A Critical Evaluation of U.S. Airlines' Service Quality Performance: Lower Costs vs. Satisfied Customers

H. Muge Yayla-Kullu[1] & Praowpan Tansitpong[2]

[1] Lally School of Management, RPI, Troy, NY-12180, USA

[2] Mahidol University International College (MUIC), Nakhonpathom-73170, Thailand

Correspondence: H. Muge Yayla-Kullu, Lally School of Management, RPI, Troy, NY-12180, USA. Tel: 1-518-276-3337. E-mail: yaylah@rpi.edu

Received: August 15, 2013 Accepted: September 17, 2013 Online Published: November 8, 2013

doi:10.5430/jms.v4n4p1 URL: http://dx.doi.org/10.5430/jms.v4n4p1

Abstract

Providing good quality services enables airlines to retain customer satisfaction, loyalty, market-share, and ultimately profitability. However, U.S. airlines compete primarily on price and are not known for good quality service. There have been a growing number of low-cost airlines. In such a business landscape, we study whether a full-service carrier indeed outperforms a low-cost carrier in terms of service quality when we control for the operational costs. We are also interested to find out which dimensions of service quality have the greatest potential for improvement and how these potential improvement areas differ for low-cost and full-service carriers. We contribute to the service operations literature that looks at efficiency by incorporating customer service quality outputs which has never been done before for the airline industry. We find that major airlines in the industry are lacking staff enthusiasm, adequate cabin presence, and behavioral consistency. Moreover, 33.3% of firms need to deliver more comfortable seats, better meals, in-flight entertainment, and cleaner surroundings. On the other hand, notably, U.S. airlines are operating quite efficiently when it comes to service supply chain quality. We also provide managerial guidelines for U.S. airlines to improve their service quality and overall customer satisfaction.

Keywords: service quality, airline efficiency, services design and delivery

1. Introduction

Quality is defined as excellence (Garvin, 1984), value (Cronin and Taylor, 1992), or service that meets or exceeds expectations (Parasuraman, et al, 1985). It plays a role in every dimension of a business including prices, market shares, costs, and profits (Garvin, 1988). Properly measured, it reflects the way a service is delivered and outcomes of the interaction between customers and the organization. Comparing performances of service organizations without taking the quality of service into account would be a trivial pursuit. In a service industry, "*the (perceived) quality of service has to be accounted for, since it is closely intertwined—and often conflicts—with economic resource utilization*" (Becker et al., 2011, p. 2). In this paper, we fill such a gap for the airline industry and compare U.S. airlines' efficiencies by focusing on their service quality achievements which has not been done before.

Providing good quality services to passengers is important for all airlines; because this enables them to retain customer satisfaction, loyalty, market-share, and ultimately profitability. A high level of service quality can distinguish one airline from others and lead customers to choose that airline over another. However, historically, U.S. airlines compete primarily on price and are not known for good quality service (McClenahan, 1991). This price competition leads airlines to suffer from intrinsically low profit margins (Hanlon, 1999; Sissen, 1999). As a result, there have been a growing number of low-cost airlines competing in the industry. Low-cost airlines follow a focus strategy on lowering operational costs and offering only low fare class with no-frills. On the other hand, full-service airlines offer multiple classes, more comfortable seats, better connections, and various onboard products (Yayla-Kullu, 2013).

In such a business landscape, it is worthwhile to study whether a full-service carrier indeed outperforms a low-cost carrier in terms of service quality when we control for the operational costs. In other words, when an airline give up on service quality by following a no-frills strategy, can they indeed find a place on the efficient frontier for service quality as a low-cost carrier? In addition, we are interested to find out which dimensions of service quality have the greatest potential for improvement in the U.S. airline industry and how these potential improvement areas differ for low-cost and full-service carriers.

The rest of this paper is organized as follows. In the next section, we review the literature. Methods, data, and variables are explained in section 3. Section 4 presents the model. We discuss the results and present important managerial insights in Section 5. Our conclusions are provided in the final section.

