loop diagram



Source: Moizer, 1999, Fig 5.3, p128

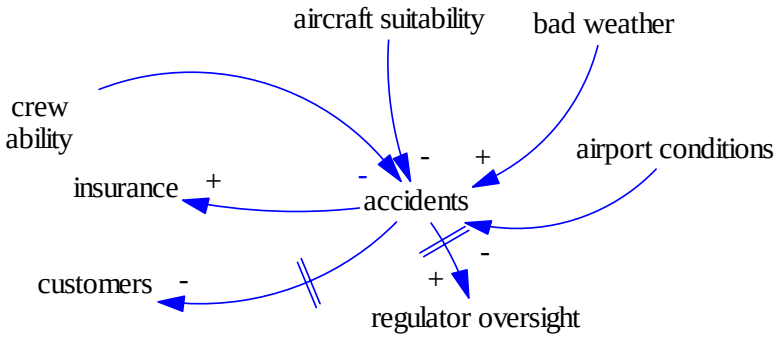
Accidents could alter client demand for that airline. Salge and Milling's (2004) model shows that 'service' affects 'reputation' which then affects 'passengers' (see Figure 6). For a safety model, accidents affect 'reputation' which then affects 'customers'. This was confirmed by the research of Castillo-Manzano et al (2012). They demonstrated that an airline involved in a major crash which killed 154 persons sustained a statistically significant reduction in custom after the crash.

What affects 'accidents'? Chen et al (2009) surveyed experts who would prioritize 78 percent of safety resources to their top 2 'causes' of flight crew and maintenance staff errors. Rhoades et al (2005) conjectured that fleet mix, fleet age, aircraft utilisation and maintenance training could have an effect on safety. We used the terms 'aircraft suitability' and 'crew ability' to cover these factors. Phillips and Talley (1992) also include aircraft and crew characteristics and introduce weather and airport conditions, which we also include in Figure 9.

None of the cited articles specifically mentions the role of the safety regulator. However it is obvious that a greater number of accidents would lead to more

oversight activity by the regulator. We thus incorporate a positive connection between 'accidents' and 'regulator oversight' after a significant delay (indicated by the parallel lines on the link). Figure 9 shows the connections discussed in the safety sub-system.

Figure 9: Initial causal connections in the Safety subsystem

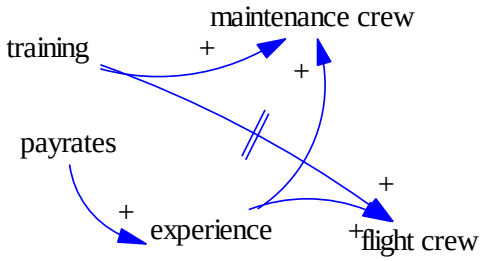


4.4 Causal Connections in the Human Resources Subsystem

Crew characteristics (flight crew and maintenance) of relevance to safety are the experience and the training of the personnel. Training can be provided by the company itself. Experience can only be 'procured' by employing experienced pilots, or retaining pilots long enough to gain sufficient experience. In both cases, pay rates are a major factor in the retention and recruitment of experienced staff (Cavana, et al., 2007).

Wilson (1997) noted that the US regulator was concerned about Valujet's pay rates. Rhoades and Waguespack (2000) go further and directly associate the lower pay of regional carriers compared to major airlines as a reason for the worse safety record of regional carriers. This is shown in Figure 10.

Figure 10: Initial connections in the Human Resources subsystem

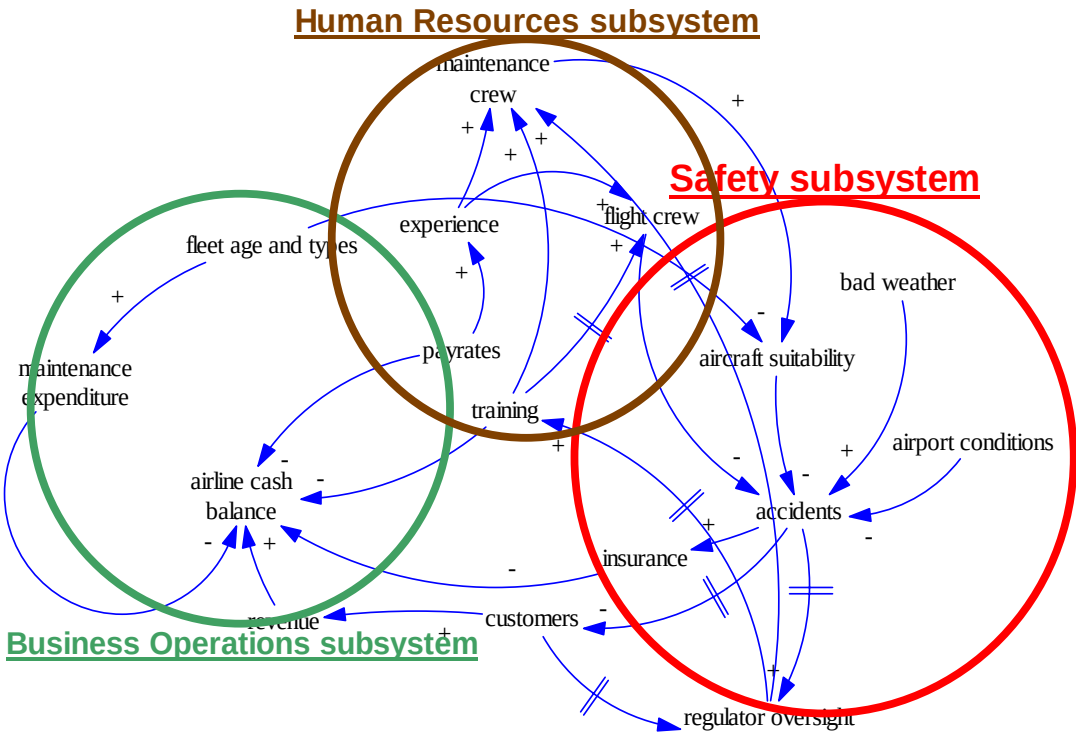


4.5 Connecting the Subsystems in the Airline Safety CLD

The three subsystems are connected via the common variables, as shown in Figure

11. The three overlapping circles reflect the interactions between the separate subsystems of business operations, human resources and airline safety.

Figure 11: Connecting the Business Operations, Safety and Human Resource Subsystems



Other connections are now made in Figure 11:

'Insurance', 'pay rates' and 'training' are connected to the 'airline cash balance' variable. The age of the airline fleet and the number of different aircraft types would have an effect on the cost of maintenance – see Rhoades et al (2005) and Easdown and Wilms (2002).

The Regulator Oversight must extend to the functions that the CAA (2012b) has authority over. This would include the maintenance performed on aircraft and the provision of training. Maintenance – as carried out by the maintenance crew – would affect the condition of the aircraft for flying. This, in turn, would affect how and if accidents occurred.

The commercial aspect of the model is incomplete. There must be a feedback loop between the 'airline cash balance' and the various expenditure items – maintenance, training, and pay rates. The capital costs of aircraft procurement or leasing must also

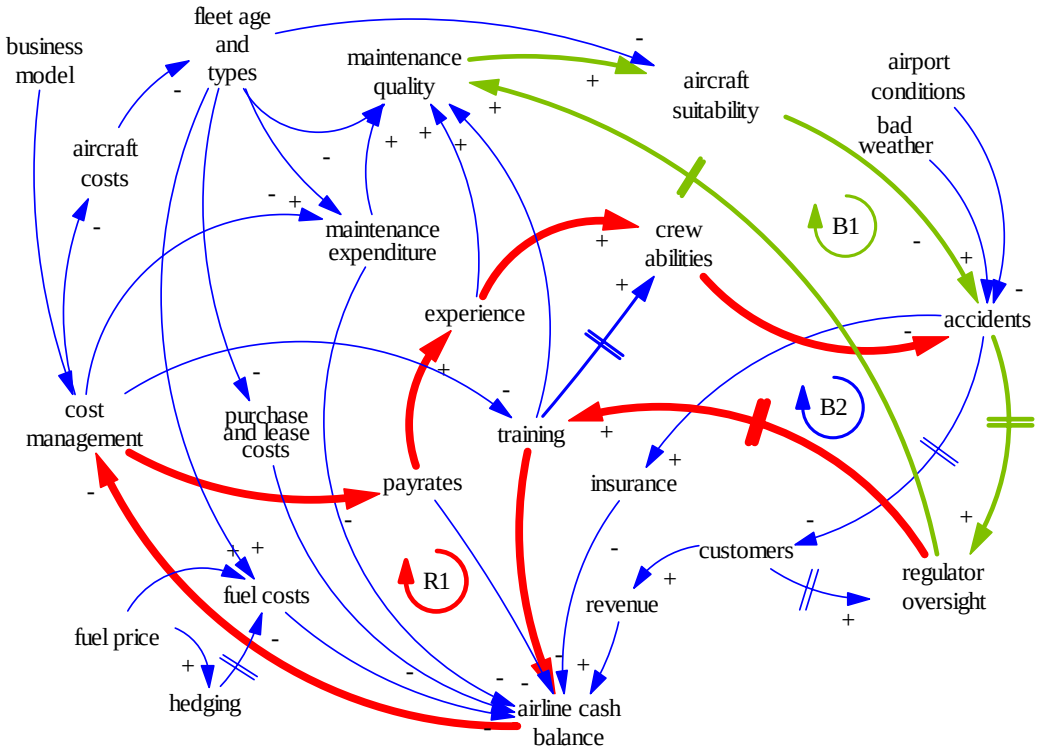
be added.

The CAA gets the bulk of its income for aviation safety from levies of airline customers (CAA, 2012b). This is reflected by a delayed connection between 'customers' and 'safety regulator'.

5. FEEDBACK LOOPS IN THE AIRLINE SAFETY CLD

Figure 12 shows the final CLD which contains 40 loops. Three such loops are highlighted. The one coloured green shows a balancing loop (B1) which involves 'accidents' and 'regulator oversight' (ie maintenance quality loop). The one coloured red identifies a reinforcing loop (R1) that involves these 2 variables plus 'training' and 'pay rates' (ie the training cost implications loop). A second balancing loop (B2) operates to reduce accidents after a delay by additional training for airline staff (staff training loop).

Figure 12: Preliminary Airline Safety CLD with Feedback Loops highlighted



In the balancing loop (B1), an increase in accidents leads, after a delay, to an increase in regulator oversight activity. This subsequently results in an increase in maintenance quality and aircraft suitability, which thereby decreasing the future accident rate.

The reinforcing loop (R1) is more elaborate. As in loop B1 above, an increase in accidents leads to an increase in regulator oversight activity. This also leads to an increase in training, which decreases airline cash balances, thus putting additional strain on the airline's cost management. Often the response to this situation is a decrease in pay rates, leading to decreases in the experience of retained and recruited staff, further decreasing crew ability and subsequently leading to an increase in accidents. This reinforcing loop fits the findings of Banks et al (2012) who found that cost pressures led to crew overwork which could reduce safety margins.

Although another balancing loop (B2) evident in this diagram does result in a reduction in accidents due to the additional training airline staff receive, there is evidence of a 'Fix that Fails' systems archetype (Senge, 1990) operating here. This balancing loop would be offset by the adverse effects of reinforcing loop R1, unless other measures are put in place to prevent these adverse unintended consequences occurring.

One policy implication of the loops shown is that there is no "one size fits all" solution. In some situations, extra vigilance by the regulator could have an effect that ultimately reduces accidents. But given a different airline business operating model, it could have the adverse effect of potentially reducing safety.

Thus the response by the regulator must be tailored to the situation. Furthermore the regulator must monitor the situation carefully to ensure any action has the desired effect.

6. CONCLUDING COMMENTS

This paper shows how the causal loop modelling tools of system dynamics can be used to develop a conceptual model of airline safety involving the subsystems of human resources, business operations and airline safety. A preliminary causal loop diagram is developed linking the variables within these subsystems and a number of feedback loops have been identified. However, the preliminary CLD outlined in this paper can be developed in the following ways:

- A more comprehensive literature from the airline safety literature can be included to provide additional links and variables to enable the development of a more comprehensive conceptual model of airline safety.
- Group model building workshops (Vennix, 1996; Andersen et al 1997) can be

undertaken to provide empirical data for the formulation of a conceptual model of airline safety. This can also be combined with the current preliminary conceptual model, and an enhanced CLD can be developed.

- The preliminary model or an enhanced conceptual model can be further developed into a computer simulation model (using system dynamics methods) for policy analysis and scenario testing for airline safety managers or air transport regulators.

Finally, we consider that the preliminary conceptual model developed in this paper does go some way towards developing a theory of airline safety using system dynamics methods as outlined in the 'theory building' special issue of *Systems Research & Behavioral Science* edited by Lane & Schwaninger (2008).

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INVESTIGATING PASSENGERS' PERCEIVED VALUE OF FULL SERVICE AIRLINES AND LOW-COST CARRIERS

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ABSTRACT

This study investigates the customer perceived value seen by Taiwanese passengers who flew between Taipei and Singapore regarding full service airlines and low-cost carriers. We collected a sample of passenger survey data at Taiwan Taoyuan International Airport. Five constructs, forming into customer perceived value, namely, nonmonetary cost, perception of monetary cost, reputation, service quality, and service contact are identified based on the results of factor analysis. A regression model is then adopted to measure the relationships between customer perceived value and potential determinants. Passengers from traditional airlines determined their perceived value based mostly on what they gained from the airlines. Nevertheless, passengers formed their perceived value for the low-cost carrier, Jetstar in this study, according to the trade-off between what they gave, especially the nonmonetary cost, and what they received.

Keywords: Customer perceived value, Low-cost carriers, Air passengers

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1. INTRODUCTION

Several studies have explored travellers' preference or choice of traditional and low-cost airlines. These studies determined that the selection criteria used by passengers (or specific passengers such as business travellers) using the two service types of airlines are quite different (Chiou and Chen, 2010; Forgas et al., 2005; O'Connell and Williams, 2005). However, the findings are not derived primarily from the viewpoint of customer perceived value. Customer perceived value (CPV) is an increasingly important factor for driving continued growth in air travel demand; this concept also correlates to passengers' hidden preferences, which play a key role in airlines' decisions (Yang et al., 2011).

CPV can be interpreted as the trade-off between the perceived benefits and the perceived costs of a specific good or service (Chen, 2008). CPV is different from satisfaction or service quality analyses, as these focus only on customers' perceptions (primarily of benefits) after experiencing the service. In contrast, CPV further considers customers' efforts from when they first contact the providers (i.e. the pre-purchase stage) (Sweeney and Soutar, 2001). Considering this period is vital, as it is a critical part of how passengers value what the air travel services they received are worth relative to what costs they give. Consequently, there is a need to understand passengers' perceptions regarding low-cost carriers, as well as full service airlines, based specifically on CPV. This issue should be important for both types of airline businesses to determine whether they deliver the right service value to passengers, and whether they gain a unique competitive position against other airlines.

This study investigates the CPV of Taiwanese passengers who flew between Taipei and Singapore, and determines the factors that influenced the CPV. The results contribute to the literature by examining whether the airline services the passengers received justify the airlines' efforts at various stages of the service process.

2. BACKGROUND

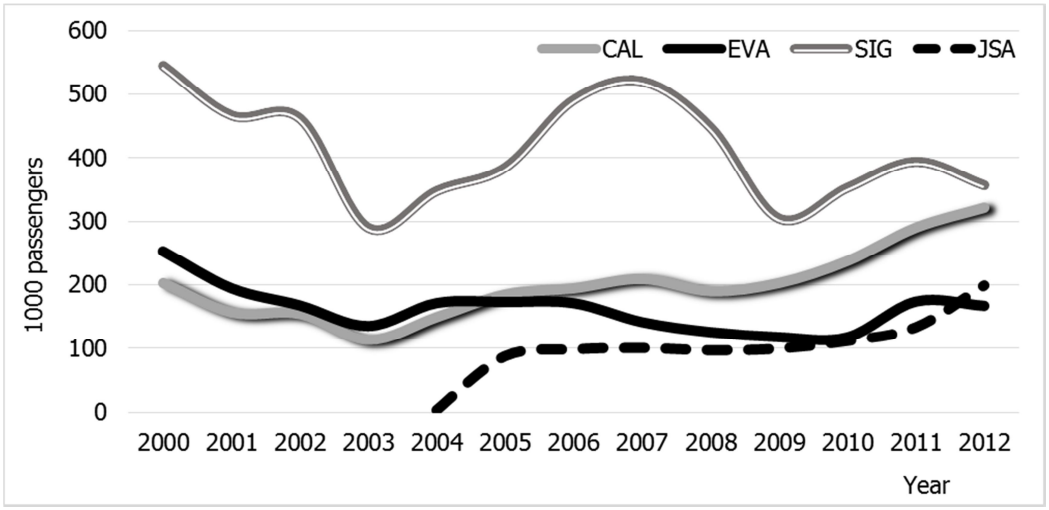
The low cost business model has matured in the airline industry in North America and Europe; however, low-cost carriers in Asia, especially in Taiwan, are still new entrants. In the study case, there are three full service airlines and one low-cost carrier[2] jointly operating in the air travel market from Taiwan to Singapore. Two of

[2] There were two new entrants in mid-2011. One is TransAsia Airways, based in Taiwan. TransAsia is considered a traditional airline. The other is Tiger Airways from Singapore, a low-cost carrier. However, this study conducted the survey at the end of 2010, preceding the advent of both new entrants; hence, only four airlines were studied.

the three full service airlines are Taiwanese: China Airlines (CAL) and Eva Airways (EVA). The third is the flag carrier of Singapore: Singapore Airlines (SIA). The only low-cost carrier is Jetstar (JSA). JSA was the first low-cost carrier in Taiwan's airline market, beginning service at the end of 2004. Figure 1 displays an annual trend of passenger traffic in the air travel market of Taiwan-to-Singapore from 2000. It shows that SIG dominated the market in last decade. However, CAL gradually caught up with SIG after financial crisis in 2009. The passenger traffic carried by JSA rapidly increased from 87,000 passengers in 2005 to 199,000 passengers in 2012, compromising approximately 15% of the Taiwan-to-Singapore air travel market. JSA is expected to continuously increase in a foreseeable future.

Nevertheless, JSA's performance in terms of punctuality does not seem to be reliable compared to the full service carriers. According to statistics announced by the Civil Aeronautics Administration of Taiwan, the average punctuality rate of JSA at Taiwan Taoyuan International Airport (TTIA) in 2011 was approximately 89%, lower than CAL, EVA, and SIA, which were 94%, 97%, and 97% respectively. Furthermore, the standard deviation of the punctuality rate of JSA approached 8%, which is also much higher than that of the three full service carriers. Although JSA draws passengers from those traditional airlines (most likely due to its lower fares), its service performance seems inferior.

Figure 1 Annual passenger traffic in the air travel market of Taiwan-to-Singapore



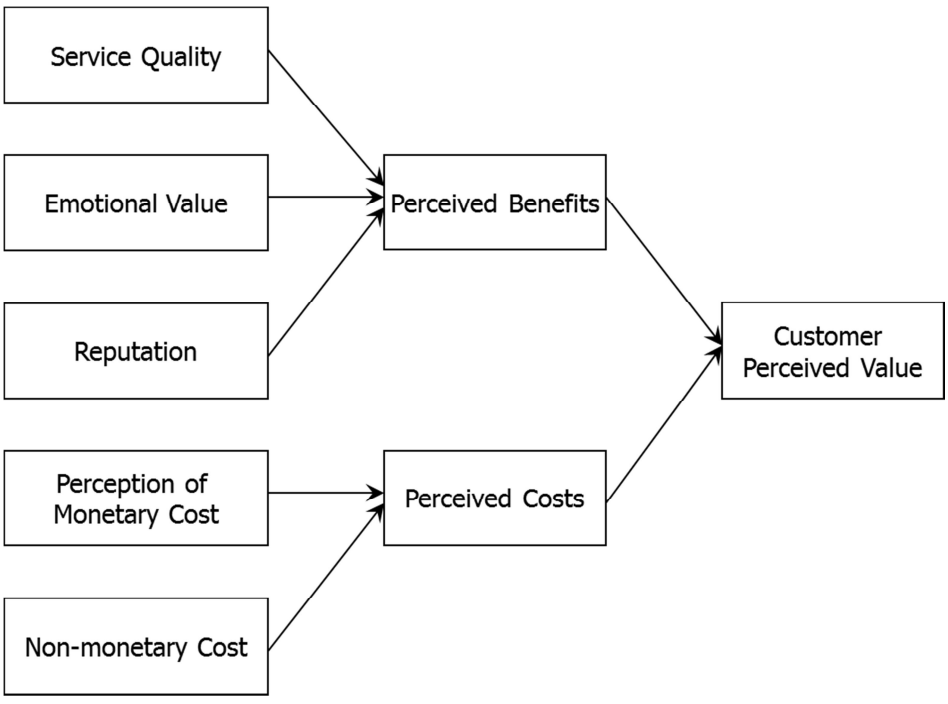
Source: Civil Aeronautics Administration, Taiwan, R.O.C. (2013)

3. METHODLOGY

3.1 Customer perceived value

CPV has been applied extensively in analysing consumer behaviour. The most popular operationalization of CPV is that it is seen to result from the trade-off between perceived benefits and costs (Chen, 2008). In other words, CPV explains whether the products or services the customers purchased are worth their efforts at various stages of the purchase process (Sweeney and Soutar, 2001). Perceived benefits are what customers gained from service providers such as full service airlines or low-cost carriers in this study. These gains are linked to such benefits as service quality (Forgas et al. 2011; Kim and Lee, 2011), pleasant or emotional value when contacting service attendants (Chen, 2008; Forgas et al. 2011; Sweeney and Soutar, 2001), and the brand or reputation of the service providers (Petrick, 2002). Costs consist of monetary cost and non-monetary cost (Chen, 2008; Chiou and Chen, 2010). Monetary cost is the exact money the customers paid for the service (i.e. ticket price). This study focuses on analysing passengers' perceptions of how expensive (or cheap) the ticket fare is rather than comparing the actual price of the ticket (Mikulić and Prebžac, 2011; Petrick, 2002). Non-monetary cost represents customers' efforts or sacrifices in order to use the service (Chen, 2008; Forgas et al. 2011; Petrick, 2002). For instance, passengers may expend great effort on searching flight information, spend a considerable amount of time reserving a seat, or modify their originally planned itinerary to use a particular airline. A conceptual framework of customer perceived value for this study is proposed in Figure 2.

