Route Preliminary Demand Forecast Model

For All-Business Airlines or Flights

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Abstract — **From 2005 onward, a number of new low-cost all-business airlines have emerged in the transatlantic market. All of these airlines have aggressive plans for expanding their route network. This paper describes the development of a preliminary forecasting tool, to be used by such airlines in a preliminary profitability study of new or current routes. This means the model can be used to assess both the profitability of a new route of interest and of continuing an existing route. The model in its current state indeed provides this capability. This is shown using a rough validation calculation, carried out using the model and based on the business case of Eos Airlines, one of the recently erected all-business airlines. The model's forecasting accuracy is still fairly limited. To improve this, more research should be conducted on both the refinement of the model as on the data required for using the model.**

Keywords – all-business airlines, demand forecast, demand drivers, air travel routes, business travel.

I. INTRODUCTION

Recently, from 2005 onward, a number of new low-cost airlines have been erected aiming specifically for transatlantic business air travelers [1]. These airlines provide services with aircraft equipped solely with business class and/or first class seats. Such airlines include MAXjet (which has already filed bankruptcy at the end of December, 2007), Eos Airlines, both operating between the US and the UK (mainly between London and New York), Silverjet, with destinations London, New York and Dubai, and L'Avion, flying between Paris and New York. These airlines, according to reference [1], all have expansion plans with respect to their routes. For instance, Eos Airlines will open a new route between Paris and New York in 2008 [2] and Silverjet has shown interest in flying to Chicago, Miami, India and South Africa [1].

In order to determine whether these relatively new all-business airlines will be able to compete in the fiercely competitive environment that the airline business is composed of, it is important to forecast demand as accurately as possible. According to reference [3], forecasting of demand is the most important and critical aspect of managing an airline, since so many important decisions are based on it. Obviously, demand forecasting is a very complex issue, as a lot of the determining factors, or drivers, for demand are unknown or cannot be know in advance. In short, one is dealing with the uncertainty of the future. Reference [3] also states that forecasting of demand is

extra difficult when applied to new air routes. In the case of the new all-business airlines, this is particularly difficult because of their lack of long term historical demand data and experience.

The aim of this paper is to develop and describe a basic demand forecasting tool for these new airlines that can be used to quickly determine whether or not on a (new) route of interest enough demand is present and what the requirements are to satisfy this demand. This can subsequently be used to determine whether or not it is worthwhile to open or continue a certain route, i.e. the model's forecast can be used to make operational decisions. In this paper, only the basic framework for the model will be presented. This means that a number of assumptions is made throughout the paper in order to facilitate the ease of model development. These, however, limit the capabilities of the model. The assumptions and limitations are summarized in section VI.

In order to devise a market demand model for all-business airlines, first the factors that drive the demand will have to be found and valued according to their importance and influence. These factors are numerous and a lot of them are interconnected. The initial discussion of this paper will be on these factors and their importance (section II). The next section will express the importance of each driver in a quantitative manner in order to use them for the development of the model. Section IV will deal with the full-scale development of the demand forecasting model. Section V will apply the model based on the route expansion and fleet plans of an existing all-business airline. Section VI will discuss limitations of the model and resulting recommendations for further research and model development. Finally, section VII will conclude this paper.

II. DEMAND DRIVERS

Before fully developing the market demand model, first the determining factors for the demand will be presented. A distinction can be made between five different types of drivers; economic drivers, so-called demand inherent drivers, service quality, promotion and competition. These are the drivers that affect business travelers in the making of their choice for a certain airline and service.

A. Economic Drivers

This category of drivers is quite extensive and the future variation of the drivers in this category is most difficult to predict, let alone the measure to which they affect the market demand. A number of sub-drivers determine the main driver in this category, which is the relative or perceived ticket price. These sub-drivers are the global and regional economic climate, the currency exchange rates between the currencies in the destination areas, and price elasticities for the targeted passenger types. The currency exchange rates are influenced by the global and regional economic climates. Together with the ruling price elasticities, the economic climate, the currency exchange rates and the absolute ticket price influence the relative or perceived ticket price for the passenger. Furthermore, they also are of influence to the intensity of business activities globally and between the regions of interest, which will be discussed in the next subsection. Of course the economic climate also influences the absolute ticket price. These interconnections are shown in Fig. 1. The arrows and lines in this figure merely indicate the influence of the different aspects on each other.