2. Literature Review

There is a rich literature that discusses the efficiency of airlines (Douglas and Miller, 1974; Graham et al., 1983; Windle, 1991; Schefcyzk, 1993; Good et al, 1995; Fethi, et al, 2000; Scheraga, 2004; Barbot et al, 2008). While all papers agree to use costs and expenditures as the input, the measure of output (i.e. performance) varies. Majority of the literature use capacity measures such as the load factors together with financial measures such as revenue passenger miles (Graham et al, 1983; Truitt and Hayden, 1994; Good et al, 1995). However, such measures do not have any implications on how the work is done or how it should be done. The discussions in these papers are limited to reducing costs. This line of research by and large overlooks the customer service quality aspect of airline industry. Note that such financial efficiency is also shown to be not correlated with the actual performance and effectiveness of the firm (Ho and Zhu, 2004). In this paper, we aim to fill this gap and provide detailed managerially relevant insights regarding customer service above and beyond the financial efficiency.

There are also a number of studies that focus on measuring the "dissatisfaction" of the customers such as on-time performance, mishandled luggage, and frequency of complaints (Bitner et al, 1990; Bejou et al, 1996; Lapre and Scudder, 2004; Wyld et al, 2005; Tsikriktsis, 2007; Sherry et al, 2007). Such output measures focus on how badly the work is done instead of the actual customer satisfaction. Moreover, Parast and Fini (2010) found that such dissatisfaction measures are not a significant predictor of profitability in the U.S. airline industry. While it may be important to measure how "badly" the work is done, it is more important to measure how "well" the service is delivered. Actual experience of the customer builds the image of the firm especially in the airline industry. It is particularly critical to make sure that passengers have a good experience even when there are no significant failures (e.g. delayed flights, lost luggage, and complaints). Hence, in this paper, we aim to fill this gap and evaluate the U.S. airlines' efficiencies based on customer-perceived service quality measures.

Service quality is a commonly used output measure in other service industries including banking (Roth and Jackson, 1995; Soteriou and Stavrinides, 1997; Soteriou and Zenios, 1999; Metters et al., 1999; Kamakura et al., 2002; Sherman and Zhu, 2006a), marketing (Parasuraman, 2002; Ayanso and Mokaya, 2013), information systems (Becker et al, 2011), maintenance (Backhaus et al., 2011), hotels (Yilmaz and Bititci, 2006), and airport operations (Adler and Berechman, 2001). Soteriou and Zenios (1999) study how the operational characteristics of services translate into customers' perception of quality. In their study, resource investments, such as training, employee selection, and recruitment are linked to improvements in service quality. Service quality is also used in a mediating role that bridges inputs to customer satisfaction to profitability (Kamakura, et al, 2002; Backhaus, et al, 2011). Backhaus et al. (2011) points out that "*service quality as perceived by the customer acts as a 'link' between service inputs used by the service provider and some financial performance measure that relate to service sales*." However, the efficiency relationship between input resources (costs) and customer perceived quality has never been studied within the airline industry and we aim to fill this gap with this paper.

3. Methodology

We use Data Envelopment Analysis (DEA) to determine the most efficient airlines in transforming their resources into good quality services. DEA is a non-parametric technique that generates a comparative ratio of weighted outputs to inputs for each decision making unit (DMU). The model compares multiple input and output measures simultaneously into a single measure of performance. We compare airlines on how well they transform their resources (personnel, equipment, and flight operations) to achieve their level of service quality in multiple dimensions including employee behavior, physical surroundings, and service supply chains. This helps us generate managerially relevant insights with regard to resource allocations as well as improvements in customer service quality of the U.S. airline industry. It allows us to compare operational and services management of each airline with best practices in the sample. We will be able to identify paths to achieve real improvements in customer service quality in the U.S. airline industry.

In this section, first we discuss U.S. airline industry and present our sample. Next we describe the inputs and outputs in detail. Finally, we present the model.

3.1 Sample

The airline industry has undergone a considerable change, especially in the aftermath of September 11, 2001. Airlines are cutting costs as competition is increasing. Business models focus on simplicity and getting overall costs down to 40–50% of incumbent costs (Doganis, 2002). However, airline efficiency is increasingly questioned, particularly as to whether lower fares make airlines perform better in terms of providing good quality services or not.

Our analysis is performed with data collected at the end of 2011 on a sample of U.S. based airlines. Our sample covers 86% of the industry (12 out of 14 national carriers). Both low-cost carriers (Allegiant Airlines, Frontier Airlines, JetBlue, Southwest Airlines, and Spirit Airlines), and full-service airlines (Alaska, American, Continental, (Note 1) Delta, Hawaiian, United, and US Airways) are well represented.