Figure 2 Conceptual Framework of Customer Perceived Value



3.2 Survey set up and questionnaire design

The survey was conducted using a face-to-face questionnaire interview. Taiwanese passengers leaving for Singapore were intercepted at TTIA. The survey questionnaire consisted of three parts. The first part sought information related to trip characteristics of passengers, including the airlines used, experiences of flying the same airlines, purposes of the trip, places of ticketing, and travel cost. The second part obtained perceptions related to benefits and perceived costs regarding the airline for this trip. Perception benefits reflect airline image, service quality, and service contacts with employees. Perception costs include perception of monetary cost and nonmonetary cost. Table 1 lists the 'perception variables' that gauge the perceived benefits and costs of the airlines the passengers used. A seven-point Likert scale ranging from 'Strongly agree' (= 7) to 'Strongly disagree' (= 1) is used for this purpose. The last part anchors personal backgrounds, including gender, age, monthly income, and vocation.

3.3 Survey sample characteristics

The survey targeted Taiwanese passengers flying from Taipei to Singapore. The survey received 567 responses. In the sample, 133 respondents flew CAL, 132 flew EVA, 154 flew SIA, and 148 respondents flew JSA. Moreover, more than 70% of the sample had flew the same airlines in a past year. Fewer than 5% of the respondents were traveling abroad for the first time. The sample characteristics are summarised in Table 2. With respect to trip characteristics, approximately 60% and 55% of the respondents flew CAL and EVA, respectively, for a business purpose, while 66% and 97% of the respondents flying SIA and JSA, respectively, travelled for a non-business purpose. Approximately 85% of JSA respondents ticketed their flights via the Internet; however, over 50% of the respondents flying full service carriers bought their tickets through travel agents.

Table 1 Perception variables

Construct/Concept	Source
Service quality: service process is smooth and comfortable	
The check-in service of ABC[1] is quick and assured	Chiou and Chen (2010); Forgas et al. (2010); Kim and Lee (2011)
The boarding operation of ABC is efficient	
The in-flight service of ABC satisfies my needs	
The baggage service of ABC is reliable	
I am satisfied with the service quality of ABC	
Service contact: service attitude of employees and relations with passengers	
The employees of ABC are kindly	Forgas et al. (2010)
The employees of ABC always take care of my needs	
The employees of ABC are glad to help me	

I am familiar with the employees of ABC	
Reputation: passengers' evaluation on airline's image and reliability	
I always trust the service of ABC	Chiou and Chen (2010); Forgas et al. (2010)
I always have positive attitude toward ABC	
I am not worried about the safety records of ABC	
The reputation of ABC is good	
Perception of monetary cost: feelings of the ticket fare	
The fare of ABC is expensive	Forgas et al. (2010); Mikulić and Prebežac (2011)
The fare of ABC is not reasonable	
Non-monetary cost: time spending on buying the airline service	
I spend a lot of time to seek information of flight and fare of ABC[1]	Forgas et al. (2010)
I spend a lot of time to confirm the space	
I change my schedule to fit the flight of ABC	

[1]: ABC indicates the name of the airline passengers used.

Table 2 Sample characteristics

	CAL		EVA		SIA		JSA	
Characteristics	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Gender								
Male	71	53.4	81	61.4	73	47.4	58	39.2
Female	62	46.6	51	38.6	81	52.6	90	60.8
Age (years old)								
< 30	43	32.3	24	18.2	44	28.6	81	54.7
31 – 40	34	25.6	39	29.6	49	31.8	45	30.4
41 – 50	37	27.8	32	24.2	36	23.4	15	10.1
> 51	19	14.3	37	28.0	25	16.2	7	4.8
Monthly income (NTS)								
< 20,000	30	22.6	18	13.6	20	13.0	56	37.8
20,001 – 35,000	16	12.0	21	15.9	11	7.1	30	20.3
35,001 – 50,000	32	24.1	24	18.2	32	20.8	44	29.7
50,001 – 65,000	23	17.3	18	13.6	25	16.2	12	8.11
65,001 – 80,000	4	3.0	10	7.6	18	11.7	1	0.7
80,001 – 95,000	6	4.5	15	11.4	22	14.3	0	0.0
> 95,001	22	16.5	26	19.7	26	16.9	5	3.4
Vocation								
Manufacture	34	25.6	33	25.0	23	14.9	15	10.1
Business	44	33.1	48	36.4	68	44.2	40	27.0
Public servant/Education	9	6.8	9	6.8	18	11.7	9	6.1
SOHO	4	3.0	10	7.6	8	5.2	8	5.4
Student	17	12.8	13	9.8	18	11.7	55	37.2
Other	25	18.8	19	14.4	19	12.3	21	14.2
Total Sum	133	100.	132	100.	154	100.	148	100.

4. RESULTS

4.1 Descriptive statistics analysis

Table 3 presents the mean and standard deviation of each perception variable by airline. The table shows that the means of the variables regarding 'Service quality',

'Service contact', and 'Reputation' perceived by JSA respondents are lower than the means of the corresponding variables perceived by the respondents from the three full service carriers, indicating that the benefits the passengers received from JSA seemed less than what passengers gained from full service carriers. Furthermore, JSA respondents also perceived high scores on the variables associated with 'Perception of Monetary cost'. This response implies that passengers do not perceive JSA's low-cost position, even though it positions itself as a low-cost carrier.

This study also surveyed one additional question regarding the general perception of customer value of the airlines the respondents used. The question is 'The airline I used is worth the money'. The survey shows that JSA respondents gave a low score on this question, meaning that although JSA offers passengers low fares, the services the respondents received are still not worth this fare. These outcomes are not consistent with the findings of Mason (2002), which showed that more than 80% of corporate travel managers and 75% of business travellers think that low-cost airlines do offer value for the money, while the full service carriers do not.

4.2 Factor analysis

The factor loadings of the perception variables, applied by the principle factors method and after orthogonal varimax rotation, are presented in Table 4. The factor analysis suggests that five-factor is the best solution and explains 81.9% of the total variance. However, two perception variables were excluded in the analysis due to low factor loadings. These variables are 'I am satisfied with the service quality of the airline I used' and 'I am familiar with the employees of the airline I used'.

Table 4 shows that the first factor is marked by high loadings (in italics) on nonmonetary costs such as time spent on space confirmation and changes of schedule to fit the flight, while the second factor is marked by high loadings on the perception of monetary cost; i.e., the ticket fare is expensive, and the ticket fare is unreasonable. The third factor consists of four variables associated with reputation. The fourth factor comprises four perception variables concerning service quality. The fifth factor is marked by high loadings on the variables regarding service contact. Furthermore, the value of Cronbach's alpha for each factor is calculated and suggests that the reliability of each factor is acceptable (i.e. above 0.75).

Table 3 Descriptive statistics of perception variables

	CAL		EVA		SIA		JSA		ANOVA	
Variables	M	S	M	S	M	S	M	S	F	p
Service quality										
The check-in service of ABC[1] is quick and assured	5.20	1.19	5.52	0.96	5.77	1.23	5.13	1.18	2.87	0.04
The boarding operation of ABC is efficient	5.34	1.09	5.38	1.00	5.60	1.22	5.13	1.15	1.17	0.32
The in-flight service of ABC satisfies my needs	5.51	1.08	5.40	1.06	5.62	1.22	4.29	1.07	10.37	0.00
The baggage service of ABC is reliable	5.56	1.10	5.43	1.13	5.63	1.14	4.58	0.89	6.99	0.00
I am satisfied with the service quality of ABC	5.56	1.03	5.55	1.01	6.00	0.95	4.90	1.04	7.77	0.00
Service contact										
The employees of ABC are kindly	5.51	1.21	5.35	1.10	5.35	1.17	4.68	1.22	3.36	0.02
The employees of ABC always take care of my needs	5.22	1.19	5.25	1.03	5.31	1.18	4.65	1.20	2.46	0.07
The employees of ABC are glad to help me	5.24	1.22	5.43	1.03	5.38	1.22	4.61	1.20	3.51	0.02
I am familiar with the employees of ABC	4.51	1.57	5.13	1.44	4.21	1.89	3.74	1.53	4.54	0.00
Reputation										
I always trust the service of ABC	5.37	1.04	5.50	0.93	5.92	1.22	4.87	1.09	6.29	0.00
I always have positive attitude toward ABC	5.17	1.02	5.53	0.96	5.98	1.15	4.84	1.10	8.74	0.00
I am not worried about the safety records of ABC	4.41	1.55	5.65	1.00	6.25	0.88	5.06	1.00	21.71	0.00
The reputation of ABC is good	4.80	1.31	5.52	1.01	6.23	0.92	4.74	1.18	17.74	0.00
Perception of monetary cost										
The fare of ABC is expensive	4.46	1.36	3.68	1.44	4.33	1.57	4.90	1.62	1.21	0.01
The fare of ABC is not reasonable	4.56	1.61	3.68	1.42	4.67	1.38	4.77	1.71	1.39	0.01
Nonmonetary cost										
I spend a lot of time to seek information of flight and fare of ABC	2.80	1.79	3.75	1.68	2.58	1.80	2.90	1.72	3.65	0.01
I spend a lot of time to confirm the space	2.90	1.69	3.50	1.54	2.48	1.65	2.68	1.45	3.27	0.02
I change my schedule to fit the flight of ABC	3.15	2.12	3.30	1.74	2.73	1.67	3.32	1.72	1.04	0.38

[1]: ABC indicates the name of the airline passengers used. M = mean; S = Standard deviation. F = F statistics; p = p value (α=0.05).

Table 4 Factor analysis

Variables	Factors 1	2	3	4	5
I spend a lot of time to confirm the space	*-0.920*	-0.080	-0.018	0.003	-0.030
I change my schedule to fit the flight of ABC[1]	*-0.811*	-0.335	-0.076	-0.094	-0.113
The fare of ABC is expensive	-0.101	*-0.944*	-0.078	-0.067	-0.093
The fare of ABC is not reasonable	-0.183	*-0.928*	-0.070	-0.048	-0.142
I always trust the service of ABC	0.060	0.042	*0.795*	0.193	0.284
I always have positive attitude toward ABC	0.011	0.093	*0.809*	0.195	0.291
I am not worried about the safety records of ABC	0.021	0.091	*0.793*	0.201	0.196
The reputation of ABC is good	0.077	0.093	*0.766*	0.284	0.221
The check-in service of ABC is quick and assured	0.028	0.071	0.545	*0.641*	0.201
The boarding operation of ABC is efficient	0.035	0.070	0.376	*0.772*	0.239
The in-flight service of ABC satisfies my needs	0.040	0.092	0.205	*0.662*	0.392
The baggage service of ABC is reliable	0.085	0.103	0.226	*0.614*	0.501
The employees of ABC are kindly	0.072	0.134	0.261	0.257	*0.810*
The employees of ABC always take care of my needs	0.051	0.120	0.231	0.216	*0.845*
The employees of ABC are glad to help me	0.056	0.132	0.273	0.149	*0.843*

[1]: ABC indicates the name of the airline passengers used.

Factors 1 to 5 refer to nonmonetary cost, perception of monetary cost, reputation, service quality, and service contact, respectively.

4.3 Regression analysis

The five constructs, two representing perceived costs and the other three relating to perceived benefits, are then used as independent variables to regress with the general perception of customer value (i.e. 'The airline I used is worth the money') for each airlines. The ordinary least square technique was adopted to estimate the regression relationships. Table 5 reports the results of the regression models by airlines. A post diagnostic was also did using residual-versus-predictor plot to see whether any heterogeneity effect is existed among the independent variables (i.e. the five constructs). The plots, which were not reported here due to space limitation, indicated that the residuals of each regression were randomly (or approximately randomly) distributed on each construct. That is to say, the heterogeneity effects

among the independent variables can be reasonably ignored.

According to Table 5, two variables related to perceived costs were both not estimated to have expectedly negative impacts on customer perceived value in each regression models. This might be because that certain of the variables were correlated with each other[3]. However, after removing such variables which were highly correlated with others from the regression models, the estimated results were still not significantly improved (i.e. especially to the perceived cost variables). Hence, the five variables were kept altogether in the final models. Table 5 shows that one of the variables linked to the perceived costs, 'Nonmonetary cost', is estimated to be statistically significant in the JSA regression model only. This finding implies that demonstrably reducing passengers' efforts in the period of information seeking, space confirmation, or changes of trip schedule can enhance the customer perceived value for the low-cost carrier.

Table 5 Regression analysis

	Dependent variable = Customer perceived value			
Variable	CAL	EVA	SIA	JSA
Constant	0.226	-0.334	0.900	0.907
	(0.421)	(-0.780)	(1.544)	(1.358)
Perceived cost				
Perception of monetary cost	0.055	-0.068	-0.033	0.067
	(0.996)	(-1.286)	(-0.579)	(1.255)
Nonmonetary cost	-0.070	0.037	-0.002	-0.116**
	(-1.293)	(0.808)	(-0.036)	(-2.168)
Perceived benefits				
Reputation	0.193*	0.047	0.530***	0.114
	(1.890)	(0.462)	(5.734)	(0.953)
Service quality	0.352***	0.372***	0.096	0.442***
	(3.245)	(2.861)	(0.858)	(3.665)
Service contact	0.434***	0.658***	0.204**	0.293***
	(4.692)	(7.283)	(2.081)	(3.151)
Number of observation	133	132	154	148
R-square	0.545	0.738	0.458	0.414
F-statistics	30.375***	71.145***	25.019***	20.035***

*: $p<0.1$; **: $p<0.05$; ***: $p<0.001$

[3] The five constructs were originally independent to each other as they were generated using factor analysis with orthogonal rotation. After segmenting the variables by airlines, certain of the variables were becoming correlated with each other. We have checked the correlation coefficients among the five constructs of each airlines and found that the coefficients were all less than 0.6.

In both the CAL and EVA regression models, two of the variables regarding the perceived benefits, 'Service quality' and 'Service contact', are estimated to be significant. Moreover, according to the magnitudes of the variables' coefficients, the CPV for these two traditional airlines is dominated by 'Service contact' higher than 'Service quality'. With respect to the SIA regression model, the variables related to perceived costs are estimated to be negative; however, they are far from significant at α-level of 0.1. Two variables corresponding to the perceived benefits, 'Reputation' and 'Service contact', are estimated to be statistically significant, and the marginal effect of 'Reputation' on CPV is higher. This finding shows that SIA has successfully achieved a good reputation with passengers.

Finally, in the JSA regression model, besides 'Nonmonetary cost', 'Service quality' and 'Service contact' are also estimated to be statistically significant. Different from the cases of CAL and EVA, the customer perceived value for JSA is highly determined by 'Service quality', as it has a higher marginal effect.

5. CONCLUDING REMARKS

This study investigates airline passengers' perceived value of low-cost carriers and traditional full service airlines. Perceived value is not like service quality analysis, which only focuses on passengers' perceptions after experiencing services; it further considers passengers' efforts in the pre-purchase stage. Our analysis found that, although JSA positions itself as a low-fare airline and truly attracts a substantial amount of passengers (ref. Fig. 1) in the Taiwan-to-Singapore air travel market, respondents still perceived higher monetary cost but fewer benefits. In other words, Taiwanese passengers perceive that using JSA might not be worth the money. This finding differs from some previous studies such as Mason (2002) and Saha and Theingi (2009).

The determinants of CPV of traditional airlines mostly relate to perceived benefits; however, the important factors influencing the perceived value of the low-cost carrier are 'Nonmonetary cost', 'Service quality', and 'Service contact'. This finding implies that Taiwanese passengers' perceived costs of the full service airlines, regardless of whether they are monetary or nonmonetary, might not be crucial to determining their perceived values; instead, the passengers place more value on what they gain, i.e. perceived benefits, to form the perceived value. Just like SIA, she has established

good reputation in passengers' mind and delivered delicate services to passengers. Hence, even though SIA is perceived costly compared to CAL and EVA, SIA still dominates the Taiwan-to-Singapore air travel market in last decade. In contrast, JSA needs to pay more attention to reducing passengers' perceived costs, such as time spent on information seeking or space confirmation and to improve passengers' perceived benefits, such as service quality, at the same time.

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RISK ASSESSMENT PROFILING PROCEDURE (RAPP) FOR AIR CARGO SECURITY

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ABSTRACT

This paper offers a risk assessment profiling procedure (RAPP) for air cargo based on leveraging the role of the human factor along the security process. RAPP is based on principles taken from the Israeli method of passenger profiling and suspicious signs published by the United State Department of Homeland Security. RAPP is challenged with the plot of 2010 to bomb an all-cargo airplane using explosives concealed in printers originating from Yemen. The core competence of RAPP is individually assessing the risk of each shipment by a qualified agent, who looks for suspicious signs and anomalous patterns and addressing the level of risk by adjusting appropriate technological resources for detecting the explosives. RAPP allows less screening of cargo and makes the security process of air cargo more active. The combination of the human factor and the right technological resources enhances the level of success in securing air cargo.

Keywords: risk, assessment, profiling, procedure, cargo, security

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1. INTRODUCTION

Air operators worldwide handle more than 70,000 tons of air freight on a daily basis. The low amount of explosive required in order to create a mid-air explosion makes targeting air cargo desired by terrorist. Concealing a bomb inside a cargo shipment is relatively easy due to the different types, sizes and volumes of goods (Giemulla, Rothe & Zielinski 2014).

The plot to bomb a plane over U.S. soil in 2010 using explosives concealed in printers originated from Yemen was prevented due to real-time intelligence report. The bombs had not been detected by technology along the shipment's course from Yemen to Chicago via Cologne. This proves that technology itself cannot give a whole and complete solution for securing air cargo shipments (Giemulla, Rothe & Zielinski 2014).

The concept of passenger profiling was introduced three decades ago by the Israeli Security Agency. The core concept of passenger profiling is that qualified security agents assess the level of risk from each and every passenger flying from Tel Aviv Ben-Gurion airport. Each passenger is then given an individual level of security check according to different levels of threat. The agents do not look for the explosives, but rather look for suspicious signs and anomalous patterns, which send warning signals of possible terrorist method of operation (eds Zureik, Lyon & Abu-Laban 2011).

The aim of this paper is to offer a profiling procedure for air cargo security based on assessing individual risk of every cargo shipment. The paper begins with a description of the theoretical background on aviation terrorism and air cargo security, continues with comprehensive explanation of the Israeli passenger profiling method and ends with developing a new air cargo security method of profiling air cargo shipments. All information and interpretation used in this paper are non-classified and were taken from open sources.

2. THEORETICAL BACKGROUND

2.1 Aviation terrorism

Terrorism is defined as 'the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives' (Federal Bureau of Investigation 2014). Terrorism targets non-military personnel, and differs from civil wars, guerrilla warfare and riots. The act of terrorism has the objective to influence

political behavior by maximizing media exposure and further spreading the atmosphere of fear (Baseren 2008).

The aviation industry has been facing terrorism for the past half-century. The reason for the attractiveness of carrying out an attack against civil aviation is due to the amount of deaths and media exposure that could be achieved compared to other forms of attacks (eds Zureik, Lyon & Abu-Laban 2011). Due to the international characteristics of the aviation industry, terrorism against civil aviation is used as a tool to fight globalization, or in other words, the domination of western values worldwide (Baseren 2008).

2.2 Air cargo security

Air cargo is defined by the International Civil Aviation Organisation (ICAO) as 'any property carried on an aircraft other than mail, stores and accompanied or mishandled baggage' This definition excludes, others than mail, all supplies intended for consumption during the flight by the passengers or by the crew and goods needed for the operation and maintenance of the aircraft such as fuel and lubricants. The only stores defined as cargo, are those which have the classification of dangerous goods (International Civil Aviation Organisation 2009 p. 3). Aviation security is 'the combination of measures and human and material resources intended to safeguard civil aviation against acts of unlawful interference' (Morrel 2011 p. 170).

The security threats deriving from air cargo are: (1) Hijacking of an all-cargo airplane in order to use it as a weapon of mass destruction by crashing it on ground, (2) Bombing a cargo shipment concealed with explosive on board an all-cargo plane or on board a passenger plane, which carries cargo (Bart 2010). According to Transportation Security Administration (TSA) experts, the improvements implemented in the field of air passenger security have caused terrorists to consider attacking air cargo instead. Cargo is transported by both all-cargo and passenger planes. Security experts claim that the efforts and focus of authorities should be mainly given to securing cargo shipments which are loaded on passenger airplanes. This is explained by the claim that targeting an all-cargo aircraft is not likely to create the same fear effect amongst the public as compared to targeting a commercial passenger aircraft and the achieved level of media exposure is relatively less as well (Bart 2007). However, the failed plot to bomb an all-cargo airplane using printers concealed with explosives originated from Yemen in 2010 suggests otherwise. In this incident, a terror group in Yemen linked to al-Qaida has sent cargo shipments to the

United States which contained bombs. The explosives were concealed in a sophisticated manner inside printers and were addressed to Jewish synagogues in Chicago. Technological screening failed to detect the explosives, and only due to reliable on-time intelligence reports, the printers were located, searched and the bombs were disarmed (Department of Homeland security 2010a). This failed plot has shown that the bombing of an all-cargo airplane is still an important threat, which should be addresses (Bart 2010).

Nevertheless, unlike targeting a commercial passenger aircraft using an attacker on board or by concealing a bomb inside a passenger's baggage, the method of operation of targeting air cargo is different and lacks the key advantage of timing of the explosion. Unless assisted by individuals with access to the aircraft or to the ground handling procedures, terrorists have no influence on the course of the shipment along the supply chain and, therefore, can neither precisely predict the specific flight the cargo is loaded to nor the location of the explosion (Bart 2009).