1) Economic Climate and Currency Exchange Rates

"Air transport has experienced rapid expansion since the Second World War as the global economy has grown and the technology of air transport has developed to its present state" [4]. Furthermore, "The world economic climate and the rate of economic growth in particular countries or regions of the world influence demand in a variety of complex ways" [3, p. 196]. They determine both the level and distribution of personal income and, more relevantly, company revenues and nature of international business activities and trade and through this the demand for air transport services.

According to reference [4], air transport has traditionally undergone larger growth than most other sectors in the economy. Furthermore, according to reference [3, p. 196], the demand for the total air travel grown roughly twice as fast as the world GDP. In this paper, the effect of changes in global and regional GDP are assumed to be incorporated in the trade elasticities, which will be discussed later on. This is valid according to reference [3], which states that the effect of changes in income, and thus in economic climate, on demand can be measured through an income elasticity. For business travel a trade elasticity is often used as an income-related variable.

It is well known that the US Dollar has recently followed a devaluating path for quite some time now. On the one hand this will cause goods from the US to be relatively cheaper for European companies and consumers. On the other hand, for US based companies and customers, doing business with European companies will become increasingly more expensive. Similarly, effects will be acting on ticket prices. It is assumed in this report that the net effect of changing currency exchange rates on demand is zero.

2) Price Elasticities

Next to income, a second factor that has a large impact on the financial drivers of air travel market demand is price [3]. The response of market demand with respect to price is expressed through the price elasticity coefficient (E_P).
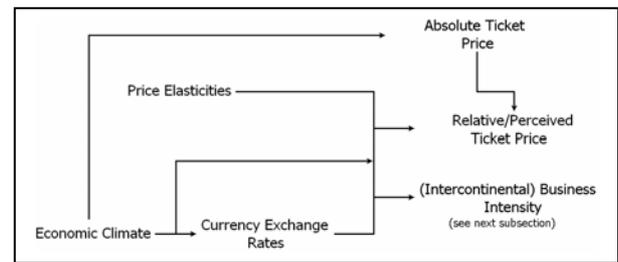

Figure 1. The interconnections between the different economic factors.

This elasticity coefficient is similar to the trade elasticity [3] and is expressed through:

$$E_P = \frac{\% \Delta D}{\% \Delta P} \qquad (1)$$

In this equation, ΔD is the change in demand and ΔP is the change in ticket price. Unlike the trade elasticity, price elasticities are always negative, due to the fact that a higher price will induce a lower demand.

Price elasticities are different for different passenger types. Because business travelers usually do not pay their own travel expenses, one would expect them to be less sensitive to changes in ticket prices. Indeed, whereas leisure travelers expose a price elasticity of around -2.0, the price elasticity for business travelers is generally less (absolute sense) than -1.0 [3]. This is affirmed by reference [5], from which an average price elasticity for business travelers of almost -0.8 can be found.

Other reasons for this low price elasticity may be that air travelers have less substitute methods of transport. Furthermore, they have no choice in destinations. Business travelers usually also have a higher valuation of time, so their need for their journey to be as short as possible is greater. Finally, business travelers often have to go straight to work after their flight. In order to better cope with this, a higher level of comfort may get them across less tired and with more energy.

3) Relative or Perceived Ticket Price

The absolute price is simply the price in true units of currency. This is different from the relative, or perceived, price since this is dependent also on overall economic climate and income and revenue standards. Also inflation can play a role. Inflation is, however, neglected in this paper, because prices and revenues are assumed to automatically adapt to this. The relative price is not directly determined in this paper. Rather, the effect on demand is immediately determined through the use of elasticities because this circumvents the need to first determine the perceived ticket price and its influence on demand.

B. Demand Inherent Drivers

1) Trade Elasticity

Besides influencing the relative or perceived ticket price, price elasticities, exchange rates and the economic climate also determine the intensity of global business and thus also between the US and Europe. This effect can be expressed using

a trade elasticity [3], which was already mentioned before. The trade elasticity (E_T) is defined as:

$$E_T = \frac{\%\Delta D}{\%\Delta T} \qquad (2)$$

In equation (2), ΔT is the change in trade. Reference [6] states that international business travel for the UK seems to be linked with changes in the volume of trade between the UK and important overseas markets.

With respect to business travel, reference [3] states that the growth of demand for business travel is directly affected by the level of economic activity and trade. According to reference [7], trade elasticities, elasticities where trade is used as an income-related variable, for business travel for Schiphol Amsterdam Airport are between 0.8 and 1.0.