Figure 1: Points of exploiting the air cargo movement based on International Civil Aviation Organisation (2013)

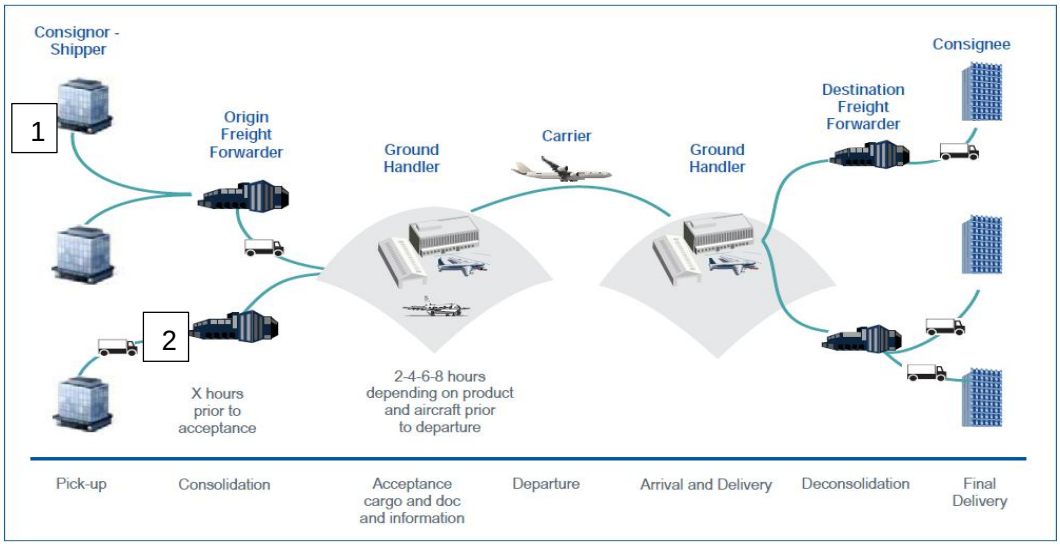


Figure 1 explains the terrorist method of operation of exploiting the air cargo platform. Terrorist execute their plans either by concealing explosives in a sophisticated manner in the beginning of the supply chain at the shipper phase (marked by 1), or by targeting the movement of the cargo along the supply chain, where terrorist can add an improvised explosive device to the cargo shipment (marked by 2) (Department of Infrastructure and Transport 2013).

2.3 Status Quo

As of August 2010, all cargo transported on commercial passenger aircrafts to and from the United States of America must be entirely 100% checked. This mandatory obligation has been decided as part of the recommendations post September 2001 attacks in order to compare the cargo's level of security checks to the security level of passengers' checked baggage (Bart 2010). The costs of implementing 100% check are tremendous. An analysis by the Congress Research Service (CRS) has concluded that the costs of implementing a 100% check of all cargo carried on commercial passenger aircrafts expected to reach the sum of $3.6 billion over a period of 10 years (Bart 2007). The consequences of this decision have made the transporting of goods by passenger aircraft less appealing economy wise (Giemulla, Rothe & Zielinski 2014). Moreover, shippers and forwarders of cargo from countries outside of the US have had to comply with the new regulation and adjust their cargo security checks to the standards issued by the American authorities, forcing them to purchase expensive technological machines (Morrel 2011).

The European Union (EU) has emphasized the importance of securing the supply chain as a tool of improving air cargo security. The European Commission (EC) mandates each EU member state to regulate the various entities of the supply chain of air cargo on condition that each entity along the process meets strict standards of controls, which includes background checks of staff, training and other legal obligation. By ensuring a secured supply chain, cargo companies can be officially validated as 'known consignor'. Once cargo is accepted from a known consignor, it can be exempted of additional screening and loaded directly onto the aircraft. If, however, cargo shipments are accepted from an unknown consignors, or if cargo has not been fully protected during its transportation prior of arriving at the airport for loading, it is mandatory to fully screen its content (European Commission 2014 a).

2.4 Technology limitations

Technology is widely used worldwide for cargo screening. The TSA certifies the X-ray and the Explosive Trace Detection (ETD) as approved technological machines for the detecting of explosives (Department of Homeland security 2010b). The EC does the same and approves the use of sniffer dogs as well (European Commission 2014). The main limitation of technology is that it requires the involvement of humans to analyze threat items produced by each machine. An unqualified screener may not recognize alerts produced by an X-ray machine, unless he is trained appropriately and has the right experience. The failure of detecting the threat items can be attributed to the

fact that the item looks different when scanned than in reality and that there are items that the screener might not know from everyday experience (Schwanninger 2006). A study about the role of the human factor in the layers of airport security suggests that airport security staff does not trust the technological security tools they use (Andriessen, Van Gulijk & Ale 2012).

The effectiveness of using technology is limited. An X-ray machine is utmost effective in screening low density cargo shipment shipments that are identical from unit to unit. ETD is effective as long as security personnel are able to take samples of shipment surface that is contaminated by explosives. If a sample is taken from a non-contaminated surface, or if taken hastily, then no alarm is produced (Crowely and Butterworth 2007).

3. PROFILING AS A RISK ASSESSMENT TOOL

3.1 Profiling of passengers in Israel

For more than four decades, Israel has been facing terror plots, attacks and threats on its commercial aviation industry both in its territory and abroad. The cornerstone of the aviation security in Israel can be dated to the year 1968, when an EL AL Boeing 707 was hijacked to Algiers on its way from Rome to Tel Aviv. Immediately after this successful hijacking, the Israeli government has formulated security regulations and created a security system with the goal of preventing attacks on Israeli carriers both domestically and internationally (Israel security Agency n.d. a).

The need for great aviation security in Israel is driven from the long-lasting Arab-Israeli conflict. Targeting Israeli airplanes is very much appealed by terrorist. Israel's tourism industry is dependent on air traffic to and from the country, and an attack would have catastrophic results on this industry. In addition, hijacking an Israeli airplane would force Israel to release terrorists that would re-enter the cycle of violence (Hasisi, Margalioth & Orgad 2012). Moreover, bombing of an Israeli airplane would force Israel to declare a war against the entity responsible for the attack (Israel security Agency n.d. b).

Profiling can be defined as 'the observation, recording and analysis of selected characteristics of individuals or groups for the purpose of predicting future behaviour (eds Zureik, Lyon & Abu-Laban 2011, p. 373). During the process of profiling, personal data is collected and cross checked with existing models of behaviour (eds Zureik, Lyon & Abu-Laban 2011). Profiling enables the authorities to dedicate efforts

and target not every single passenger, but those passengers who are more likely to fit the model behavior of a terrorist. Profiling acts as a risk based security technique, in which the individual level of risk from each passenger is assessed according to each passenger's risk category (Hasisi, Margalioth & Orgad 2012).

Israel airport security procedures are made of four security circles:

1. Detecting suspicious passengers outside of the terminal area – by matching names to checklists based on intelligence sources.
2. Information gathering from data found on the airline ticket - flight habits, method of purchasing the ticket and whether or not the passenger is flying alone.
3. Passenger profiling by a qualified security agent – each passenger is verbally screened by security agents, who determine the level of security the passenger should be granted.
4. On-board security (Orgad & Hasisi 2010).

The profiling method in the third circle of security highlights the use of the human factor. The method of passenger profiling depends on the expertise and the qualifications of the security staff. All of the security agents working at Tel Aviv's Ben Gurion airport and EL AL Israel Airlines' stations worldwide are well trained by Israel Security Agency (ISA), and have all completed mandatory military service. The agents' common sense, experience and intuition are the basic of the profiling method, and the variables in the profile process are based on empirical analysis of previous attacks and constant assessment of the threat by the authorities (Hasisi, Margalioth & Orgad 2012).

The passenger profiling method has proven to be very successful. After its implementation in 1968 all attempts to hijack an Israeli airplane have failed. In addition, the profiling has proven to thwart all attempts to bomb an Israeli airplane, except for one incident in 1971, when young European women were exploited to carry suitcases concealed with bombs (Hasisi, Margalioth & Orgad 2012). Advocates of the profiling procedure claim that the profiling is not simply based on the passenger's religion or ethnicity, but is rather behavioral. While interviewing each passenger, the agents look for anomalous pattern which flags warning signals that there is something wrong with regard to a specific passenger (eds Zureik, Lyon & Abu-Laban 2011).

The effectiveness of the profiling procedure can be illustrated by the successful preventing of two plots to bomb Israeli planes in the 80's. The first incident had occurred in Zurich in April 1980. A Christian German citizen was tricked to smuggle a suitcase of diamonds to Israel in return of money. The passenger was not aware that the suitcase did actually contain a bomb given to him by a member of the terrorist group Bader Meinhof. While being asked by the Israeli agent at Zurich airport regarding his trip to Israel, he acted nervously, was sweating and gave contradictory statements. His answers regarding his visit to Israel were not sufficient, which led him to expose his ties with the Palestinians. The Israeli agents had successfully detected the bomb after intrusive search of his suitcase (Hasisi, Margalioth & Orgad 2012).

The second terror plot in April 1986 to bomb an Israeli plane departing to Israel from London Heathrow illustrates the anomalous patterns that send warnings and assist the agent to assess the level of risk. An Irish woman named Ann-Marie Murphy was tricked to fly to Israel by her Jordanian lover, Nizar Hindawi. Murphy had carried Hindawi's unborn child and was six months pregnant at the time. Hindawi had connections with the Syrian intelligence officers, who promised him money in return of plotting to bomb an Israeli plane using Murphy's alleged visit to Israel. Hindawi bought Murphy a flight ticket to Tel Aviv, gave her a handbag with a present to his family in Israel and asked her not to mention her relationship with him. Murphy was not aware that the present she got from Hindawi did actually contain a sophisticated bomb. While being profiled, Murphy could not provide details about her visit, had no suitcase and only carried 150 dollars cash. Further questioning revealed her connection to Hindawi, and led to strict search of her bag. The bomb hidden in her handbag was not detected technologically by an X-ray machine. However, the anomalous patterns of her story made the agents to physically search the bag, when the bomb was finally revealed (Hasisi, Margalioth & Orgad 2012).

3.2 Non-classified Passenger Profiling Procedure

According to the academic and non-classified studies by Hasisi and Orgad (2010) and Hasisi, Orgad & Margalioth (2012), the Israeli airport security staff allegedly evaluates dozens of suspicious signs as shown in Table 1.

During the profile procedure, the agent identifies discretely suspicious signs and sorts each passenger into different risk groups: low risk, medium risk and high risk. Generally, the security checks of each passenger get more intrusive, in accordance to

the amount of suspicious signs detected. The screening resources are also adjusted to each risk group according to the proportion of risk level. If a passenger does not pass the process of profiling, he would be subjected to additional intensive questioning, which could lead to frisks and searches (Hasisi, Margalioth & Orgad 2012).

Table 1: Suspicious signs allegedly used by Israeli profiling agents based on Hasisi, Margalioth & Orgad (2012) and Hasisi and Orgad (2010)

Behavioural signs			
nervousness	Lack of cooperation with the airport security officer	Contradictory statements	Avoidance of answering
Passport signs			
Passengers who do not speak the language of	Passengers who do not match the passport photo or physical description entered	Passengers who have different names in the passport and the flying ticket	
Ticket signs			
Cash purchase of a one-way ticket prior to boarding in high-risk countries and with foreign currency			
Traveling signs			
New suitcases	A large amount of cash	No alternative ID's	Previous trips to high-risk countries	No luggage for a long trip
Nationality signs			
Country of citizenship	Country of residence	Ethnicity	Country issuing the passport

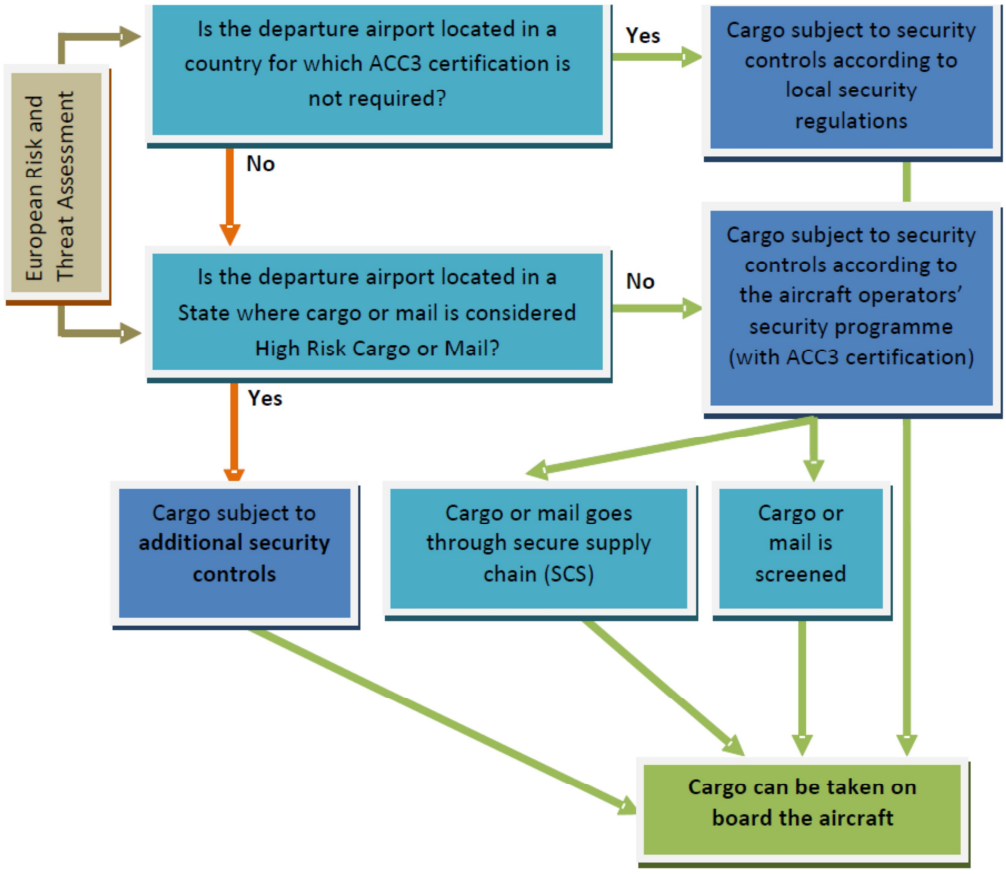
Civil rights organisations in Israel claim that the process of profiling causes discrimination against Muslims. Their claim points put that Israel conducts ethnic profiling and singles out intentionally Arab and Muslim oriented passengers from other passengers who are neither Arabs nor Muslims. The ethnic profiling results in different technological screening. Bags belonging to Arabs passengers are sent to an X-ray scanner with a higher resolution than the one that is used for bags belonging to Jewish passengers. The discrimination of passengers is visibly seen by the tagging system of stickers put on the passengers' passports, thus publicly identifying each passenger with different level of risk (eds Zureik, Lyon & Abu-Laban 2011).

3.3 Air cargo profiling

Profiling of air cargo in the United States is conducted using the programs of 'known

consignor' and 'known shipper', which ensures that these entities have been approved by the regulated authorities to have the mandatory screening processes and secured supply chain (Bart 2010). Profiling of air cargo is also conducted in the European Union. The EC has initiated new regulations regarding cargo arriving to the continent from airports outside of the EU. An air operator wishing to transport goods to the European Union from a third country airport must first obtain ACC3 validation, which ensures proper standards of cargo screening and a secured supply chain. In addition, the EC differentiates cargo arriving from high risk countries. A list of high risk countries is not publicly published, but every ACC3 air operator gets relevant information about suspicious cargo on a 'need to know' basis, and must be physically screened in accordance to different screening standards (European Commission 2014). Once a shipment is categorized as a high risk cargo, the only mandatory check of it by the air operator is to screen it according to strict standards. In other words, technology screening plays the major roll or the risk mitigation resources (Macario et al. 2012).

Figure 2: Security procedures for air cargo and mail originating in airports outside of the EU as from 2014, adopted from Macario et al. 2012)



However, according to a former EL AL security expert, Amotz Brandes, air cargo profiling is conducted differently based on the Israeli approach. Brandes claims that EL AL conducts risk assessment on every single shipment with a special air cargo profiling technique. The specific air cargo profiling technique is not published due to classified security reasons. Nevertheless, Brandes indicates that for cargo profiling, the best tool for mitigating and preventing a terrorist threat is by questioning or inquiry (Airline Pilot 2007).

4. RISK ASSESSMENT PROFILING PROCEDURE FOR AIR CARGO SECURITY

4.1 Suspicious signs

This paper offers a RAPP for air cargo originating from both low risk and high risk countries. RAPP is based on the same principles and ideas from the Israeli passenger profiling procedure as explained in the previous chapter. However, the suspicious signs of RAPP ,shown in table 2, are taken from the United States Department of Homeland Security's own study regarding the failed 2010 plot to bomb a cargo plane using explosives concealed in printers.

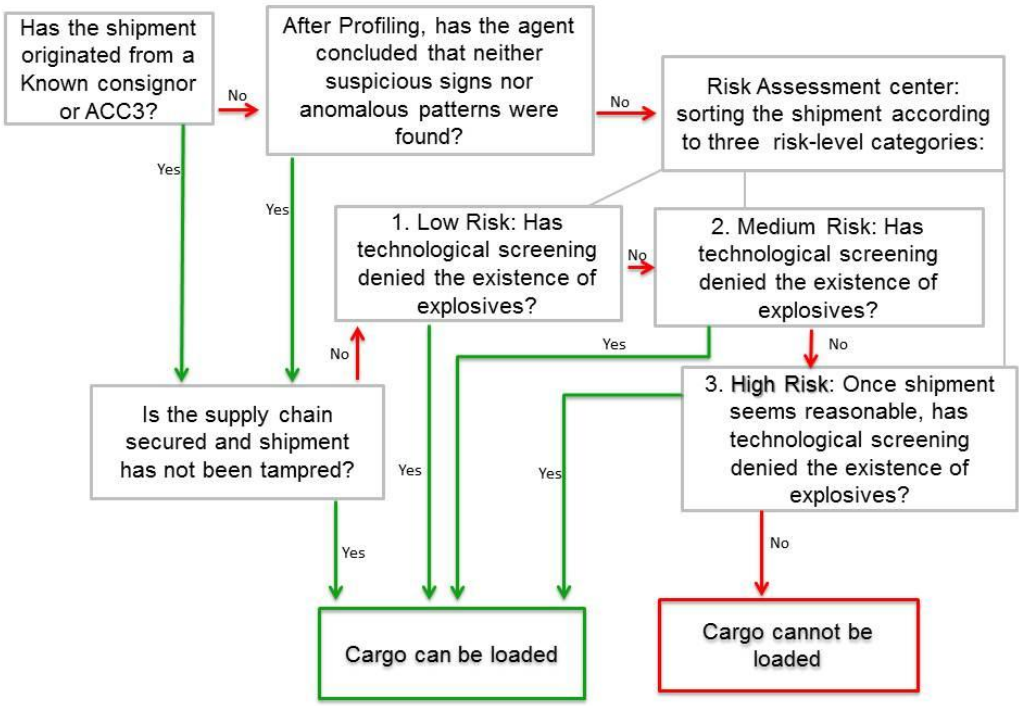
Table 2: Suspicious signs for air cargo profiling based on Department of Homeland Security (2010a)

Signs related to the physical characteristics of the package			
Unusual odors	Sealed with excessive tape	Lopsided or uneven shape	Indications of liquids/powder leaking from the package
Signs related to dispatching mistakes			
Poorly or illegibly typed or written addresses	Use of incorrect titles	Mailed with excessive postage	Addresses misspelled or containing only titles of recipient.
No return address			
Signs related to anomalous patterns			
Unexpected packages mailed from outside the United States		Restrictive markings destined for a specific, high-profile person	

4.2 Cargo originating from low risk countries

RAPP makes full use of the 'Known Shipper' programs and validated secured supply chains. RAPP suggests that every cargo shipment should be first filtered into two groups according to its country of origin – high risk vs. low risk countries. Figure 3 illustrates the security process of a cargo shipment originating from a low risk country.

Figure 3: RAPP for cargo shipments originating from low risk countries



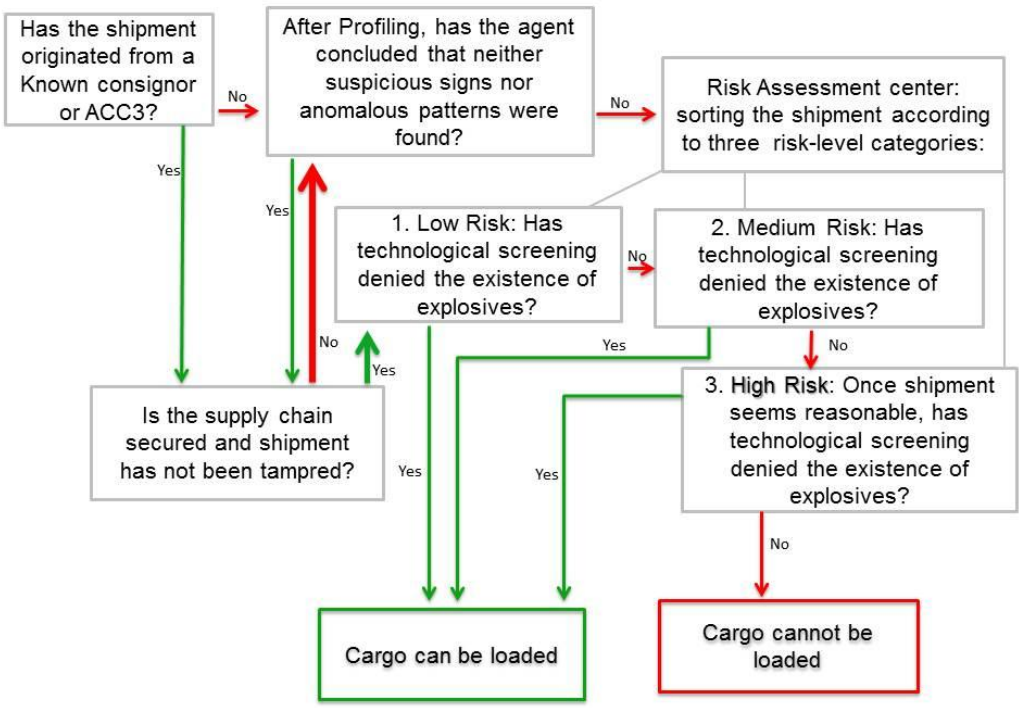
A cargo shipment can be exempted from any technological screening if it is originated from a low risk country by a known consignor or ACC3 validated air operator using a secured supply chain. If neither known consignor nor ACC3 apply, the cargo shipment must be profiled by an agent who looks for anomalous patterns and suspicious signs according to table 2. If the profiling ends successfully, the cargo can be loaded without technological screening once the course of the shipment (the supply chain) was secured. If the supply chain is not secured and / or if the profiling resulted in failure, the shipment must be further inspected according to risk assessment (by an agent) filtering the shipment into three risk categories: low risk, medium risk and high risk. For every level of risk, the technological resources intensify. A low risk shipment which was successfully screened can be loaded. If problems were detected, it becomes a medium risk category. Failure while screening the cargo shipment as a medium risk makes the shipment a high risk. Once a cargo

is categorized as high risk, an agent must determine if the shipment seems reasonable and logic. Once the agent did, the cargo must be technology screened, and if no explosives are detected, the shipment may be loaded. If problems are detected during the checks of a high risk category shipment, the shipment cannot be loaded. RAPP allows for less cargo shipments to be screened, which contributes saving time, money and manpower.

4.3 Cargo originating from high risk countries

Figure 4 illustrates the security process of a cargo shipment originating from a high risk country. This process is similar to the process above, with the obliged technology screening of every shipment even if it is originated from a known consignor or a validated ACC3 entity. In addition, risk assessment is mandatory if a cargo shipment has passed the profiling stage but its supply chain is proven not to be secured or if the shipment is tempered. However, according to RAPP, a tempered cargo is not a high risk cargo and it is checked according to the specific circumstances. High risk cargo is only attributed after a risk assessment has been completed or if the screening of a medium risk cargo fails.

Figure 4: RAPP for cargo shipments originating from high risk countries



RAPP makes sure that the technology is used smartly and in accordance to the risk assessment, in which the screener is aware of the security threat and uses the

technological tools properly to the level of threat. The Air cargo shipment that raises concern during profile is subjected to an additional inquiry and suspension just as it is done with passengers, whose security checks require them to undergo an additional questioning. The agent's main objective is to look for a terrorist method of operation by analyzing anomalous patterns.

4.4 Case study

RAPP can be challenged with the 2010 concealed printer plot to check its effectiveness. Giemulla, Rothe and Zielinski (2014) suggest the following regarding this plot:

1. The shipment was of two packages originated from Sanaa, Yemen, in 26.10.2010, and each contained a Hewlett Packard laser printer, books and souvenirs.
2. The terrorists used Semtex explosives, which were sophistically concealed inside the printers' toner together with the bomb mechanism. This had made the explosive very difficult to be detected. A question rises on whether the bomb could have been identified by standard screening.
3. The bombs were detected after a real time intelligence report had been given.

Homeland Security (2010b) report on the failed plot adds that:

4. The packages were shipped to likely fictitious individuals formerly associated with Jewish synagogues in Chicago, Illinois.

Assuming Yemen is a high risk country, the printer shipment would have been checked according to figure 4. The shipment was not originated from a known consignor or from an ACC3. In retrospect, the suspicious sign of 'Unexpected packages mailed from outside the United States' might have been detected if an agent had tried to contact the addressee. This sign would have led the agent to determine a risk category. The agents would have realized that sending a printer, books and souvenirs to a Jewish synagogue is likely unexpected and follows an anomalous pattern. This finding would have categorized the unreasonable shipment as a high risk cargo shipment. The shipment might have been halted with no further screening and denied from being transported. In retrospect, RAPP could have increased the chances of stopping the plot with no technology involved, regardless of intelligence agency's real-time assistance. The combination of the human factor and

technology is the core advantage of RAPP. Technological tools are smartly used after a human agent asses the risk and determines the terrorist method of operation.

5. CONCLUSION

The vulnerability of securing air cargo shipments makes it an easy target for terrorists. Technology plays a major role in the security process of air cargo shipments worldwide and new regulations have been ruled by governments in order to address the threat facing from air cargo terrorist attacks to shipments.

The paper introduces the Risk Assessment Profiling Procedure (RAPP) for air cargo security, which is based on principles taken from the Israeli passenger profiling method. RAPP maximizes the role of the human factor in the security process of air cargo and uses the current technological resources smartly. According to RAPP, after passing the profiling stage and as long as the supply chain is secured, cargo shipments, which originated from low risk countries can be exempted from technological screening whether or not the consignor is a 'known consignor' or certified as an ACC3. Shipments originated from high risk countries, however, are subjected to technological screening only after a risk assessment has been completed. The purpose of the risk assessment is to track the terrorist method of operation and to allocate the right tools for addressing the threat. In retrospect, RAPP could have successfully stopped the plot of 2010 to bomb explosives concealed printers originated from Yemen.

The authors believe that human factor and technology complements each other. RAPP allows the authorities to focus more energy on the suspicious cargo shipments and makes the security process more efficient by less screening. In addition, by applying RAPP, the industry becomes more active against continuous threats by terrorist and acts instead or reacts to security threats.

Future studies of this topic should focus on operations and business aspects. It is important to research how likely it would be to implement RAPP on a large scale for cargo shipments of different origins, and what economic consequences RAPP would have on the industry.

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AN INVESTIGATION OF THE UNITED STATES AIRLINE PILOT LABOUR SUPPLY

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ABSTRACT

Over the next 20 years, the United States airline industry is expected to hire in excess of 95,000 pilots. This hiring will be the result of new aircraft growth, pilot retirements, and pilot attrition from the industry for reasons other than retirement. In addition, government regulations may also cause an increase in the number of new pilots required. Given this increased demand, will there be enough new pilots to ensure a long-term and continuous supply? The purpose of this research is to examine the supply and demand for US airline pilots. Several new considerations are having an impact on future supply and demand of airline pilots including cost of training, growth, retirement, regulatory changes, and slowing supply of military pilots. The methodology provides an empirical analysis of the pilot labor supply in the US. A multivariate regression model was developed to forecast demand. To explore supply, a variety of data sources have been included and a survey was implemented. The results of the study indicate that the US airline industry will experience a shortage of approximately 35,000 pilots for the 2013 to 2031 time period. The impact of the shortage on regional and major airlines is examined. Possible solutions are discussed.

Keywords: Pilot supply forecast, international pilot hiring, pilot shortage, cost of flight training, major airline hiring

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1. INTRODUCTION

The United States airline industry is estimated to contribute $1.3 trillion to the national economy, 5.2% to the country's Gross Domestic Product (GDP), and around 376,000 jobs to the nation's workforce (FAA, August 2011). The industry faces many dynamic and well-documented challenges, including high fuel prices, occasionally contemptuous labor disputes, and sensitivity to general economic conditions. While these issues may be well-known, obtaining adequate staffing levels amongst employee groups has been the source of both historical and recent speculation. Specifically, the availability of properly trained and qualified pilots has garnered recent interest.

Will the United States airline industry have enough qualified pilots to appropriately staff its aircraft? Several recent forecast efforts have attempted to quantify both the future pilot demand as well as training capacity. When taken in their totality, every forecast indicates there will be an increased worldwide demand for commercial airline pilots. The purpose of this research initiative is to answer a simple question: will the United States experience a future pilot shortage?

Future pilot demand is generated from three different events: industry growth, retirements, and attrition for reasons other than retirement. On the supply side, future airline pilots are created from both civilian and military sources. Historically, the airline industry in the United States has generally been able to find enough qualified pilots from these two areas. Given this historically balanced relationship has existed in an equilibrium for years, what, if anything, has changed?

Current retirement data indicates that over 45,000 pilots will retire from major airlines over the next 20 years. Given there are currently an estimated 18,000 regional pilots, it doesn't take an elaborate mathematical analysis to conclude that unless a large number of new pilots enter the workforce in the coming years, the industry faces a critical shortage.

The situation appears to have been complicated by the introduction of several new rules. In particular, Congress passed Public Law 111-216 which mandates, among other requirements, that pilots who operate at an airline would be required to have 1,500 hours (2010). In addition, the Federal Aviation Administration has also instituted new flight-time and duty-time rules. It is important to note the purpose of this study is not to evaluate the efficacy of any newly-mandated rules or laws; rather,

the purpose is to evaluate their effects, if any, on the pilot supply.

In the media there has been much written and debated about the possible pending pilot shortage (Kaufman, 2012, Carey, Nicas, Pastzor, 2102, O'Connor, 2012). It begs the question, what is meant by "pilot shortage?" Does pilot shortage refer to a situation where the lack of available qualified pilots results in operational disruptions such as changes in schedule or reduction of flights? Using this definition, the last pilot shortage occurred in the 1960s (Carey, Nicas, Pastzor, 2012). In this era it was noted that thousands of hours of flights by major airlines had to be cancelled and operations adjusted due to the unavailability of qualified pilots to hire (Simmons, 1969). There are indications this is occurring again now. In the Fall of 2013, Great Lakes Airlines in the US Midwest, has cancelled nearly two dozen flights, attributing the cause to lack of pilots (eTN, 2013)

Or, does pilot shortage mean a lowering of hiring requirements to dip in to the next wave of applicants who, of course, still meet FAA requirements but are not at the top of the flight experience hierarchy? There is evidence to support this was the case at the regional carriers in the most recent hiring wave of 2007 and 2008. Atlantic Southeast Airlines lowered its hiring minimums twice in six months during that period. At that carrier, average hours of pilots in new hire classes dropped from 1,200 total time with 200 hours of multi-engine time to 800 hours total time and 50 hours of multi-engine time. (Lunan, 2007, Robertson, 2009)

Another consideration is that the industry may be facing a hiring wave versus an actual pilot shortage. Numerous hiring waves have existed in the past. Key periods of hiring include the mid to late 60s, 1990 and into 1991, late 90s into 2001, and the 2006 to 2008 time frame (Simmons, 1969: FAPA 2012). Ultimately, these waves came to a grinding halt due to circumstances in the operating environment, which reduced the demand for pilots. Often these circumstances are beyond the control of the operators. For example, one can argue that key factors leading to the decline of hiring waves include economic factors such as the price of oil and the state of the economy; political events such as the Gulf War and Iraq War; natural disasters such as hurricanes and tsunamis; and aviation events such as the attacks of 9/11. Major aviation accidents and other aviation factors such as safety concerns and regulatory changes also may play a role. Of course these events cannot be examined individually but often occur simultaneously creating a perfect storm to slow the demand for pilots.

Numerous factors appear to be coming together that will create a significant demand resulting in a hiring wave at the least and possibly a shortage of qualified pilots. The current pilot workforce is experiencing a wave of retirements as the 2007 Fair Treatment and Experienced Pilots Act is now impacting many pilots reaching age 65. Costs for aviation training are on the rise. Regulatory changes in the areas of fatigue related work rules and changing qualifications for airline first officers will increase the need for pilots. International aviation is growing quickly and may result in the hiring of pilots from the US (Jones, 2011). The military supply of pilots has slowed (Lynch, 2012). Those who are trained in the military are staying in the military longer (Jones, 2013).

Clearly, an empirical analysis of the United States future pilot labor supply is warranted. If there are future conditions which could lead to pilot shortages, the nation's economic conditions could be negatively impacted. Given the reach of the industry, the impact could be serious and cause widespread negative disruptions throughout the country.

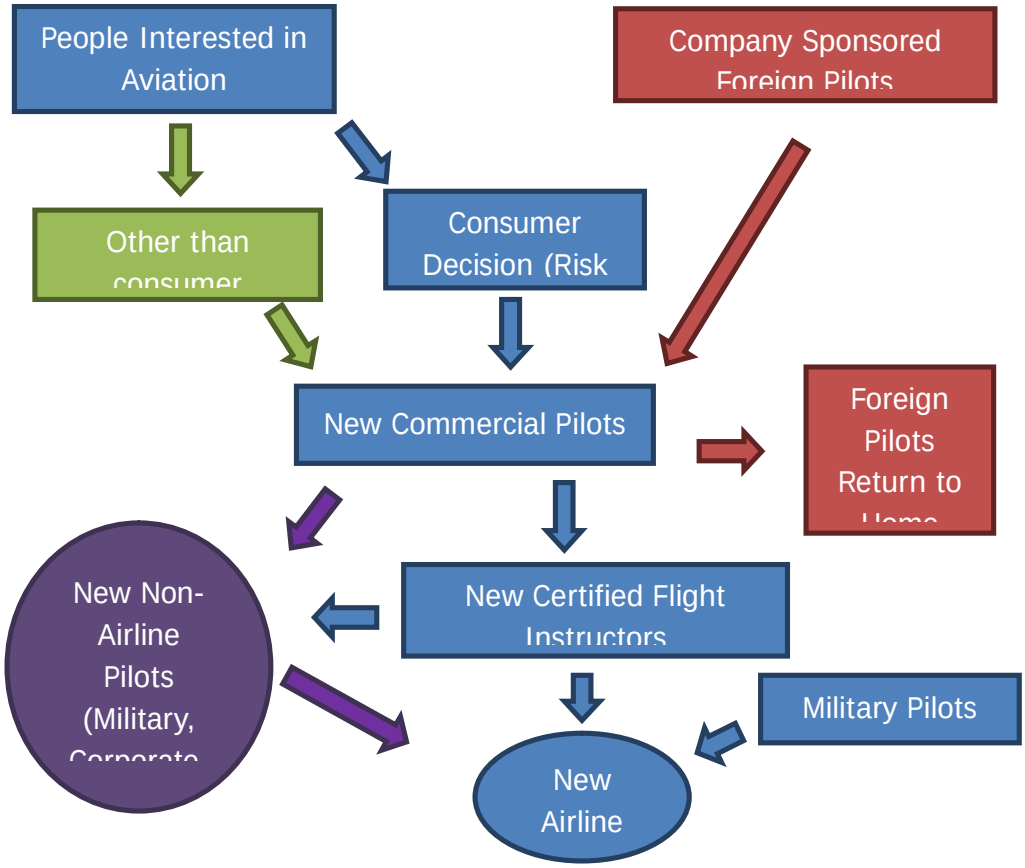
This forecast assumes that when there are short-term disruptions in the supply of new pilots, the industry and regulators will not react. Of course, this is unlikely, as scarcity of required labor will most certainly cause individual airlines to react, and could cause a reexamination of the current regulatory environment. Some examples of this reaction from an industry view could include signing bonuses, scholarships for flight training, pathway programs which outline a clear path to a major airline job, and/or increased wages. It is important to note that, at present, no correlation has been found linking these factors to new pilots, but unless the pilot labor market follows fundamentals which are different from other industries, there likely is a relationship yet to be identified. It should also be noted that the airlines may find they have limited ability to react monetarily given they may be constrained by their current operational and market dynamics. The regulators could have a role to play and react by lessening some barriers in obtaining pilot certification. Any of these above measures would likely change the following analysis. Accordingly, this forecast should be viewed as a hypothetical, or a “what-if,” which details the effects of the continuation of current market forces without mitigation.

2. SUPPLY-SIDE: BACKGROUND

There are three pilot certificates that allow for employability — Commercial, Airline Transport Pilot (ATP), and Certified Flight Instructor (CFI). A pilot holding one of

these certification levels is able to be compensated for operating aircraft. As of August 2, 2013, pilots who are employed at part 121 air carriers are required to hold an ATP certificate. Current requirements needed to obtain the ATP will likely require several years of academic instruction and flight training. Figure 1 depicts the basic flow pilots follow on their way to the airlines.

Figure 1: Flow of Pilots to the Airlines



When examining the historical number of pilots holding each type of certificate, trends can be seen. Because the FAA tracks all active pilots—those that hold a current medical certificate—an actual census can be examined (FAA, 2012). Figures 2, 3, and 4 depict historical numbers of active CFI, commercial, and ATP certificates along with newly created pilots on a yearly basis, respectively. The typical path to the airlines for a civilian-trained pilot involves several steps. Most pilots begin with obtaining a private pilot certificate and then advance to a commercial certificate with a multi-engine rating. Most of these pilots also obtain a CFI which allows for them to obtain an entry-level flight position wherein they can obtain more flight time and experience. As part of this research project, over 1,600 collegiate aviators were surveyed as part of a Career Aspirations Survey (CAS) regarding their long-term

career plans. The results indicated that only 53.67% of CFI certificate holders have a long-term career plan of working at the airlines. While this variable has not been tracked longitudinally and only represents a snapshot of current opinion, it belies the notion that the vast majority of aspiring or recently-earned CFIs seek long-term major airline jobs.

Figure 2: Historical CFI Population

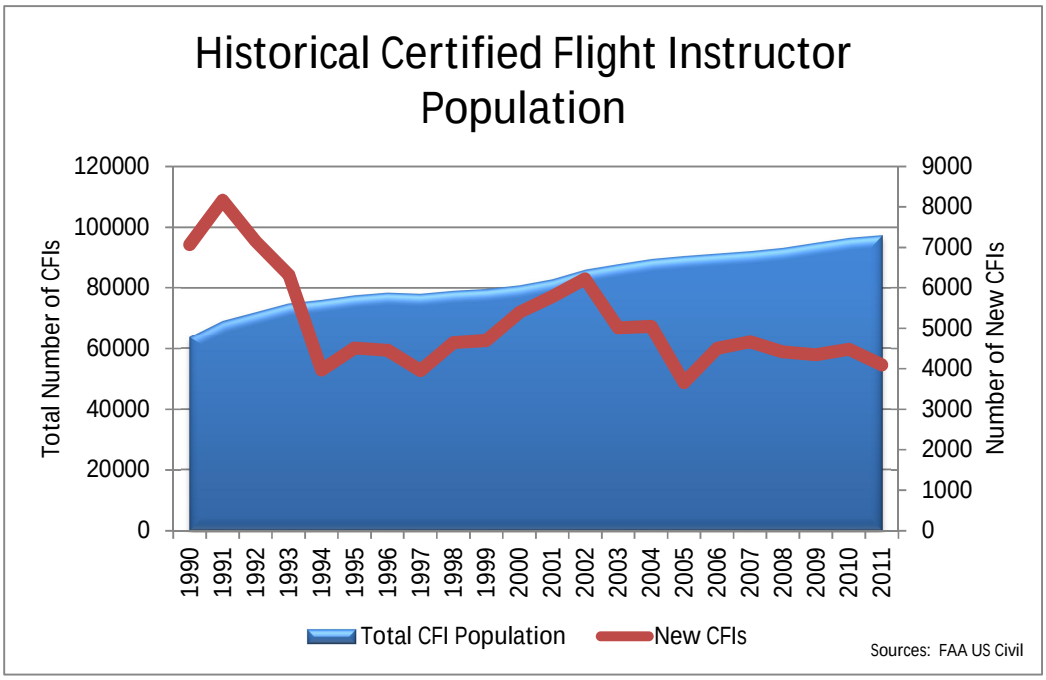


Figure 3: Historical Commercial Pilot Population

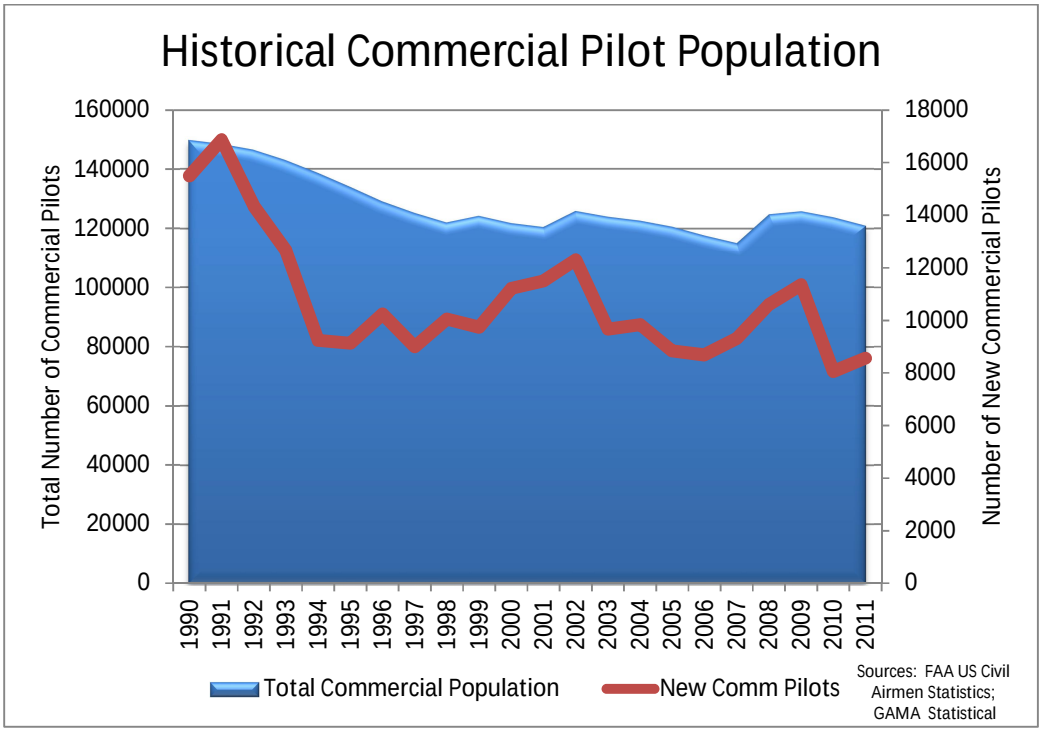
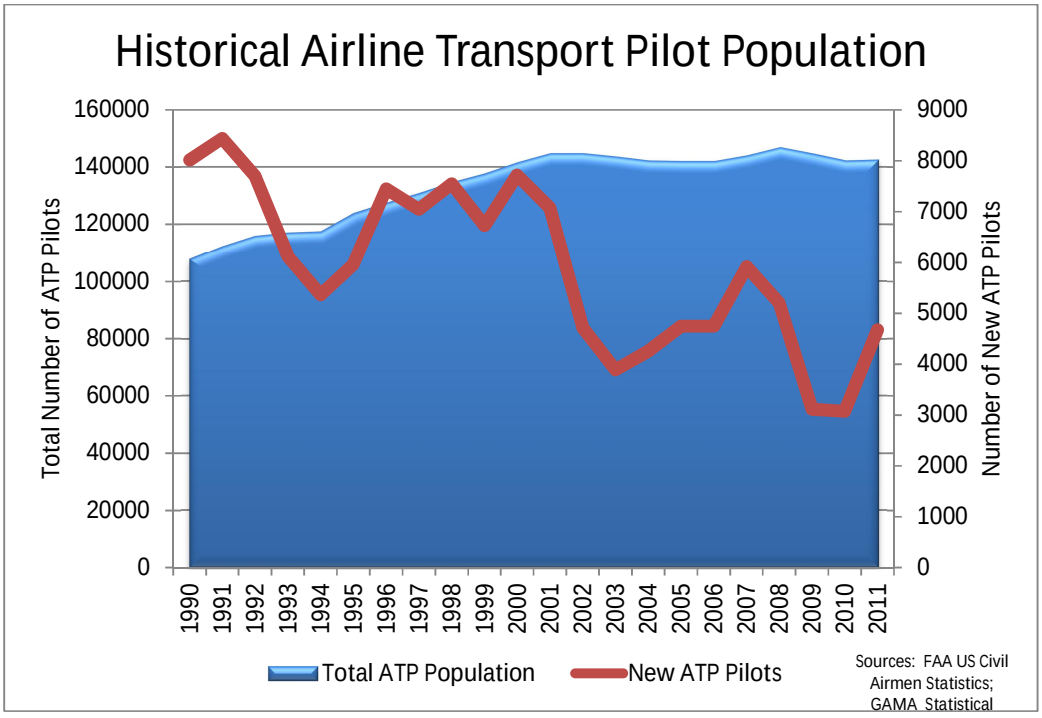


Figure 4: Historical ATP Population



3. THE FORECAST MODEL

3.1 Determination of the Outcome Variable

One complicated aspect involved with predicting the future airline pilot labor supply is identifying an appropriate outcome variable. In previous years, the number of new commercial pilots seemed to be a plausible candidate as a commercial certificate represented the basic unit of employability. The use of new commercial pilots is no longer a viable variable due to the following reasons:

1. An ATP certificate is now required to become employed at an airline.
2. A large number of foreign pilots are now training in the United States. These pilots will obtain their commercial certificates yet have no intention of working as commercial pilots in the United States.