2) Seasonality and Peak Problems

As is the case in many industries, the airlines business is exposed to seasonal variations in demand. These variations can be divided in daily, weekly and seasonal variations [3], and can be identified in an airline's flight schedule as peaks and troughs. A high difference between demand in peak periods and in off-peak periods can be severely unbeneficial to an airline. The reason for this is that a lot of extra capacity is needed to be able to satisfy the demand during a peak period. However, this capacity is not utilized or at best underutilized during the off-peak periods.

Peaks and troughs in demand for business travel are mainly dependent on the pattern of annual holidays, such as the Christmas holiday season, and working days and weeks for factories and offices. Daily demand for business travel is usually highest in the mornings and evenings. Similarly, weekly demand is usually highest at the beginning of the week, on Mondays and sometimes Tuesdays, and the end of the week, on Fridays [3]. Thus, certain peak demand variations for business air travel are dependent on each other. The reason for this lies in the scheduling of normal working days and weeks in Western countries.

This also causes the demand for business travel to slack off during the weekends. For all-business airlines, a possibility could be to fill excess capacity during the weekends and holidays with leisure passengers. These airlines could for example attract wealthier British leisure travelers that want to go shopping in New York. Additionally, they could decrease their capacity during the off-peak periods. An optimal way in which to do this would be to schedule maintenance and repair activities during these periods.

A general trend that is visible within the airline industry is that the peak problem is less severe in case there is a lot of business travel on a certain route [3]. The reason for this is that business travel is less prone to seasonality than leisure travel. Most companies simply keep on running during holidays and a lot even during the weekends. This means that business will also keep going. Furthermore, business travel is not dependent on seasonal climate and weather variations, contrary to leisure travel. Still, the peak problem can also be quite a challenge for airlines that transport a lot of business travelers.

C. Service Quality as Demand Drivers

1) Passenger Treatment and Service

References [8] and [9] state that service quality is defined by the end customer and that the quality the customer perceives is related to the difference between the customer's expectations and perceptions. Factors that are of relevance for the perceived quality of service are on-time performance, (schedule) flexibility, baggage handling, quality of food and beverages, seat comfort, check-in service and in-flight service and treatment [10].

Reference [11] concludes that there are two types of business travelers; "luxury-loving" and "no-frills". Clearly, the one of most interest to an airline having only business class seats is the first type. Reference [12] found service quality to be a major driver for demand for an airline's services.

In case an airline can increase its standards (over that of the competition) without increasing its ticket price, this will surely increase the demand for its services. In contrast, in case of a severe economic downturn, an airline may be forced to lower its standards and increase its ticket price, which would have a negative impact on demand.

2) Passenger Importance Segments

According to reference [13] there are five segments to be distinguished in the business traveler market. This segmentation is based on the importance given to different aspects of the travel experience and expenses by the traveler. The five segments are based on:

- Punctuality.
- Comfort.
- Price.
- The Price/Performance ratio.
- Catch-all/Flexibility (all of the above are important).

Which one is of importance to a particular airline is dependent on its exact business model. Whereas price is mostly important to lower and middle management employees, the other four segments are highly valued by middle to senior management executives that are frequent flyers [13]. Furthermore, the price/performance ratio is of more importance to entrepreneurs that have to pay for their flight themselves.

D. Promotion

A driver that an airline can actively influence to a large extent is the promotion of its services. This can be done using all kinds of advertising, frequent flyer programs, publications, etc. Through promotion, an airline can also influence its image as perceived by the outside world. To this respect, also performance in respect of safety, service quality and on-time delivery of passengers is critical. Especially for young airlines, promotion can be an important tool to gain market share, as these airlines are still well in the process of expanding and implementing major operations, i.e. they still have to prove their worth in the market.

Reference [14] indicates that advertisement programs aimed for business passengers should put extra emphasis on

high quality ground and in-flight services, connection options and on-time service, since these aspects are of most concern to business travelers. The reason for this is that business travelers usually have inflexible travel plans and do not personally pay the ticket fares [14].

Reference [15] has found that frequent flyer program membership induce the willingness for business passengers to pay significantly extra in order to fly with their carrier of choice. This thus means that frequent flyer programs can increase the demand for an airline's services.

E. Drivers from Competition

With respect to competition, the new all-business carriers are operating in quite a fierce market. The route between London and New York is one of the busiest air transport routes in the world. A large part of this stems from the demand from business travelers, since London and New York are actually among the most important business centers in the world.