Because of Public Law 111-216, an ATP certificate is required to be employed at an airline. Accordingly, pilots will have to accumulate enough flight time to become eligible to obtain this certification. According to data collected in the 2010 Pilot Source Study, 85.2% of civilian-trained ATP pilots hired at the airlines held a CFI certificate at some point in their career (Smith et al, 2010). It is important to note this percentage has occurred prior to the enacting of the Public Law; accordingly, given the increased hour requirements needed in the future, even more pilots seeking employment at airlines will likely have to obtain CFI certification. This theme

was further identified qualitatively in the CAS.

There has been a sharp increase in the training of foreign pilots in the United States. Using data supplied by the FAA's certification branch, in 2004, for every 4.80 pilots with United States citizenship training for their commercial pilot certificate, there was one foreign pilot training in the United States. In 2012, that ratio changed to 1.19 to 1 (1.19 U.S. pilots for every one foreign pilot). This data is encapsulated in Figure 5, which depicts the number of pilots, based upon citizenship, completing the commercial pilot written/knowledge tests by year. For the periods from 2009-2011, the percentage of commercial written tests completed by foreign pilots has hovered above 40%. In 2012, this percentage jumps to around 45%. The number of pilots completing their commercial written is significantly correlated to new commercial pilots the following year, $R^2 = .52, F(1,7) = 7.67, p = .03$.

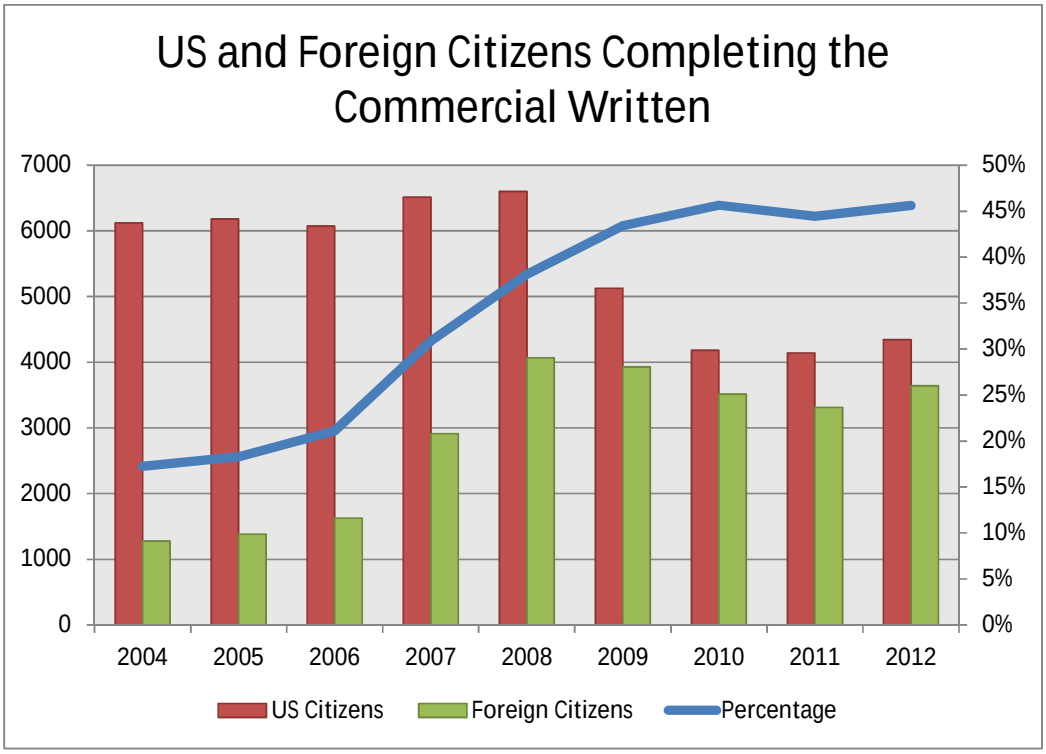
The authors of this study note that the training of foreign pilots in the United States is not a negative happening; moreover, these pilots provide for opportunities for United States CFIs to obtain flight experience. In addition, from an economic point of view, this training represents a national export-surplus. In terms of impact to using new commercial pilots as an outcome variable for a pilot supply study however, given their proportion of impact to new commercial pilot numbers, the presence of foreign-training confounds the use of commercial pilots as an outcome variable.
For the aforementioned reasons, this study uses the creation of new CFIs as the outcome variable. This outcome variable recognizes that the vast majority of civilian ATPs (presently over 85%) have been a flight instructor at some point in the career and that this percentage will increase given the new ATP-airline requirements. This outcome variable also successfully deals with the confounding issue of foreign-pilot training, as a relatively small number of foreign-trained pilots will require or seek CFI certification in the United States.[2]

Another important aspect considered when selecting newly created CFIs (NCFI) is that it can take several years from the time a pilot starts their initial training until they achieve CFI certification. Further complicating this fact is that while the NCFI data is tracked by the year, some pilots can complete their CFI training in a year, and

[2] According to recent CFI written test data, from 2004 to 2012, an average of 10.68% of CFI written examinations were completed by foreign pilots.

some may take several years[3]. This part of the variable is difficult to track and measure. Because of this difficulty, the determination of length of time it takes to obtain certification can be determined using a *post hoc* determination of model fit. This *post hoc* method will be discussed in further detail, but through multiple model builds, the largest significant R^2 values were found when the outcome variable included a mixture of new CFIs of 5% in two years, 25% in three years, and 70% in four years. This study uses this "mixture" as a weighted yearly average and is used as the outcome variable in this study.

Figure 5: Commercial Pilot Written Examinations by Citizenship



3.2 Determination of Predictor Variables

When attempting to predict the future supply of airline pilots in the United States, there are several candidate predictor variables, which could be descriptive. In 2009, researchers at the University of North Dakota attempted to identify useful predictors. Among the list of potential predictor variables included: starting pay at regional airlines, high school student interest in aviation careers, prestige of being an airline pilot, job satisfaction of being an airline pilot, the cost of flight training, hiring at the

[3] Some pilots may train in a collegiate environment where it can take 3-4 years on average to obtain CFI certification, and some pilots might achieve CFI certification from an *ab initio* environment.

airlines, and hiring at major airlines.

Several of these potential data sources were eliminated because there was no useful historical data source. The historical data is needed to determine whether there is a predictive correlation between newly created CFIs and the metrics of the predictive variable. Some predictor variables had valid historical data, but no correlational relationship between newly created CFIs was demonstrable. Table 1 lists the potential predictor variable, potential data sources, and the disposition for use as a predictor.

Table 1: Candidate Predictor Variables, Data Sources, and Disposition

Candidate Predictor	Potential Data Source(s)	Disposition
Starting pay at regional airlines	Airlinepilotcentral.com; UND Contracts Database	No relationship found
High school student interest in aviation careers	National Research Center for College and University Admissions (NRCCUA)	No relationship found
Prestige of being an airline pilot	General Social Survey (GSS); Gallup	No meaningful historical data source found
Job satisfaction of being an airline pilot	General Social Survey (GSS)	No meaningful historical data source found
Cost of flight training	Aircraft Owners and Pilots Association (AOPA); University Aviation Association (UAA)	Relationship found in model
Hiring at major airlines	Future and Active Pilot Advisors (FAPA)	Relationship found in model

From the predictors in Table 1, two variables showed relationships with the future creation of CFIs. The first variable is Major Airline Hiring (MAH). Figure 6, generated from data gathered from Future and Active Pilot Advisors (FAPA), shows historical hiring at major airlines. FAPA's data starts in 1989 and continues through present day. Table 2 lists the major airlines tracked by FAPA. Many of these carriers have merged or ceased to exist, but still prove useful when examining the efficacy of MAH as a predictor.

A regression was conducted with MAH versus NCFI. A significant relationship was found, $\beta = .78$, $t(18) = 5.06$, $p < .001$. MAH also explained a significant proportion of variance in NCFI, *adj.* $R^2 = .60$, $F(1, 17) = 25.60$, $p < .001$. Figure 7 depicts the regression scatterplot of this relationship. The regression is expressed as Y = .42X + 3789.87, where Y = NCFI and X = MAH.

Figure 6: Historical Hiring of Pilots at Major Airlines

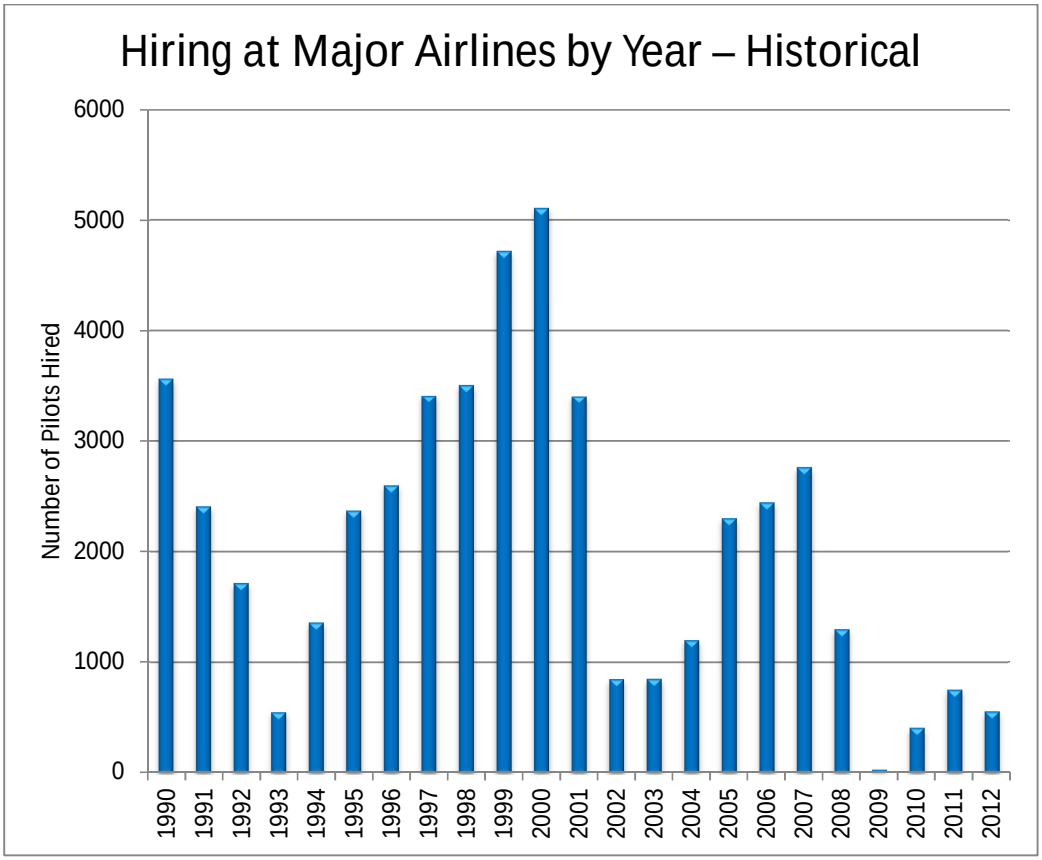


Table 2: Major Airlines Tracked by FAPA

Major Airlines Tracked by FAPA	
ABX Air	FedEx
AirTran Airways	JetBlue
Alaska Airlines	Northwest
America West	Southwest Airlines
American Airlines	United Airlines
ATA	UPS
Continental Airlines	US Airways
Delta Air Lines	

The other predictor variable from Table 1 which indicated a relationship with NCFI is Cost of Flight Training (CFT). Using data collected from the University Aviation Association (UAA) member schools, the average cost of private pilot certification (initial flight training) was $4,270 in 1990 (adjusted to 2012 dollars) and rose to $9,476 in 2012. This cost is just for the initial certification. Figure 8 depicts the historical CFT adjusted for inflation along with the percent change in cost year-over-year. It should be noted that data was collected by the UAA in 4-5 year periods, and intermediate points were straight-line interpolated. From 1990 to present, inflation, as measured by the Consumer Price Index (CPI) and tracked by the Bureau of Labor Statistics (BLS), grew at a 2.8% annual rate. CFT grew an average of 3.9% during

that same period, which demonstrates that CFT is growing faster than inflation.

Figure 7: MAH vs. NCFI

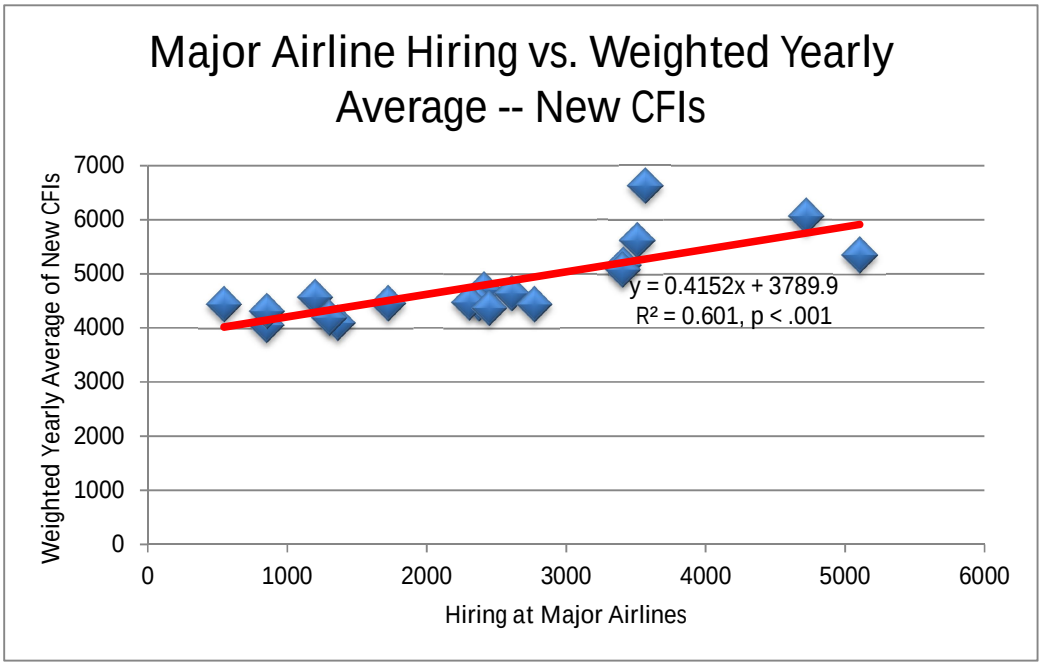
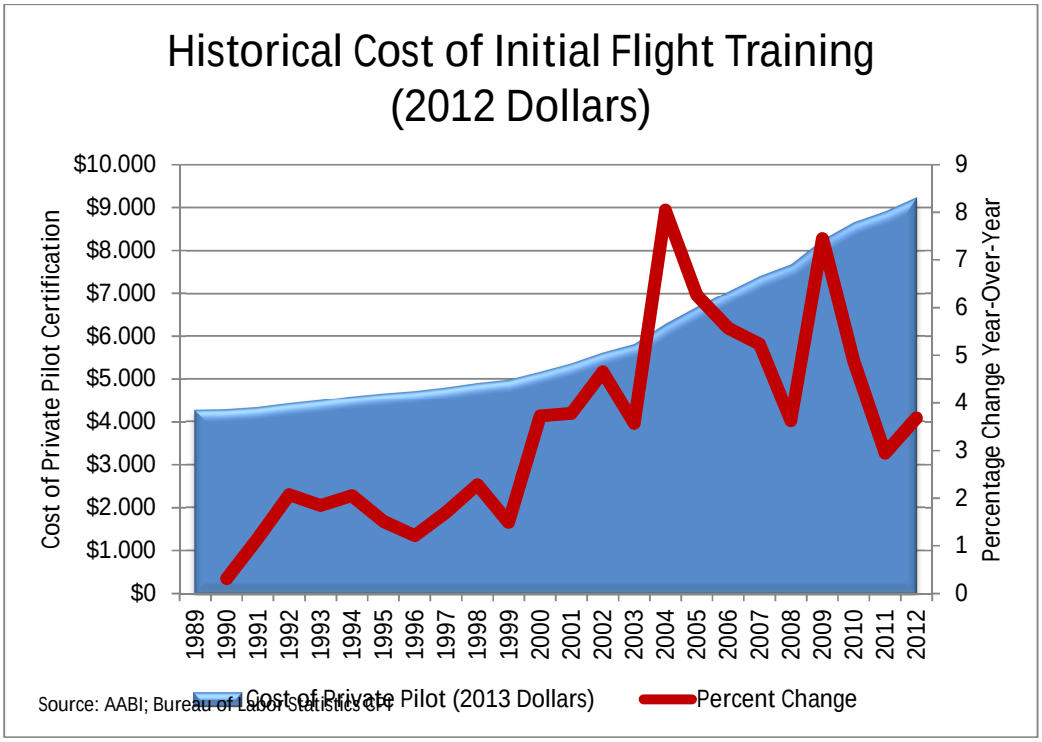


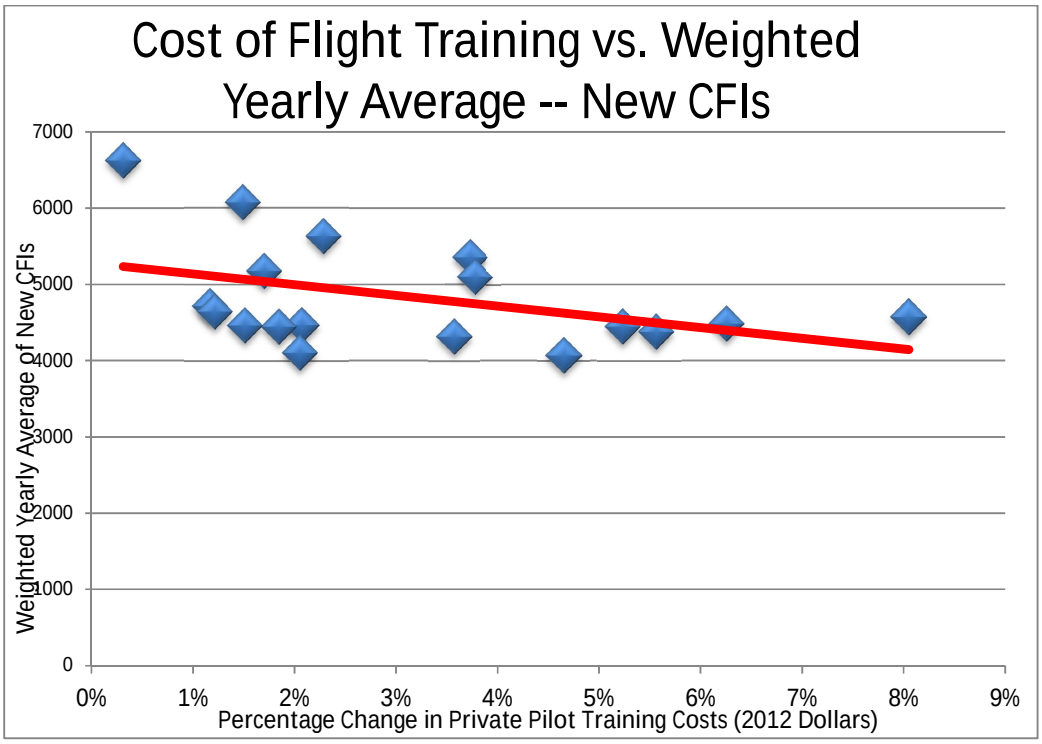
Figure 8: Historical CFT



A regression was conducted with CFT versus NCFI. A significant relationship was not found, β = -.43, $t(18)$ = -1.95.06, p = .068. CFT did not singularly explain a significant proportion of variance in NCFI, *adj.* R^2 = .18, $F(1, 17)$ = 3.81, p = .068.

Figure 9 depicts the regression scatterplot of these two variables. While the regression for CFT was not significant, its p value of .068 makes it a candidate for use in a multivariate regression model. This variable can also be measured for moderation effects, if any, on MAH.

Figure 9: CFT vs. NCFI



3.3 Building the Multivariate Model

Because MAH was singularly significant, and because CFT approached significance, a multivariate model may appropriately be able to better explain the overall relationship, if any, between all three variables (MAH, CFT, and NCFI). In addition, the relationship can be probed for interactive effects between the predictors to possibly increase the predictive power of the model.