Within this highly competitive market, quite a number of rivals is aiming at the business traveler. These include low-cost all-business (LCAB) carriers and regular airlines' business class (RABC). The latter are a major source of competition [1], mainly through their business class and/or first class services. Compared to the recently emerged low-cost all-business carriers, regular airlines' business class can offer more frequency and connectivity, but at the cost of higher ticket prices (roughly up to five times as much as the new low-cost all-business carriers. Furthermore, regular airlines are well established in the market, whereas the new airlines still need to gain trust from the market [1].

Another source of competition is the branch of airlines that provide on-demand business air travel (ODBA), generally called air-taxi services. Also, some large companies may operate their own corporate jets.

Currently, the low-cost all-business airlines have filled a niche in the air travel market. However, economic conditions may change and competition may be overlapping to a much larger extent that it currently is. Therefore, it should be noted that the exact threat from competitors is very difficult to estimate and forecast. It is, however, also not in the scope of this paper to do so.

III. DRIVER QUANTIFICATION

Having described all relevant factors, this section will indicate the amount of influence of each driver on the total demand within the model that will be developed in the next section. This will be done by indicating their specific method of use within the model.

1) Economic Drivers

With respect to the economic drivers, the basic model framework will only take into account the price and trade elasticities. These will constitute the model's back bone, providing a basis for the rest of the model. Thus these elasticities are considered the most important drivers for the demand forecasting model. As was stated in section II, an average price elasticity of -0.8 was found from reference [5].

The trade elasticity was found to typically range between 0.8 and 1.0. The exact value is dependent on the exact route and airline business model considered. It will simply be assumed that the trade elasticity is equal to 0.8 in this paper as a result of a lack of accurate data. When a more detailed demand prediction is needed from the model, more research should be performed on the exact value of both elasticities.

Based on these elasticities and predicted or assumed price and trade changes, a current demand can be extrapolated to a future demand. Obviously, for this method to be accurate, accurate predictions of the future price and trade levels compared to current price and trade levels are needed.

2) Demand Inherent Drivers

Apart from the price and trade elasticities, the model will include a correction for seasonality and peak occurrence. Basically, for this a so-called peak factor will be used, which will indicate the difference between peak and off-peak periods. In fact, any peak pattern can be corrected for using this factor.

Reference [3] finds a peak to trough ratio of 1.54 to 1.00 for the route New York – London. Thus this would mean the peak factor is 1.54 on that route. Note, however, that this peak factor is valid for the total passenger air travel, including all non-business passengers. Once again, for more accurate results from the demand forecast model, more research should be conducted on the true peak factor ruling on the particular route of interest.

3) Service Quality Standards

This driver is actually a lot harder to materialize. In the model, use will be made of an efficiency factor for the service quality standards to gain market share (E_{SQ}). In order to establish accurate values for this variable, the effect of service quality on demand should be further researched based on the particular airline of interest. Already quite some research has been performed on the effects of service quality on demand, some even of a quantitative nature [15], [16], [17]. References [15], [16] and [17] provide a good basis for this further quantitative research.

4) Promotion

With respect to promotion, the model will employ a so-called promotion efficiency factor (E_{PR}), which is similar to the service quality efficiency factor. The promotion efficiency factor is simply expressed as a percentage increase in demand resulting from a certain promotional activity. Further research on a per airline and route basis should establish exact values for the promotion activities' efficiency to induce more demand. A good starting point for such research is provided by reference [12].

5) Competition

While three important sources from competition were found in the previous section, in the model, these sources of competition will be grouped into one competition variable. This is done because this paper focuses on the total model and not on the specific characteristics of competition (or any other variable in that respect). Thus:

$$MS_{COMP} = MS_{LCAB} + MS_{RABC} + MS_{ODBA} \qquad (3)$$

In this equation MS_{comp} stands for competition Market Share. Now, any airline's future market share is given by the sum of the current total market ($M_{Tot\,i}$) and the change in total market (ΔM_{Tot}), minus the market share of the competition:

$$MS_{airline\,i+1} = M_{Tot\,i} + \Delta M_{Tot} - MS_{COMP\,i+1} \qquad (4)$$

Note that the future is denoted by the subscript i+1, while the current is denoted by i.

Thus, it is evident that an airline's market demand is dependent on the market share it can capture, which it can partly influence by increasing its internal capabilities of service quality, its ticket price and its promotion intensity for example, and on the developments in the total market, which it cannot influence. The change in total market is by definition of the trade elasticity determined from the change in trade and the trade elasticity.