Interactive regression involving multiple variables is similar to a factorial Analysis of Variance (ANOVA), except the continuous nature of the predictor variables can be maintained. One issue that sometimes surfaces in interactive regression is the problem of multicollinearity — a condition where one or more predictor variables are highly correlated with the interactive term. As indicated in several texts on the subject (Jaccard & Turrisi, 2003; Franzese & Kam, 2007; among others), the problem of multicollinearity is avoided by centering the predictors. Centering is accomplished by transforming each variable by subtracting the actual score from its distribution mean.

Another way to envision an interactive model is to examine whether one predictor moderates another predictor's overall effect on the outcome variable. In this case, MAH was seen as singularly significant. An interesting question is: does CFT moderate MAH's effect on NCFI?

One limitation of the data set is the sample size is limited to 19. This is due to data only being available on an annual basis and only from 1990 onward. The limited size is further narrowed because NCFI is spread out over four years (2013 - 4 years = 2009). The limited sample size also precluded other statistical techniques such as Vector Auto Regression (VAR), which may have also been helpful in demonstrating a relationship. Of course, a limited sample size affects the power of the model. Having an n=19 equates to only being able to detect large effect sizes. An *a priori* power analysis indicated that a sample size of 19 had a reasonable expectation of detecting an effect size of around .8.

A simultaneous stepwise multivariate regression was conducted with three predictors, MAH, CFT, and MAH * CFT (interaction of MAH and CFT) and a single outcome variable, NCFI. MAH, CFT, and the interaction of MAH and CFT significantly predicted NCFI, adjusted R^2 = .774, F(3, 15) = 21.55, p < .001. In addition, each of the three predictors indicated individual significance: MAH, β = .58, t(18) = 4.74, p < .001; CFT, β = -.25, t(18) = 12.16, p = .003; MAH*CFT, β = -.42, t(18) = -3.52, p = .047 (Figure 10).

The regression equation is given by:

$$Y = .31X - 84.60Z - .14XZ + 4593.78$$

Where:

y = Future Certified Flight Instructors over the next 3 years;

x = Number of pilots hired at major airlines;

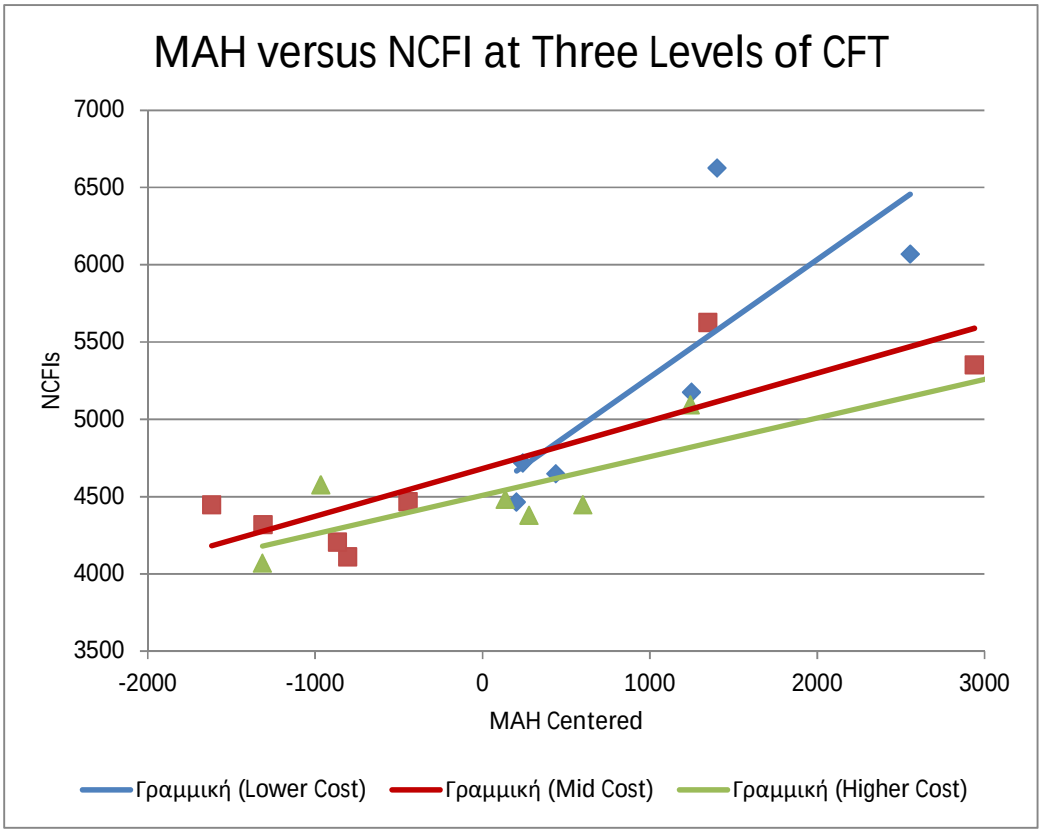
z = Percent change in cost of obtaining Private Pilot certification (adjusted for inflation).

Figure 10: Coefficients and Significance of Individual Predictors

	β	t	p
MAH	.58	4.74	.001
CFT	-.25	12.16	.003
MAH * CFT	-.42	-3.52	.047

In order to examine the moderation effect of CFT on MAH, Figure 11 depicts the various slopes of MAH regressed against NCFI at three different levels of CFT. The interactive effect is demonstrated by the differing slopes across the levels of CFT. From these slopes, CFT moderates MAH by increasing NCFI at a faster rate than at the two higher CFT levels.

Figure 11: MAH versus NCFI at Three Levels of CFT



Due to the centering of all predictor variables, multicollinearity was avoided in the regression as indicated by all tolerances (MAH at.84, CFT at .90, MAH * CFT at .93) being greater than .1 and all Variable Inflation Factors (VIFs) near 1 (MAH at 1.19, CFT at 1.07, MAH * CFT at 1.11). In addition, the lowest eigenvalue noted is .56 which further indicates avoidance of multicollinearity issues.

While this model predicts that for every pilot hired at a major airline there is .31 new CFIs created over the next 4 years. In addition, for every percent increase in the cost of initial flight training, there is a loss of 84.6 new CFIs over the next 4 years. According to Tracz (1992), causation can be demonstrated if three elements are present: temporal order, existence of correlation, and control of other causes. Given the significance of the model, the large overall R^2 value, and the temporal nature (MAH and CFT occur years before NCFI), this model may demonstrate causation.

It is possible the MAH variable is behaving in an exogenous capacity and is masking a more latent underlying relationship. For example, MAH could actually represent the higher wages and/or work rules associated with employment at a major airline. While this could be construed as a "substitution effect," the underlying premise remains. Whether MAH is a surrogate for increased wages or not, the model demonstrates a stimulation of new pilots whenever hiring occurs at major airlines. The impact of whether this is part of a larger substitution effect will more likely influence overall industry reaction and mitigation initiatives, rather than the identified relationship itself. Although the available dataset is limited by annualized data, a possible measurement of the impact (if any) of concessionary and growth labour contracts at MAH carriers could be examined to determine if MAH was impacted. If so, the substitution effect concept would become stronger and deserving of more investigation.

Given causation and the prevailing substitution accommodation of MAH (if necessary), this model demonstrates that 77.4% of people considering entering the aviation industry make a consumer decision. At its core, this decision is based upon a risk-reward paradigm. The risk is encapsulated by CFT (due to the fact that most people have to self-fund their own training). The reward is represented by MAH. In essence, a potential future commercial pilot evaluates the cost they will incur (risk) against the potential for getting hired at a major airline (reward).

4. DEMAND SIDE: USING THE MODEL TO FORECAST FUTURE SUPPLY

In order to determine the future number of NCFI going forward, a separate forecast must be made for the two predictors—MAH and CFT. Future MAH is dependent upon three factors: growth of an airline, pilot retirements, and attrition for reasons other than retirement. Figure 12 outlines the flow of staffing on the demand-side.

4.1 Future Hiring at Major Airlines

For every airline operating aircraft, there is a corresponding staffing ratio of required pilots. For example, at American Airlines, they operate 618 aircraft and have 8,481 pilots (airlinepilotcentral.com, 2013); this yields a staffing ratio of 13.72 pilots per aircraft. These staffing ratios can be determined for each airline. Table 3 lists each of the airlines that comprise MAH (or their consolidated surviving carriers) and their corresponding staffing ratios. The aggregated weighted staffing ratio for all the passenger MAH carriers is 14.44 and for the MAH cargo carriers 12.37.

Figure 12: Outline of Pilot-Staffing Needs.

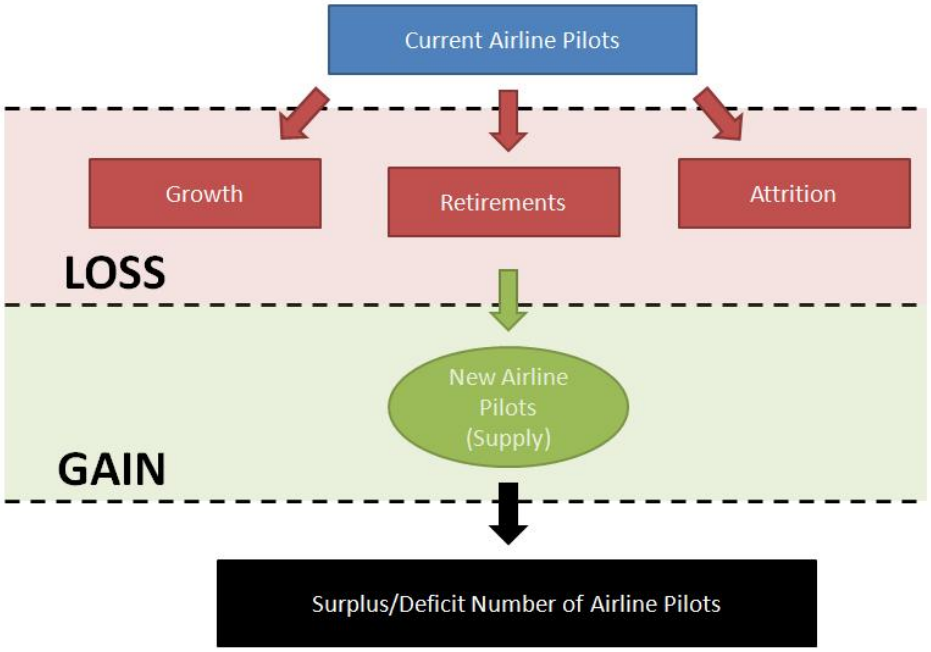


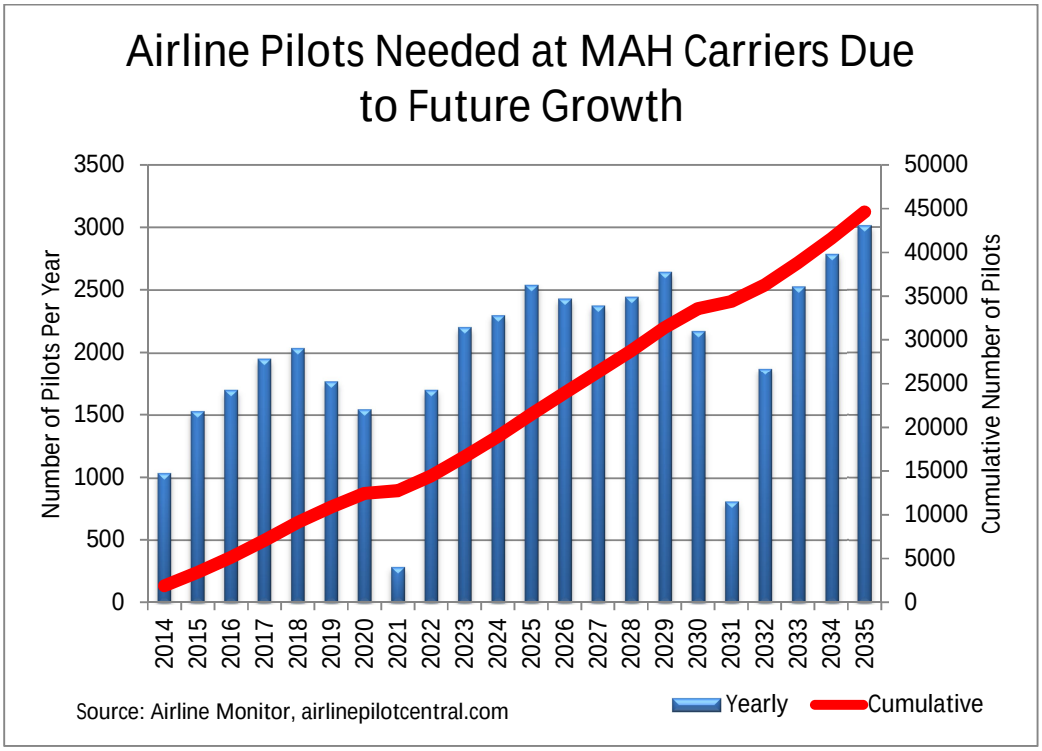
Table 3: Staffing Ratios for MAH Carriers.

	Number Pilots	Number Aircraft	Ratio
Alaska	1472	120	12.26667
American	8481	618	13.72330
Delta	11770	720	16.34722
United	11005	705	15.60993
US Airways	5085	346	14.69653
AirTran	1526	129	11.82946
JetBlue	2377	180	13.20556
Southwest	6327	565	11.19823
ABX	460	35	13.14286
FedEx	4541	351	12.93732
UPS	2573	229	11.23581

The number of new pilots needed for growth can be calculated by multiplying the weighted staffing ratios by the number of future aircraft. There are a few forecasts that predict the future number of airline-utilized aircraft. The FAA publishes a publicly-available annual forecast which projects the number of aircraft expected to be in service several years into the future. The Airline Monitor is a commercially-available aircraft forecast used by financial companies and other businesses reliant upon forecast information for strategic planning purposes. Given that the Airline Monitor has more of a business focus, this study made an *a priori* determination to

utilize this forecast for future aircraft growth. Figure 13 indicates the number of pilots who will be needed by the MAH carriers.

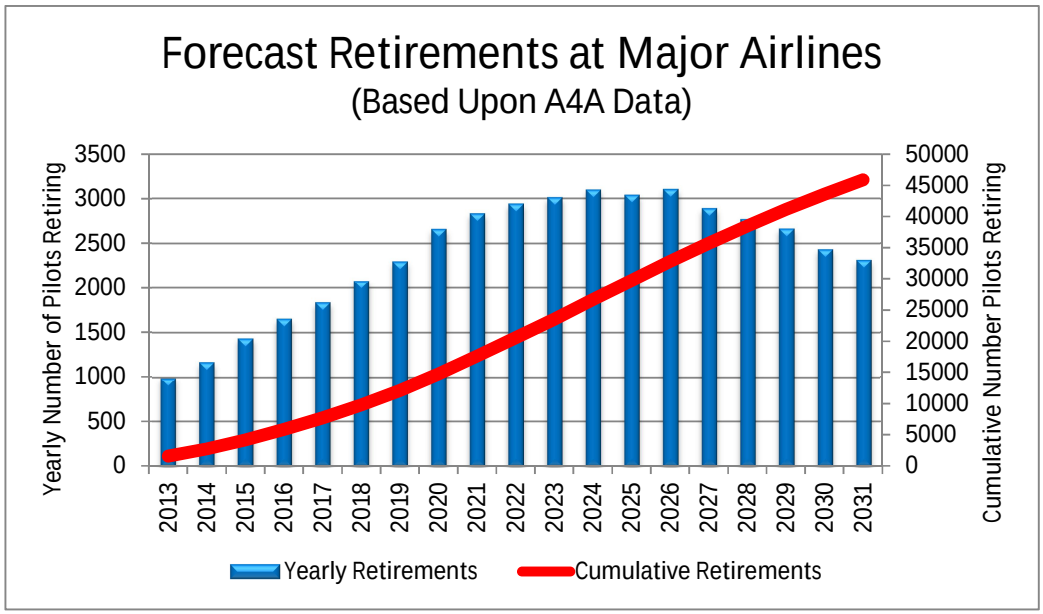
Figure 13: Pilots Needed at MAH Carriers due to Growth



Retirements at major airlines are easily predictable given that all airline pilots must retire by the time they reach 65 years of age. Not all pilots make it to the age of 65 because they become medically disqualified prior to reaching that age. It is unclear what percentage of pilots actually make it to age 65, so this forecast makes the assumption that all pilots make it to full retirement age. Figure 14 indicates projected retirements at the major airlines from 2013 to 2031.

Airline pilots may leave their professions for reasons other than retirement. Examples of this attrition could include loss of medical certification, separation from employment (furloughs, voluntary layoffs, terminations, etc.), or a personal decision to change careers. Determining this rate historically is difficult. An examination of the entire population of both commercial pilot and ATP certificate holders adjusted for new pilots created and retirements can help determine this level in retrospect. The problem with this approach is the combined population of commercial pilot and ATP certificate holders are obviously not all major airline pilots. Using the data from Table 3, the population of the major airline pilots (MAH carriers used) is 55,617.

Figure 14: Forecast Retirements at Major Airlines



This figure can be used as a numerator over the combined commercial pilot and ATP certificate holders (263,376) as a denominator. This metric, calculated at 21.12%, was used as a percentage estimate of the number of pilots who fly for major airlines. Figure 15 indicates a historical year-by-year calculation of attrition for reasons other than retirement at the major airlines. The historical average attrition rate at the major airlines was calculated to be 1.52%.

Figure 15: Historical Rate of Attrition for Reasons Other than Retirement

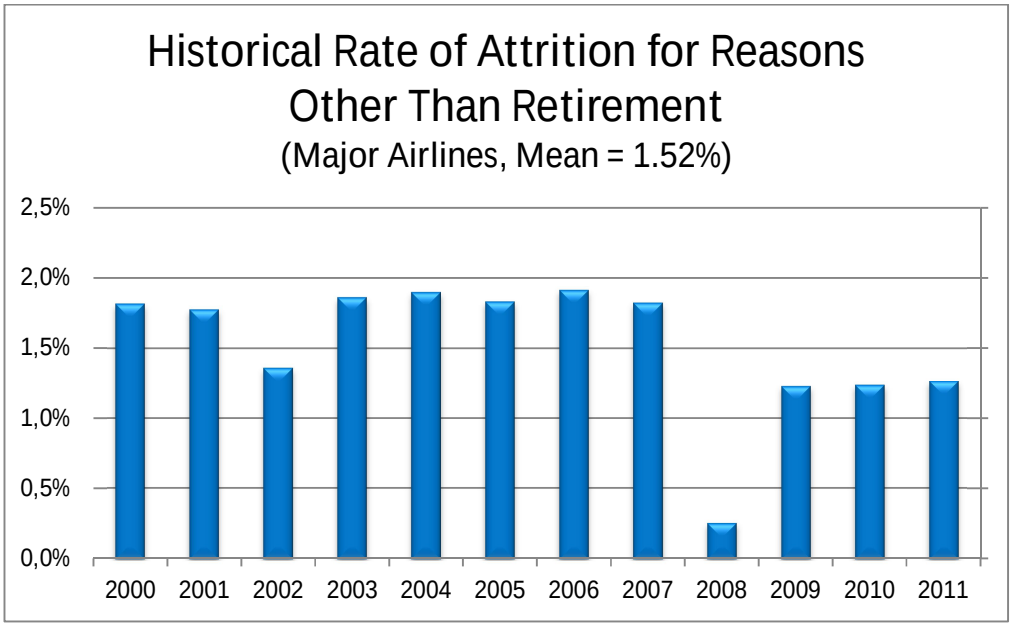
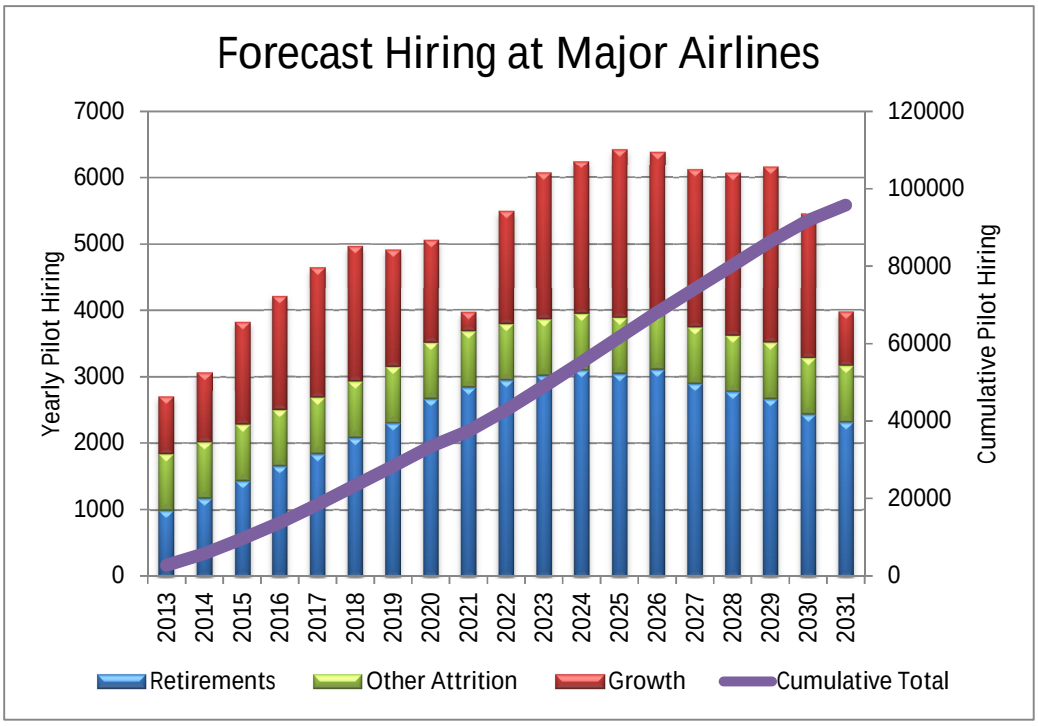


Figure 16 depicts the forecast hiring at major airlines. These figures were derived

from the sum of new pilots needed for growth (Figure 12), new pilots needed because of retirements (Figure 14), and using the historical other attrition rate of 1.52% (Figure 15). In the period from 2013 through the end of 2031 it is predicted that major airlines will hire 95,790 pilots.