IV. DEVELOPMENT OF THE DEMAND FORECAST MODEL

A. Model Back Bone

As was stated, the model's back bone is based on the use of price and trade elasticities. When the current total demand for business air travel is known, as well as a trade elasticity value and an expected growth or decline in trade levels for the future time or period of interest, the total demand for that future time frame can be found through:

$$M_{Tot\,i+1} = M_{Tot\,i} \times (1 + E_T \times \Delta T) \qquad (5)$$

Before being able to apply a price elasticity on this, in order to assess the effect of a ticket price change, first the market of the particular airline of interest in the future period ($M_{AL\,i+1}$) must be determined. This is done by multiplying by one minus the competition's market share in the future period of interest:

$$M_{AL\,i+1} = M_{Tot\,i} \times (1 + E_T \times \Delta T) \times (1 - MS_{COMP\,i+1}) \,(6)$$

What remains now is the total expected demand for the airline in the future, should no changes with respect to price, service quality and promotion and airline image occur. It should be clear that for the model to be accurate, the expected market competition market share should be carefully predicted.

As was already hinted, the next step is to include the effect of ticket price on the demand through the use of the price elasticity. Equation (7) shows the result:

$$\begin{aligned} M_{AL\,i+1} = M_{Tot\,i} &\times (1 + E_T \times \Delta T) \times (1 - MS_{COMP\,i+1}) \\ &\times (1 + E_P \times \Delta P) \end{aligned} \qquad (7)$$

B. Model Refinement

The back bone of the model is now firmly established. The model can now be refined by adding corrections for service quality and promotion and image. Furthermore, also a variable peak factor can be implemented in order to take into account a variable peak and trough pattern in demand. First of all, a correction for service quality changes is added:

$$\begin{aligned} M_{AL\,i+1} = M_{Tot\,i} &\times (1 + E_T \times \Delta T) \times (1 - MS_{COMP\,i+1}) \\ &\times (1 + E_P \times \Delta P) \\ &+ (M_{Tot\,i} \times (1 - MS_{COMP\,i})) \times E_{SQ} \end{aligned} \qquad (8)$$

Thus, an increase (or decrease) due to changing levels of service quality is added. It is assumed in this that a current improvement (or deterioration) in service quality results in an increase (or decrease) in demand in the future, because an increase in service quality is assumed to only reach the passengers that are currently flying with the airline of interest. Thus, this increase (or decrease) is based on the current time market demand.

Similarly, an addition for the promotion effect on demand can be made. The effect of promotion is acting on the market share the airline of interest can obtain in the future time period. Thus, the factor ($1-MS_{COMP\,i+1}$) is determined from ($1-MS_{COMP\,i}$) multiplied by ($1+E_{PR}$) (9).

$$\begin{aligned} M_{AL\,i+1} = M_{Tot\,i} &\times (1 + E_T \times \Delta T) \\ &\times (1 - MS_{COMP\,i}) \times (1 + E_{PR}) \\ &\times (1 + E_P \times \Delta P) \\ &+ (M_{Tot\,i} \times (1 - MS_{COMP\,i})) \times E_{SQ} \end{aligned} \qquad (9)$$

Finally, a peak factor (PF(x)) provides the final refinement to the demand forecasting model. From the notation, it should be clear that the peak factor is a variable. One could either use a continuous peak function or a number of discrete peak factor values, both obtained from experience or general market trends. The final model thus becomes:

$$\begin{aligned} M_{AL\,i+1} = [M_{Tot\,i} &\times (1 + E_T \times \Delta T) \\ &\times (1 - MS_{COMP\,i}) \times (1 + E_{PR}) \\ &\times (1 + E_P \times \Delta P) \\ &+ (M_{Tot\,i} \times (1 - MS_{COMP\,i})) \times E_{SQ}\,] \\ &\times PF(x) \end{aligned} \qquad (10)$$

C. Using the Demand Forecasting Model

There are basically two instances in which this model will provide a preliminary demand forecast. The first situation is when an all-business airline is intending to open a new route

and needs to know its potential. The second case is when an airline is unsure of whether or not to continue servicing a certain route or when it is unsure of how much (extra) capacity will be needed.