Figure 16: Forecast Hiring at Major Airlines



4.2 Future Cost of Flight Training

Forecasting the future cost of flight training in terms of year-over-year percent cost change (CFT) presents a new set of challenges. Figure 8 depicted the historical percent changes. Given the involvement of multiple macroeconomic influences, a time-series methodology is appropriate. Due to the lack of seasonality, a simple Holt exponential smoothing algorithm is appropriate and was applied.[4] Figure 17 depicts the future cost forecast using this method, MAPE = 37.4, Stationary R^2 = .73.

4.3 Forecasting NCFI

Using the data from Figures 16 and 17 and applying the regression model going forward, a year-by-year calculation can be made which forecasts the number of new CFIs. Once this calculation is determined, 53.67% of the NCFI are considered potential candidates for airline employment due to findings in the previously mentioned CAS. In addition, due to the new requirements to obtain an ATP

[4] Several models were built using IBM's SPSS model builder. The model that led to the lowest MAPE was selected.

certificate prior to operating as a pilot at an airline, a CFI will not become available for airline employment for a period of time. While the length of time needed for a CFI to achieve ATP minimums will vary, a period of two years[5] was used in this study. Figure 18 indicates newly available pilots for airline hiring.

Figure 17: Historical and Forecast Change in Flight Costs

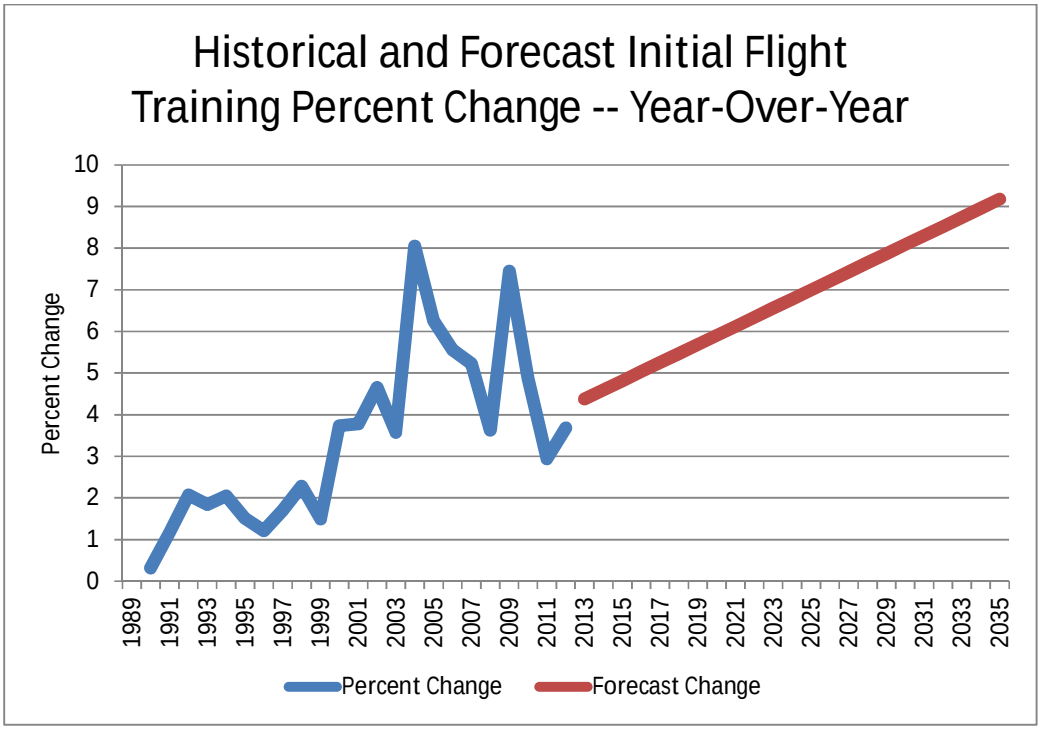
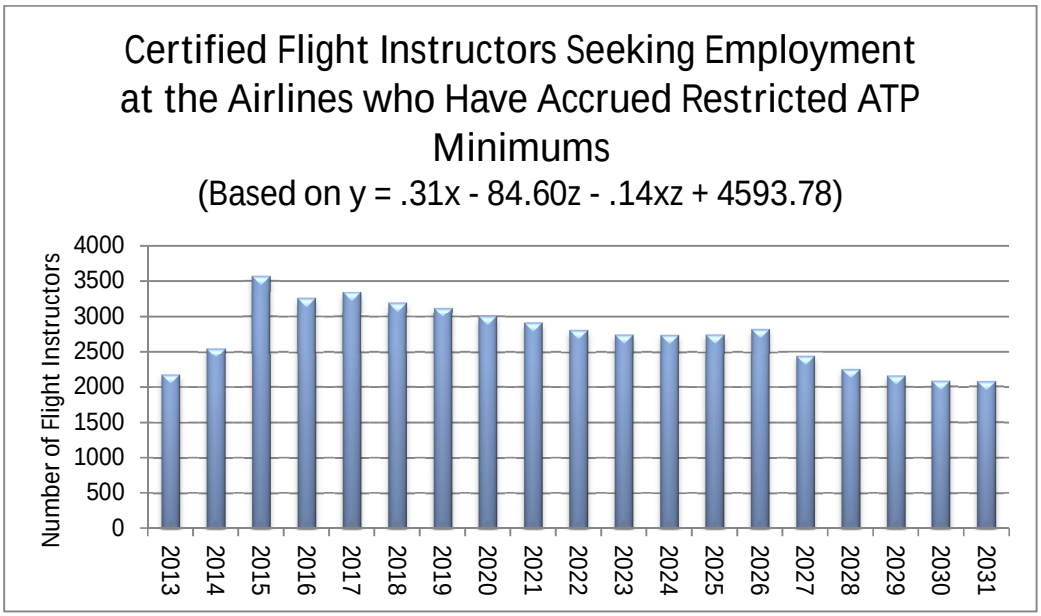


Figure 18: Newly Available Pilots for Airline Hiring



[5] Two years was selected simply because the FOQ NPRM recently published by the FAA outlined some restricted ATP minimums.

One additional supply of pilots available for hire at airlines is the military. The number of retiring military pilots will change based upon several factors, including sequestration and/or changing military missions. United Airlines recently completed a study of future available military pilots from all branches (2013). While variation in the yearly supply of military pilots is inevitable, a calculation of an annually-averaged 1,244 military pilots will be hired by major airlines during the forecast period. This number could be affected by diminishing military pilot populations as defense budgets are reduced, the increase in the UAS military pilot population that would not be eligible for airline pilot hiring, and the effect of stop-loss orders by the Department of Defense if military pilot populations moves to an unacceptable attrition rate.

5. QUANTIFYING THE SHORTAGE

A simple year-by-year calculation can be conducted which simply compares the available new pilots to the pilots leaving the industry. A simple equation for this calculation is given as:

$$\text{Surplus/Shortage} = (R+OA+G) - (M+I)$$

R=Retirements; OA =Other Attrition; G=Pilots Needed for Growth; M=New Military Pilots; I=Available and Qualified CFIs;

Figure 19 depicts the year-by-year and cumulative forecast shortages for airline pilots in the United States. For the years 2013 to 2031, there is a forecasted 35,059 pilot shortage. It should be noted that all forecasts lose accuracy over longer periods of time simply due to changing macro conditions. In the case of this forecast, no reaction by the industry or regulators is taken into account.

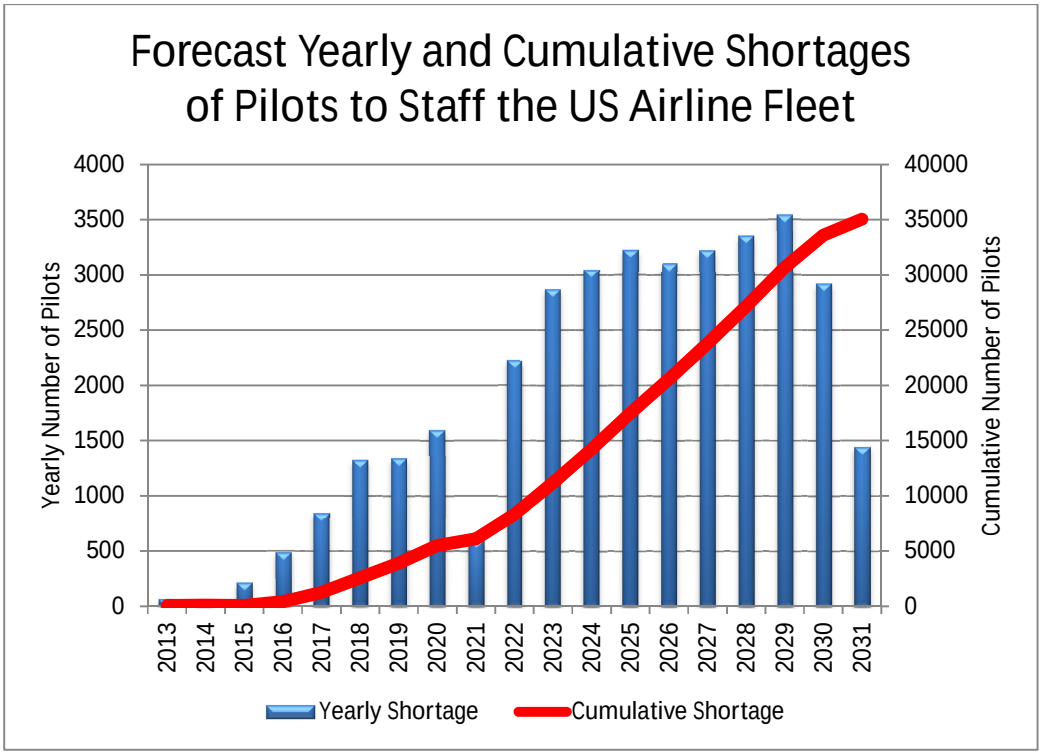
5.1 Factors not Considered by this Forecast

This study does not take into account three major issues affecting US airline pilot supply, i.e. increased staffing requirements for the newer flight time/duty time requirements for Part 121 operations; foreign hiring of US pilots, and any further career aspiration changes as a result of Public Law 111-216.

The effects of the new flight time/duty time requirements are not fully understood at this time. The new rules will most likely affect the major mainline air carriers to a lesser degree than the regional air carriers due to the differences in the contractual

work rules with their pilot groups. Anecdotally, due to several conversations with operations managers for various airlines, many of them have not yet determined its full impact; many are in the midst of making that determination. Some data does exist. Two regional air carriers projected increased pilot staffing by 7% due to the new flight time/duty time regulations. One major carrier expected it would need to increase its pilot staffing requirements by 2.7% to 3.1% in order to handle the increase of the reserve contingencies of their flight operation schedule due to the new regulations. While these data points may be of interest, there currently is no aggregated quantifiable metric that will allow for the measurement of the impact, if any, of the new flight-time/duty-time on the overall industry. That being said, in almost all scenarios, the implementation of these new rules will likely require additional staffing not contemplated in the forecast above.

Figure 19: Forecast Yearly and Cumulative Shortages of Pilots to Staff the US Airline Fleet



How foreign hiring will continue to affect US airline pilot supply is also unclear. Over the past decade many US pilots have left their country to fly for foreign air carriers because of increased worldwide demand for pilots. Given the coming ATP requirements in the US, will new, lower-time pilots leave the country in order to circumvent Public Law 111-216? According to the CAS, when asked the question from the study's survey, 'How likely are you to relocate to another country if flight

time requirements were lower for second-in-command?" 796 individuals answered 'likely' or 'very likely' to do so, out of a total of 1340 respondents. This represents 59.4%. In another related question, "If a non-US airline opened up a base in the US, how likely would you consider a career at that airline?", 1016 individuals out of 1342 (or 75.7%) indicated they were 'likely' or 'very likely' to consider that situation. Both of these responses indicate a willingness to work abroad if the employment opportunities are more positive for younger pilots entering the industry today.

The final issue is not taking into consideration the affects of Public Law 111-216 concerning the perception of younger people's attitudes towards their career aspirations as US airline pilots. Again, from the survey that was recently completed, 1410 respondents answered the question of how the new ATP requirement and 1500 hours to fly as a first officers had affected their career aspirations, 112 (7.9%) indicated it had changed their mind about pursuing a career with airlines due to the proposed rule change. Another 469 (33.2%) indicated they were starting to think twice about a career with the airlines based on the proposed rule changes. Based on the survey, a small population (7.9%) of up and coming pilots have elected not to pursue the airlines as a career. The group that is starting to think twice is much larger and could have a significant negative impact on US airlines pilot supply if they also move away from an airline career.

Each of these factors, flight time/duty time regulations, foreign hiring of US pilots, and Public Law 111-216 could impact the labor supply by increasing the shortage. Additional research to explore this impact would enhance the literature on pilot supply issues.

6. CONCLUSION

It is clear from the data that the United States faces a shortage of airline pilots. The current forecast calls for a shortage of over 35,000 pilots in the US between 2013 and 2031. While shortages have been predicted from time to time, this particular shortage forecast is based upon factors not previously experienced. These factors include the following:

1. New pilots who may enter the profession make a consumer decision based upon cost of flight training and the potential to obtain employment at major airlines. The cost of flight training is increasing which will negatively impact the future pilot supply.
2. Major airline retirements are accelerating and will accelerate in the future.

3. Growth will continue within the airline industry.
4. Only a small majority of CFIs intend to work for the airlines as a long term career aspiration.
5. The requirement of obtaining an ATP prior to operating as a line pilot at an air carrier is negatively impacting the pilot labor supply, and may further negatively impact the pilots supply further in the future.

Other factors not specifically considered by this forecast:

1. The impact of the new flight-time/duty-time rules.
2. Foreign carriers may decide to aggressively compete and employ lower-time entry-level pilots.

From the data, it appears that the larger major carriers will likely not experience any shortage in the next five to seven years. However, the same cannot be said for the regional carriers. It is likely that the regional carriers will experience large-scale shortages, and that a relatively small population of newly-available and qualified pilots will have ample opportunities to obtain employment as the regional airlines compete for employees. Regarding this competition for employees, the regional airlines will likely become aggressive in their recruiting tactics. Today, some regional airlines are already offering "signing bonuses" and "gateway" programs to help attract new pilots.

7. IMPACT

Most airlines in this country operate the majority of their flights via a hub-and-spoke model. Passengers fly into the hub and then transfer to another flight that will carry them to their final (spoke) destination. Successful hubs rely on service from both mainline as well as the regional carriers.

Atlanta's Hartsfield Jackson International Airport, is the world's largest airport when measured by aircraft movements and passengers (Airports Council International, 2012). It also serves as the largest hub for Delta Air Lines and will be an important hub for Southwest, as it continues to implement its merger with AirTran.

Nearly one in three aircraft departures out of Atlanta are operated by regional airlines (Regional Airline Association, 2012). At Chicago's O'Hare International Airport, a hub airport for both American and United Airlines, over 64% of departures are operated by a regional carrier (Regional Airline Association, 2012). Regional flights allow

carriers to support existing domestic and international service. Without regional airline flights, many markets would not receive the same level of service (or any service) as they do today.

The importance of the regional airlines in providing air service throughout the country cannot be understated. Regional airlines serve 681 airports throughout the United States. About 70% of those airports, 476 airports in total, are served exclusively by regional airlines. This means that in the event that regional airlines have to reduce service due to the inability to hire qualified pilots, many communities will see a reduction in air service. Assuming a constant or increase in demand, airfares in many of those cities would rise.

In order to appreciate the potential consequence of this situation, one can examine the economic impact that a loss of airline service would have on the city of Abilene, Texas and its airport. Abilene is a city with a population of nearly 120,000 people (U.S. Census Bureau, 2013). The Abilene Regional Airport has scheduled airline service provided by one carrier, American Eagle Airlines. A review of the February, 2013 flight schedule shows that Eagle operates seven round-trip daily flights and one additional flight scheduled for every day except on Saturday to Dallas Ft. Worth International Airport (City of Abilene, 2013).

The vast majority of passengers flying out of Abilene are connecting onto another flight in Dallas to go to another destination. The average fare for passengers flying out of Abilene during the third quarter of 2012 was $521[6] (Bureau of Transportation Statistics, 2013). This relatively high fare is most likely due to the fact that only one carrier provides service to Abilene. In the event that American Eagle was to reduce service due to its inability to find qualified pilots to support its scheduled flying, it would have to reduce service to various cities. Abilene could experience a reduction in service, which would very likely result in an increase in fares due to the fact that there are less seats available for sale. This may deter some passengers from flying which can lead to a reduction in economic activity at the airport.

[6] Provided by the Bureau of Transportation Statistics, Airline Origin & Destination Survey. Average fares are based on domestic itinerary fares, round-trip or one-way for which no return is purchased. Fares are based on the total ticket value which consists of the price charged by the airlines plus any additional taxes and fees levied by an outside entity at the time of purchase. Fares include only the price paid at the time of the ticket purchase and do not include other fees, such as baggage fees, paid at the airport or onboard the aircraft. Averages do not include frequent-flyer or 'zero fares' or a few abnormally high reported fares. Airports* ranked by U.S. originating domestic passengers in 2011.

Airline service can be an important revenue stream at many airports and their communities. In addition to transporting passengers, airline service supports the movement of air cargo and jobs at the airport (CDM Smith, 2010). With the so-called 1500 hour rule, many airports-both large and small-may face a reduction in air service over the next several years, if airlines are unable to find a sufficient number of qualified pilots to fly their planes.

In 2010, the University of North Texas' Center for Economic Development and Research published some data on the economic impact of airport related activity in Abilene (University of North Texas Center for Economic Development and Research, 2011). The study highlighted the importance that commercial, general aviation and military operations have on the airport (University of North Texas Center for Economic Development and Research, 2011). The report stated that commercial and general aviation activities at the airport generated over $148 million in economic activity (University of North Texas Center for Economic Development and Research, 2011).

Again, in the event that the airport were to see a reduction in air service due to American Eagle's inability to find a sufficient number of pilots, cities like Abilene could see a reduction in air service. The airport would also experience a reduction in economic activity.

8. POTENTIAL SOLUTIONS

In the face of the upcoming pilot supply disruptions and shortages, the industry must seek solutions; otherwise, the effects can be catastrophic both on multiple local levels as well as the national economy. There are two areas which the data suggest might provide the most relief:

1. Given the consumer decision made by potential pilots, the industry should focus on both the risk (CFT) and reward (MAH) variables. This concentration should focus on reducing of costs related to flight training, such as paid scholarships or funding in return for future employment; or, providing a clear pathway to the major airlines from early pilot training, such as a gateway program which outlines a career progression culminating in major airline employment.
2. The industry should focus their efforts on recruiting and attracting CFIs who have no intention of obtaining employment in the airline industry. The data currently suggests that around 47% of CFIs fall into this category and have no

intention of becoming airline pilots in the long-term. If these pilots can be attracted to the airline industry, the effects of the shortage could be mitigated.

9. FINAL REMARKS

In the face of forecasting and the errors associated with forecasting methodology, one fact is certain: as time passes, the industry will know for sure if previous forecasts were accurate. Unfortunately, given that it takes several years for a pilot to enter the airline pilot labor supply, the industry cannot afford to "wait and see" if there will be enough pilots in the future. Accordingly, the industry must make its best efforts to forecast and mitigate, if necessary, any future shortages. These efforts should begin now and in earnest. The likely result of inadequate staffing will be the reduction of flying in smaller-communities and other markets served by regional airlines. The overall effect could also cause harm and disruption to the entire airline industry. Given the far reach of the airline industry and its effect on the national economy, this threat should be taken seriously, and mitigations should be enacted in an attempt to circumvent this potential hardship.

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In the Summer of 2012, the industry formed a stakeholders group which sought to analyze the current state of the airline pilot labor supply. From this stakeholders group, a subgroup of collegiate aviation researchers formed and endeavored to help provide a scientific foundation to this process. This group could not have completed their work without assistance. In particular, the industry helped form the underlying research questions examined by this study, as well as provide detailed data to help facilitate the analysis. The authors of this study wish to acknowledge the contributions of many people representing the airline industry. The authors wish to specifically thank the following people:

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HOLIDAY TRIPS: CONVENIENCE, EFFICIENCY AND EFFECTIVENESS

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ABSTRACT

This paper aims to provide an understanding on the decision making process that guide tourism trips based on the various strategies developed by the airlines. The primary research data was analysed using factor analysis as a pertinent statistical tool for grouping variables in order to understand common consumption behaviours. The results of the study are indicative and suggest that tourists are classified in accordance with 'customer service' that include ground and in-flight service. Then, the second factor is 'price sensitive and Internet', which refers to dimensions such as the airline ticket and the frequency of trips. Finally, 'selection in travel behaviour' is associated with the choice based on the operation of the airlines, for instance the airports.

Keywords: airports, airlines, consumer behaviour, factor analysis, Cyprus

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1. INTRODUCTION

In an attempt to describe the airline industry briefly, it is interesting to note that its past was rather 'monotonous-monopolistic' and restrictive (Adrangi 1999), in contrast to the present, which is liberal, deregulated and competitive (Inglada, Rey, Rodriguez-Alvarez & Coto-Milan 2006). The hallmark for the recent state of the industry was the introduction of deregulation policies, with a starting point in the USA, in 1978, which was followed up by Australia, in 1990, and then the European Union with gradual procedures and final completion in 1997 (Smit 1997). Naturally, the behaviour of the airlines has changed dramatically, and newcomers gained the privilege to enter the market. Consequently, competition was introduced and substantial structural changes (Starkie 2002) occurred in the aviation industry in terms of flexibility concerning the operations, the fares, the routes and the capacity (Frenken, Terwisga, Verburg & Burghouwt 2003).

This paper aims to explore the critical issues or the situation of the global airline industry and to identify the effect on tourists' behaviour in relation to the tourism industry. This will be achieved by an in-depth analysis of the situation that emanated from airline deregulation, as being the endogenous impetus behind the 'new era' in the industry. That forced the proliferation of new carriers and more specifically low-cost carriers (LCCs) by the establishment of new strategies (Papatheodorou & Lei 2006). In particular, the aviation industry became flexible, generous in offering low air fares (Williams 2001; Pels & Rietveld 2004) and alert to technological changes (Buhalis 2003).