1) Opening a New Route

For this case the model is somewhat simplified, because in this case the new entrant on a certain route does not yet have any market share, i.e. (1-MS$_{COMP\ i}$) is equal to zero. In effect, the market share the airline can obtain in the future period needs to be obtained through a prediction. Also, it is assumed that the influence of service quality is negligible, because on the new route nobody has had the opportunity to actually experience the quality of service. Thus, the model becomes as in (11).

$$M_{AL\,i+1} = [M_{Tot\,i} \times (1 + E_T \times \Delta T) \\ \times (1 - MS_{COMP\,i+1}) \\ \times (1 + E_P \times \Delta P)] \\ \times PF(x) \tag{11}$$

This means that the effect of promotion of the airline on the new route is incorporated in the (1-MS$_{COMP\ i+1}$) variable, i.e. it is taken along in the prediction for the market share the new airline on the route can obtain.

2) Continuing an Existing Route

In this case, the model is used in its full extent, as given in (10). The variables that are needed to operate the model are:

- The trade elasticity E$_T$.

- The expected change in trade between the two ends of the route ΔT.

- The price elasticity E$_P$.

- The expected change in ticket price ΔP.

- The current total market M$_{Tot\ i}$.

- The current competition market share MS$_{COMP\ i}$.

- The expected gain in market share due to promotion E$_{PR}$.

- The effect of a change in service quality on demand E$_{SQ}$.

- A peak function or peak factor PF(x).

V. MODEL APPLICATION

Now that the model has been fully developed, its forecasting ability can be assessed based on specific data for one of the new all-business airlines performing transatlantic operations at the moment. For this, Eos Airlines has been selected for no other reason other than that it is still in operation, contrary to MAXjet. Firstly, an existing route will be investigated using the demand forecasting model. This is Eos Airlines' route between London and New York. Secondly, its plans to open a new route between Paris and New York will be compared to the model's predictions.

A. The London – New York Route

Because this is an existing route, the full model will be applied. Table 1 summarizes the data applicable to this route. Because no adequate data is available for most variables, most data is (partially) based on assumptions. This is, however, not a problem, because the assumed values are close enough and are capable of demonstrating the use and functioning of the demand forecasting model.

The trade elasticity is assumed from the previously found range to be equal to 0.8. The trade change is an average from trade growth factors that actually occurred between 2004 and 2006 between the US and the EU, obtained from reference [18]. The price elasticity was already found to be equal to -0.8 for business travelers, whereas the change in ticket price is an average determined from reference [19]. All three the current total market, current competition market share and the peak factor have been obtained from analysis of the flight schedules of all carriers operating between London and New York, where average load factors of 50 and 80 percent have been assumed (due to a lack of accurate data) for business class and first class seats respectively. From these schedules all business class and first class seats are seen as part of the total market for Eos Airlines. Note that the current total market is a monthly average over the months December 2007 to February 2008. Finally, the promotion and service quality efficiencies have simply been estimated at 30 and 70 percent respectively. This may seem high, but note that promotion is likely to be quite high for a new airline like Eos Airlines, for a large part also due to word-of-mouth promotion. Similarly, by opening up extra routes and increasing capacity [1], Eos Airlines will drastically improve its service quality with respect to its connectivity and schedule characteristics (more flights a day).

Substituting all these values in the model (10) will result in an average forecasted demand over the months December 2008 to February 2009 (the off-peak period) of 3675 passengers per month. For the peak period, which is from June to August 2008, this is 3909 passengers per month.

Knowing that Eos Airlines will operate 29 one way flights a week in 2008 [2], that it holds 48 seats per aircraft [2] and has an average load factor of 70 percent [1], one can determine that it has a capacity of almost 4200 seats per month.

TABLE I. LONDON-NEW YORK ROUTE DATA

Variable	Symbol	Value	Unit
Trade elasticity	E$_T$	0.8	-
Trade change	ΔT	9.5	%
Price elasticity	E$_P$	-0.8	-
Ticket price change	ΔP	7.75	%
Current total market	M$_{Tot\ i}$	~38000	pax/month
Current market share competition	MS$_{comp\ i}$	95.2	%
Promotion efficiency	E$_{PR}$	30	%
Service quality efficiency	E$_{SQ}$	70	%
Peak factor	PF	1.064	-

This can be seen to comply quite good with the forecasted maximum demand of 3909 passengers per month, yielding a difference of about 6.4 percent.

B.　The Paris – New York Route

Quite similarly, the Paris – New York route can be investigated. Because this is a new route for Eos Airlines, the simplified version of the demand forecasting model is used. Table 2 presents the data for this case.

Note that most variables are the same as for the previous case. The current total market share and the peak factor have been obtained from analysis of the flight schedules of all airlines operating between Paris and New York, where, once again, load factors of 50 and 80 percent have been assumed for business class and first class seats respectively. Furthermore, the future market share of the competition is simply assumed to be equal to that of Eos Airlines' competition on the route London – New York because no adequate means for estimation is available.

Once again, substituting all values into the model, this time (11), will result in a forecasted demand of 680 passengers per month for the off-peak period December 2008 to February 2009. Similarly, for the peak period June to August 2008 this is 903 passengers per month.

Unfortunately, no announcements have been made yet about the number of flights to be operated between Paris and New York. However, when assuming an initially low load factor of 35 percent, as Eos Airlines experienced during its first months of operation between London and New York [20], it can be found that the airline needs to perform 14 (one way) flights per week from London to New York and vice versa. This is in accordance with reference [21], which was created during the airline's initial months of operation.

VI.　Limitations and Recommendations

A.　Forecasting Model Limitations

With the demand forecasting model developed and found to operate seemingly well, its limitations will be shortly discussed below.

First of all, the model in its current state is limited to use applicable to all-business airlines only. Modifications could be made in order to prepare the model for use for all airlines, yet this would require quite some additional research to occur (see below). The difference in the model as it is and the model as it would be to be valid for any airline is mainly making the model as it is simpler. In order to make the model valid for any airline, one would have to incorporate quite some complexities, related to having more than one service class and more than one type of passenger, each type having different specifics and requirements. For leisure travelers for example, also destination becomes important and for them, rather than trade elasticities, income elasticities become important. All these complexities would make the model a lot more elaborate, as well as the research that would be needed to obtain the model.

TABLE II.　　Paris-New York Route Data

Variable	Symbol	Value	Unit
Trade elasticity	E_T	0.8	-
Trade change	ΔT	9.5	%
Price elasticity	E_P	-0.8	-
Ticket price change	ΔP	7.75	%
Current total market	$M_{Tot\ i}$	~14000	pax/month
Future market share competition	$MS_{comp\ i+1}$	95.2	%
Peak factor	PF	1.328	-

Furthermore, the model is only suitable for the short term use, depending on the exact accuracy of the variables introduced in the model, and provides a preliminary demand forecast only (back of the envelope calculations). More detailed demand forecasting may be required.

Finally, the model neglects any interrelations between the service quality, promotion and competition threats (except for the relation between the competition market share and the promotion efficiency).

B.　Recommendations for Further Research

Recommendations for further research are numerous, all aimed at improving the forecasting ability of the model or the accuracy of predicting the variable values needed for the model.

1)　Recommendations with respect to Model Refinement

The most important recommendation would be for the investigation of the exact quantification of the promotion efficiency and service quality efficiency. In the model's application (section V), quite crude assumptions have been made for these variables, seriously limiting the accuracy of the predictions. Further research could take away this shortcoming. This research will then also yield possible better ways to express these factors in the model. For example weight factors could be used in the model itself or within the factors that are input to the model.

Next, the model uses one variable with respect to the competition, i.e. its market share. The reason why the factor $(1-MS_{COMP})$ was used is because this forces the model user to carefully assess the threats from the competition, rather than simply estimating a market share that the user feels can be achieved by the own airline. In order to increase the accuracy and predicting power of this model feature, further research into the distinctive competitive threats from different competitions (LCAB, RABC, ODBA) should be performed.

2)　Recommendations with respect to Data Accuracy

In order to improve the accuracy of the model's back bone structure, the most stringent recommendation for further research with respect to data accuracy would be to investigate the exact value and possible variation of price and trade elasticities between two destinations of interest. Similarly, also the expected trade and ticket price changes should be investigated.

An important consideration with respect to all parameters used, is their variability and sensibility and their effects on the model results, i.e. the model's accuracy, given a certain variability in the parameters. For this, Monte-Carlo simulations would be well suitable. The reason why these have not yet been

performed is because some of the more "abstract" parameters, such as the effects of promotion and service quality, should first be further investigated. Once the way in which these parameters influence the demand is more clearly determined, Monte-Carlo simulations should best be performed in tandem with further research on how to incorporate these factors.

Finally, as a user of the model, the current total demand should be more accurately deduced. The same holds for the exact peak factor or, better, peak function for the particular airline and route of interest used in the model.

VII.   CONCLUSION

The purpose of this paper was to develop and demonstrate a preliminary demand forecasting tool for the newly emerged all-business airlines operating across the Atlantic. The model incorporates a number of demand drivers, being the effects of trade and ticket price changes, the effects of service quality changes and promotion, the effect of competitive threats, and finally the effect of seasonality. This is also the difference of this model with respect to generic demand models as described by reference [3] for example. This model takes into account the "physical" parameters instead of only empirical factors and trade and/or price elasticities.