2. AIRLINE STRATEGIES – INAUGURATION OF NEW BUSINESS MODELS

This part of the article will describe the airline business starting with the definition of the airline product. In addition, will add an understanding on the current policy formulation of the aviation industry with particular reference to the European Union. To begin with, the airline product is '... characterised by specific service features such as the immateriality, no storability and synchronicity of production and consumption (uno-actu-principle)' (Groß & Schroder 2007:44). Furthermore, it is homogenous and involves the '... transportation of the passengers from A to B that is the core service of an air trip' (Groß & Schroder 2007:44). Admittedly, the only features that differentiate one airline from another are the services that '... may be offered before, during or after the journey' (Groß & Schroder 2007:44).

The status of the airline industry it is characterised by the introduction of

deregulation policies that instigate a free market and the opportunity of new carriers to enter the market and set new strategies (Dennis 2007). The immediate aftermath of liberalisation was the emergence of LCCs, which forced an alteration in production and consumption patterns and shifted the industry's structure as such (Schnell 2003). In particular, LCCs '... have created new markets by inventing new products' (Bley & Buermann 2007:52; Dennis 2007) with the introduction of low-cost fares and the expansion to new destinations (Alves & Barbot 2007; Hasson, Ringbeck & Franke 2003). This had as a consequence, an alteration of the operations of the incumbent carriers or legacy or network carriers, with attempts being made to reduce costs in order to become flexible and able to confront their no-frills counterparts (Tretheway 2004; Dennis 2007; Duval 2007; Franke 2007; Mason & Alamdari 2007). In general, the effect on the production side or product development was on service and non-service as the main axes of differentiation (Williams 2001). Legacy carriers tried to implement and deploy a number of strategies in an attempt to confront the competition (Schnell 2003; Franke 2007).

The European airline scene is dominated by network carriers or the traditional flag carriers that are divided into mega (Big Three) and medium (Tier 2) transatlantic carriers and European (Tier 3) regional carriers (intra European) and LCCs (Low Cost Carriers) (Ringbeck et al. 2007). Traditional or network carriers offer first class or business class and economy class products that are defined by the extent of the airline service that is offered (executive lounges, catering supplies) and by the price of the ticket. The LCCs entered in the market with a total exclusion of in-flight services and a concentration on point-to-point operation with simplified procedures and lower fares (Bjelicic 2007). In addition, they employed e-commerce procedures with a ticketless service that enables the offer of cheap fares (Pender & Baum 2000; Dobruszkes 2006; Franke 2007).

Historically, in 1986, the first low-cost or no-frills airline in Europe was Ryanair, an Ireland-based company that entered the prosperous London–Dublin route and offered a decrease in fares by '... 55% from £208IR (€264) to £95.99IR (€121)' (Barrett 2004a:90). This new fare policy is directly opposed to the British Airways and Aer Lingus bilateral cooperation agreement (Barrett 2006). In 1995, EasyJet entered the UK market with 12 new 737 Boeing aircraft (Civil Aviation Authority 1998; Sull 1999).

The period between 1965 and 1989 was characterised as a 'phase of growth'

because of the technological advancement of air travel and an increase in the available disposable income. This phenomenon is directly related to the aviation industry as the fastest-growing mode for travelling worldwide. As has been argued by Law (1997 as cited in Buck & Lei 2003), any destination that seeks to stimulate the interest of tourists must have close relations to charter airlines. Furthermore, strategic responses in terms of mergers and acquisitions, or an increase in aircraft capacity or a decrease in fares, immediately affect the movements of people and of tourism arrivals (Forsyth 2008).

Historically, the charter airlines' role has been to meet the increased seasonal demand of leisure travellers and to serve the tourism industry, since they are vertically integrated with major tour operators and primarily serve the leisure market (Lafferty & Fossen 2001). Air fares were cheap and were included in the whole tourism package, which was an assemblage of the destination, the flight and the accommodation. The first two airline liberalisation packages did not affect charter airlines' operations within Europe. The main impact was when the 'Third Package' came into effect and allowed scheduled operations (William 2001; Buch & Lei 2003; Williams 2008). This had a direct effect on charter airlines and the restriction that the whole holiday package should be bought was abolished. The consumer gained the privilege of buying only the air ticket (Dagtoglou 1994; Buck & Lei 2003; Duval 2007). Thus, the charter airlines reappeared in the market, with a new hybrid strategy, and were able to confront legacy and schedule carriers.

Low-cost carriers (LCCs) have metamorphosed the relationship between the airlines and the tourism industries (Schroder 2007; Forysth 2008; Graham 2008).In particular as it was stated by Wong (2006) that '... low cost travel is becoming a norm rather than the exception'. The LCCs' evolution has contributed even further to the changing pattern of demand and the consumer now determines the consumption patterns (Page 1999) of the tourism domain and, instead of purchasing the whole package, tailors the travel arrangements to his or her own needs. LCCs have revolutionised European inbound and outbound tourism, and air travel has made tourism an activity that is accessible to more people (Wong 2006). According to Kua and Baum (2004:262):

Low cost carriers, otherwise known as budget carriers or no frills airlines, can be seen as one of the most dynamic developments within recent travel history in the United States and Europe.

As is emphasised by O'Connell and Williams (2005:259): "Low cost carriers have reshaped the competitive environment within liberalized markets and have made significant impacts in the world's domestic passenger markets, which had previously been largely controlled by full service network carriers".

The emergence of LCCs has provided flexibility in terms of the frequency of operations and the expansion to more destinations. These have provided the traveller with the opportunity to seek shorter breaks or even day return trips (Wheatcroft 1994; Williams 2001; Debbage 2002; Papatheodorou 2002; Buck & Lei 2003; Forsyth 2003; Schroder 2007). After the entrance of the low-cost carriers (LCCs), the number of passengers recorded an abrupt increase, and more people are engaged in leisure travel (Forsyth 2003; Schroder 2007; Deloitte & Touche n.d.).

A major debate in tourism is whether LCCs are the new innovative form of charter airlines, albeit with some differences (Williams 2008) that have appeared in the market to satisfy the contemporary tourism demand, along with the emergence of the new tourists, who are experienced and able to arrange the tourism package on their own (Poon 1998). The immediate aftermath has been the redirection of tourism demand from charter airlines to LCCs and the move towards independent travel (Mintel 2006a). This derives from the preference of the consumers to compose their own 'holiday puzzle' independently, using the Internet (Poon 1998; Williams 2003; Doganis 2006; Williams 2008).

To conclude, recent developments in the airline industry, with the entrance of more carriers and the diversification of airline services, have had a notable effect on tourism. New forms of consumption on the part of tourists are directly related to the airline industry network. Direct selling methods with regard to airline tickets have provided the consumer with the opportunity to enjoy cheaper fares. An expanded airline network to more destinations on a year-round basis has stimulated the interest in making more trips to unexplored destinations. This has led to an increase in competition between destinations, and survival is synonymous with a strong focus on consumer demand through better planning and innovation.

3. CONSUMING IN THE TOURISM INDUSTRY

This part will provide an understanding on the way that destinations are chosen and consumed based on the variety of services offered within the broader context of tourism services with the aim to satisfy the consumers. Urry (2000:141) argues that

'... there is an omnivorous producing and "consuming [of] places" around the globe' (Urry 2000:141) and that tourism experiences are an amalgam of several sectors on the supply side and many users on the demand side. Commonly, the new pace of tourism development worldwide is associated with '...new product development and innovation' (Cooper et al. 2006:19) and '...as the amalgamation of places generating experiences' (Snepenger et al. 2007:310). Interestingly, a destination is the place in which both consumption and production trends are taking place, and it is characterised by an intangible nature that is associated with the acquisition of a tourism experience (Britton 1991; Svab 2007; Shaw & Williams 2004; Ioannides & Debbage 1998; Agarwal et al. 2000; Dallen 2005). Tourism has entered the era of neo-Fordism, which features flexibility, tailored and focused products and uniqueness that necessitates an alteration or inauguration of a re-development in tourism (Ioannides & Debbage 1998; Coles 2004; Torres 2002).

Interestingly, the 'tourism package' has tended to become obsolete and has been replaced by direct methods of selling. The consumer has the 'role of the tour operator' and is capable of devising tourism itineraries. The contemporary way of living is characterised by the 'superabundance' of goods and the consumer has access to a large number of commodities that exist to satisfy his/her needs. Notable examples are the diffusion of DIY (do it yourself) products (Watson & Shove 2006:6), with the consumer willing to assemble the product or undertake the whole production of the product (Ritzer 2004). In the case of tourism, ICTs (Information Communication Technologies) have made possible the creation of the tourism package by the consumer, through direct methods of distribution (Buhalis 2003).

The EU tour operators' market has witnessed major companies merging, such as the case of TUI and First Choice and Thomas Cook with My Travel (Williams 2008). The elimination of tour operators has led to the emergence of mega-brands that gain increasing power in the market, a phenomenon that naturally leads to lower costs (Burns 1999). Additionally, the scale of development refers to smaller groups of people travelling to diverse geographical places and the existence of niche marketing (Lew et al. 2004; Williams 2004). Consumption is associated with experiencing and collecting memories with well-known brands that offer customised products that fulfil human needs. Put another way, the consumer prefers well-known brands that have built a story of success. Consumers buy not only a product, but also something that has been experienced by many people.

Additionally, new forms of consumption are linked to flexible packages with the consumer becoming more independent and able to arrange holiday trips (Torres 2002; Williams 2004). Both private and public organisations are engaged in a continuous search for new products that will satisfy modern society (Urry 2000; Torrers 2002; Coles 2004). Travellers are 'thirsty' and willing to be engaged '... with a never ending range of experiences' (Ioannides & Debbage 1997:229). The quest of the new tourist is demand 'for independent holidays' (Poon 1993:17) away from the mass movement of purposeless tourism has impacted on tourism development. Thus, production and consumption have moved from mass production to neo-Fordism, which indicates a concentration of power on the part of the consumer. An important market trend is attributable to the proliferation of new business models, as the aftermath of a free economy. Notable is the example of LCCs that have impacted on tourism consumption in terms of an increase in the number of holiday trips as well as a geographical expansion (Schroder & Groß 2007). LCCs offer better and greater flexibility and enable the consumer to compose travel itineraries with the best possible deals.

In particular, for the tourism industry, prominent practitioners praise the appearance of a new dimension as argued above, with regard to both the consumption and the production pole (Urry 1990; Sharpley 2001; Shaw & Williams 2004). This new and modern tourist society connotes that '... objects become representations and are commodified, packaged and consumed' and that '... the tourist consumes images or representations of a society' (Pretes 1995:2). Primarily, technology has changed the industry in a wide range of different dimensions, such as the application of new strategies, or the change in business–customer relations and the inauguration of new products. Tourists do not consist of parts of '... a particular homogeneous group' (Burns 1999:131) but rather represent characteristics of different segments with diverse needs.

In conclusion it should be further emphasised that societal dynamics have forced a change in tourist behaviour that, in turn, alters and affects the tourism industry's suppliers (Ateljevic 2002). Thus, the suppliers have become more creative in an attempt to gain an advantage in the face of the changing patterns of the new globalised business environment, which is characterised by relentless competition (Shaw & Williams 2004; Shaw & Williams 2008). The consumers are powerful and are in search of new and innovative products that can offer a rewarding experience. Pre-Fordism and Fordism can take the form of an all-inclusive holiday to a popular

and crowded area, whereas post-Fordism is the exploitation of a new destination with online booking and interaction with several activities. Neo-Fordism instigates a tourism choice with the consumer having control and becoming even more powerful and with the supply chain focusing on niche forms of tourism developments (Williams 2004). However, particular, emphasis should be given to Torres's (2002:88) statement regarding: "... many of the world's tourism landscapes embodying a complex melange of pre-Fordist, Fordist, post-Fordist and neo-Fordist elements, coexisting over time and space".

5. METHODOLOGY

Having set the theoretical background of the article, this part will sketch the methods used in order to identify the criteria set for the tourists as consumers to choose an airline for their holidays. The questionnaire used in this research was designed in such a way that it tried to obtain information regarding the airline and the tourism industries as the main themes of investigation, and to answer the related research questions. The questions were primarily 'open ended' with a variation of formats such as dichotomous (Yes/No), multiple and Likert Scale 1 to 5 (Definitely Yes – Definitely No) (Ryan 1995) and the level of measurement is nominal. The use of a Likert Scale seem most appropriate in this particular piece of research because it aims to generate '...a degree of agreement or disagreement with each of the statements (Likert 1932 as cited in Schmidt & Hollensen 2006:120).

The particular sample includes 300 structured administered questionnaires to the British tourists departing from the international airport of Larnaca (200) and the International airport in Paphos in Cyprus. The questionnaire included 26 airline attributes as the main forces behind choosing the airline for the particular tourism trip. The period of data collection was between July and September 2007. The aim of the study was to examine the key factors that affect attitudes with regard to consumption in terms of the decision making and the behaviour of British tourists.

In order for this to be achieved, it is important to employ factor analysis as a popular method for segmentation in tourism (Juaneda & Sastre 1999; Frochot & Morrison 2000; Dolnicar 2002; Dolnicar 2004; Frochot 2005). According to Dolnicar (2002:17), '... segmentation enjoys high popularity in tourism marketing, and so does data-driven segmentation'. In particular, factor analysis, '...looks at the relationships between variables among the set of cases' (Kent 1999:180).

A major concern in the use of factor analysis is the number of factors that should be obtained (Bryman & Cramer 1990). This dilemma can be solved by a set of two criteria. The first is the Kaiser–Meyer–Olkin (KMO) criterion and Bartlett's test, which indicate that the valid factors are those that have an eigenvalue greater that 1 (Bryman & Cramer 1990; Schmidt & Hollensen 2006). The second one is the graphical 'scree test' as proposed by Catell (1996 as cited in Patton 2005), in which the graph illustrates '... the descending accounted for by the factors initially extracted' (Bryman & Cramer 1990:277). In the case of the KMO criterion, it is suitable for fewer than 30 variables with an average communality of 0.70, or when the respondents exceed 250, which means that the mean communality is more than 0.60 (Stevens 1996 as cited in Bryman & Cramer 1990). A correlation greater than 0.5 is regarded as 'high' (Schmidt & Hollensen 2006). If, for example, the correlation between two variables is .65, this means that they have more than two-thirds of the variance in common (Schmidt & Hollensen 2006). In other words, the two variances have a 65% 'overlap' or a tendency to tab into those of similar members (Schmidt & Hollensen 2006:273) or the scale (i.e. 1–7).

After the determination of the number of factors, the next step it to label and explain these factors (Bryman & Cramer 1990; Pallant 2005). Thus, in terms of better labelling, factor rotation is employed (Pallant 2005). Factor rotation is a method used in an attempt to enable better interpretation and explanation of the variables (Bryman & Cramer 1999). The two rotation methods are: a) orthogonal rotation, which reflects factors that do not relate to each other, and b) oblique rotation, which indicates the relation of the factors (Bryman & Cramer 1999). In this particular research, both approaches were employed and then the interpretation was based on the one that had the clearest meaning (Pallant 2005).

6. RESULTS

As mentioned above, factor analysis is an effective method for segmenting British tourists in terms of a set of different airline attributes and for identifying different patterns among the sample. The main theme of the investigation is to understand the criteria for airline choice. Factor analysis groups together variables 'by reorganising and reducing the amount of output' by 'data reduction' (Schmidt & Hollensen 2006). There are 26 variables, thus the total correlation matrix is 676 (26*26), which was reduced to 24 meaningful constructs (Jang et al. 2004:37).

Table 1: Factor analysis (Varimax rotation) 'Airline attributes - holiday trips

Factor 1 = Customer Service			
I always travel first class on my holidays	.724		
My choice of airline is determined by the loyalty scheme	.683		
My choice of airline is determined by the weight allowance (sports equipment, luggage)	.676		
I receive email alerts for special airline offers to different destinations	.575		
I always travel with the same airline company on my holidays because I feel safer	.545		
The airport from which my flight is flying is irrelevant to me	.508		
My choice of airline affects my choice of accommodation (e.g.. Low Cost Carrier and Budget Hotel)	.450		
I travel with the same airline for my holidays as I use for business travel	.385		
Factor 2 =Price sensitive & Internet			
I often decide to go on extra holidays or mini-breaks to different destination because of a low cost carrier fares		.652	
I travel more frequently in comparison to the past because of the availability of more cheap flights		.647	
I prefer to travel with the cheapest airline on my holidays		.629	
I often decide to go on holidays because of cheap/promotional fares and/or last minute offers found while searching the internet		.579	
I travel more frequently in comparison to the past because of more choice terms of airlines		.540	
I always travel economy on my holidays		.414	
The brand image of the airline I fly with on my holidays is not important		.381	
I always book the airline ticket for my holidays directly from the internet		.367	
Factor 3 = Selection in travel behaviour			
I always choose airlines with a positive brand image			.632
I always travel with scheduled carriers for my holidays			.570
I always travel with charter airlines on my holidays			.557
I prefer to travel from main hub airports on my holidays			.535
I travel with Low Cost Carriers on my holidays			.462
I prefer to travel with airlines which fly from the nearest airport to my place of residence			.370
I prefer to travel with airlines which offer full service meals			.314
I prefer to travel from regional airports on my holidays			.286
Eigen Value	4.315	2.828	2.031
Common Variance explained	13.627%	11.116%	10.542%
Cumulative Variance explained	13.627%	24.743%	35.285%

Notes: a) negative Factors were reversed, b) statistics are associated with each number of the statements to indicate correlation and co-efficiency of each factor explained for every attribute)

The results of the factor analysis suggest that leisure travellers' decisions regarding airline trips are guided by three important parameters (Tables 1 and 2). The first is based on 'customer service', which includes attributes in terms of seat classification, loyalty schemes, weight allowances and safety. The second factor relates to airline price and online bookings and how they are related. In the final factor, the main parameter in terms of airline booking is 'travel behaviour', such as the different airline models and airport. The three factors publicised that the consumer is familiar with the airline strategies concerning the development of several products and services. The results confirm that consumers have changed and tourism destinations must be able to adapt to their demands and to offer a variety of services and products in order to survive in a competitive global market. In the case of the airline industry and holiday trips, convenience and the airport that the airline is flying from are more important than the cost of the ticket.

Table 2: Factor analysis

Factor 1 Customer Service	Factor 2 Purchase Decision	Factor 3 Choice of Airline business model/ Airport type
First class seats	Low cost carriers fares	Positive brand image
Weight allowance (sports equipment, luggage)	More frequently because of availability of more cheap flights	Schedule carriers for my holidays
receive email alerts for special airline offers	Cheapest airline fare for my holidays	Charter Airlines for my holidays
Safety	Go on holidays because of cheap/promotional fares and or/ last minute offers found while searching the internet	Low Cost Carriers for my holidays
Airport is irrelevant	More frequently in comparison to the past because of more choices in the airline service	Airlines with Full service (bar & meals)
Affects the choice of accommodation (i.e. Low Carrier and Budget Hotel)	Economy seats for my holidays	Nearest airport to my place of residence
travel with the same airline for my holidays as I use for business travel	Brand image is not important	Hub airports
	book the airline ticket for my holidays directly from the internet	Regional airports

The above results revealed the ability of tourists to create ideal package deals by using the Internet both to retrieve information and to book holidays. The results of the factor analysis are indicative and prove that tourists value customer service on the part of the airlines. Additionally, airline choice is guided by price, which leads to an increase in the frequency of holiday trips with the destination being an important pull factor. In general, consumer behaviour with regard to the airline attributes has proved to be diversified, and indeed tourists are well informed about recent airline developments. The airport from which the airline operates is an important indication that determines the choice of a specific airline.

The role of the airline in holiday trips is documented by using factor analysis to suggest three main forces influencing holiday trips: 'customer service', 'price sensitive' and 'selection in travel behaviour'. In spite of the fact that these profiles have been adequately theorised (see Debbage & Ioannide 1998; Mowforth & Munt 1998; Torres 2002), this study sets out for the first time some of the 'real-life' features of the neo-Fordist tourist.

The factor analyses support the existing literature by suggesting that the profile of the new consumer is characterised by an eager desire to be offered diversified choices. In addition, the results suggest that the decision-making process of consumers' judgement is based on the provision of pertinent information. The research provides a further insight into the concept of Fordism and, in particular, neo-Fordism, by arguing that current production patterns are flexible, and businesses, via the utilisation of the Internet, have managed to access individual needs and to provide additional services for the consumer. The consumers exert enormous power over suppliers, given the existence of multiple choices and alternatives in a neo-liberal economic environment.

7. CONCLUSION

The results suggest that tourists have become more destination-oriented and tend to value experience as a priority in their holidays. Plurality in the airline services provides the opportunity for escapism, and the 'tourism gaze' (Urry 1990) becomes a reality and a fact. Additionally, the results enrich the existing theory which attempts to profile the consumer under the Fordism concept (Torres 2002, Ioannides & Debbage 1997, Mowforth & Munt 1998). The main platform for consumers to access relevant information is the internet, which is considered to be the most effective and up-to-date source of information, and which, at the same time, enables the

consumer to plan and devise travel itineraries. Tourists travelling to Cyprus use a diverse range of airline companies, which include scheduled airlines, charters, LCCs, and a Hybrid Model.

The research provides a further insight into the concept of Fordism and, in particular, neo-Fordism, by arguing that current production patterns are flexible, and businesses, via the utilization of the internet, have managed to access individual needs and to provide additional services to the consumer. The consumers exert enormous power over suppliers, given the existence of multiple choices and alternatives in a neo-liberal economic environment. Destinations of the future will be the ones that will manage to be proactive in consumer behaviour and succeed in developing innovative products in the tourism context. Tourism practitioners should more thoroughly consider the developments in the airline industry and act accordingly.

The internet is a powerful tool in business transactions that had affected airline and tourism industries. The role of the tour operators has been redefined in response to new technological jigsaws that have led to direct contact of airlines with the consumer and the capability of online travel arrangements. This corresponds to the entrance of LCCs that have introduced direct-booking methods through the internet as the sole way for making bookings. Thus, tourism destinations should maintain an attractive stance in the market with continuous online access that will enrich and diversify consumer choices.

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