Using data and estimated data for Eos Airlines, the model has undergone a first validation calculation. Even though the data input was for a large part based on assumptions and estimations, the model's first forecasting accuracy for Eos Airlines' existing route between London and New York was found to be around 6.4 percent.

Although quite a lot more future research is needed for the model to perform with accuracy, the model interrelates a lot of previously separate areas of research, such as marketing, service quality, seasonality and trade and price changes and effects. Furthermore, the model does provide an initial framework, suitable for adapting if needed, to build on, as well as the crude forecasting abilities to be used in a preliminary route profitability assessment.

REFERENCES

[1] M. Morrison, "Premier upstarts," in Flight International, 19-25 June 2007, pp. 66-69.

[2] Eos Airlines, "Eos Airlines celebrates two years of success by announcing two new routes," Eos Airlines Press Release, New York: October 18, 2007.

[3] R. Doganis, "Flying off course: the economics of international airlines," 3rd ed., London: Routledge, 2002.

[4] ICAO, "Industry situation and airline traffic outlook," Montreal: Worldwide Air Transport Conference 2003: Challend and opportunities of liberalization.

[5] M. Brons, E. Pels, P. Nijkamp and P. Rietveld, "Price elasticities of demand for passenger air travel: a meta-analysis," in Journal of Air Transport Management, vol. 8, issue 3, May 2002, pp. 165-175.

[6] S. Maiden, "Heathrow terminal 5: proof of evidence forecasting," London: British Airports Authority, 1995.

[7] X. Veldhuis, "Forecasting process at Amsterdam Airport Schiphol," Geneva: Worldwide Forecasting, 1988-92 Conference, IATA, September 1988.

[8] A. Parasuraman, V.A. Zeithaml, L.L. Berry, "A conceptual model of service quality and its implications for future research," in Journal of Marketing, vol. 49, no. 4, Autumn 1985, pp. 41-50.

[9] A. Parasuraman, V.A. Zeithaml, L.L. Berry, "SERVQUAL: a multiple-items scale for measuring consumer perceptions of service quality," in Journal of Retailing, vol. 64, no. 1, Spring 1988, pp. 12-50.

[10] K.M. Elliot, D.W. Roach, "Service quality in the airline industry: are carriers getting an unbiased evaluation from consumers?" in Journal of Professional Services Marketing, vol. 9, issue 2, 1993, pp. 71-82.

[11] C. Huse and F. Evangelho, "Investigating business traveller heterogenity: low-cost vs full-service airline users?," in Transportation Research Part E: Logistics and Transportation Review, vol. 43, issue 3, May 2007, pp. 259-268.

[12] M. Abrahams, "A service quality model of air travel demand: an empirical study," in Transportation Research Part A: General, vol. 17, issue 5, September 1983, pp. 385-393.

[13] T. Teichert, E. Shehu and I. Wartburg, "Customer segmentation revisited: the case of the airline industry," in Transportation Research Part A: Policy and Practice, vol. 42, issue 1, January 2008, pp. 227-242.

[14] W.G. Browne and R.S. Toh, "Targeting airline advertising copy," in Annals of Tourism Research, vol. 24, issue 4, October 1997, pp. 1005-1008.

[15] K. Proussaloglou and F.S. Koppelman, "The choice of air carrier, flight, and fare class," in Journal of Air Transport Management, vol. 5, issue 4, October 1999, pp. 193-201.

[16] D. Gursoy, M.H. Chen, H.J. Kim, "The US airlines relative positioning based on attributes of service quality," in Tourism Management, vol. 26, issue 1, February 2005, pp. 57-67.

[17] F.Y. Chen, Y.H. Chang, "Examining airline service quality from a process perspective," in Journal of Air Transport Management, vol. 11, issue 2, March 2005, pp. 79-87.

[18] World Trade Organization, "International trade statistics 2007," Geneva: WTO Publications, 2007.

[19] American Express Business Travel, "Business travel demand will outpace capacity in 2008 and drive rate increases across air, hotel, car rental and meetings," New York: American Express Business Travel Press Release, October 2007.

[20] A. Ellson, "Doubts over business class airlines," in Times Online, March 16, 2006
http://business.timesonline.co.uk/tol/business/markets/united_states/artic le741770.ece, retrieved January 24, 2008.

[21] Eos Airlines, "Eos Airlines announces second daily NY-London flight," Eos Airlines Press Release, New York: July 10, 2006.