The input resources data is obtained from the U.S. Department of Transportation's Bureau of Transportation Statistics (Transtats). In Transtats Schedule P-1.2, we use the data for operating expenses, labor expenditures, number of employees, and available seat miles.

We merged the information from Transtats with detailed information on service quality provided by a professional ranking firm. Skytrax is a world-recognized brand that provides professional audit and service benchmarking programs for airlines on product and service quality (http://www.skytraxresearch.com/). They employ professional auditors to assess the quality of the work done in an airline, both onboard and in the airport terminals. These evaluations are based on consistent standards; they are unbiased and comparable across different regions. The best airlines in the world highly recognize these quality awards presented by Skytrax. When an airline is awarded a "Skytrax star-ranking" or advances to a higher ranking, they immediately announce this news by publishing press releases and posting it on their websites' most visible spots. Both overall star rankings and detailed quality assessment results are publicly available on the Skytrax website. This data has also been used in various academic studies (e.g., Tsantoulis and Palmer, 2008; Han et al., 2012). We employ this detailed data on service quality assessments as our performance measures.

3.2 Resource Input Measures

Following the literature, we use two categories as our inputs for the DEA model: labor and operating expenses (Schefcyzk, 1993; Fethi, et al, 2000; Alder and Golany, 2001; Barbot, et al, 2008). These inputs represent resource investments for personnel, equipment, and flight operations. We compute LABOR as a combination of expenses including salaries of pilots and co-pilots, trainees and instructors, ground personnel, and flight attendants, and personnel benefits. Operating expenses (OPT_EXP) is calculated to include flight operations, maintenance, passenger service, aircraft service, promotion and sales, and general administrative expenses. Note that these two cost categories are the two capital spending categories that have the most influence on a customer's service experience during, before, and after a flight.

Note that the customer service quality measures are comparable across different airlines while the operating costs largely vary based on the size of the airline. It is a well-known fact that the size of a decision making unit has a significant effect on its operational costs (Paradi et al, 2004). Unless properly controlled, smaller airlines (who always have lower total costs) appear to be more efficient in terms of customer service quality. For example, American Airlines (AA) is operating with almost 10 times greater costs than Frontier Airlines. It is not reasonable to expect 10 times better service quality from AA (which would be the case if no adjustments were made). Sherman and Zhu (2006a) show that bank branches can be found to be efficient even though they have low quality, because lower sized inputs compensate for low quality. To overcome this problem, previous studies divided their data into comparably-sized homogeneous groups (Soteriou and Stavrinides, 1997) or develop quality-adjusted algorithms that use an elimination-of-units method (Sherman and Zhu, 2006a). Neither of these approaches would be applicable in our context as the dataset is relatively small as it is.

Table 1. Input scores

Airline	OPT_EXP	LABOR	ASM	EMP	OPT_EXP/ ASM	LABOR/ EMP
Alaska Airlines	2,698,690	538,349	8.30E+13	9,599	3.25E-08	56.1
Allegiant Air	639,819	87,927	3.25E+13	1,701	1.97069E-08	51.7
American Airlines	12,526,779	2,466,541	5.13E+14	70,577	2.44272E-08	34.9
Continental Airlines	6,388,933	1,289,344	4.39E+14	40,473	1.45462E-08	31.9
Delta Air Lines	14,671,780	2,818,638	2.68E+15	81,853	5.48397E-09	34.4
Frontier Airlines	1,391,555	158,101	3.16E+13	5,244	4.40174E-08	30.1
Hawaiian Airlines	1,226,375	174,372	1.08E+13	4,314	1.13869E-07	40.4
JetBlue Airways	3,385,906	533,462	1.35E+14	14,022	2.51549E-08	38.0
Southwest Airlines	12,319,699	2,852,816	3.23E+15	38,079	3.81389E-09	74.9
Spirit Airlines	739,415	86,204	1.31E+13	3,067	5.63697E-08	28.1
United Airlines	8,546,356	1,426,015	6.07E+14	46,490	1.4088E-08	30.7
US Airways	6,985,325	1,090,965	5.38E+14	32,348	1.29728E-08	33.7
Mean	5,960,052	1,126,894	6.92E+14	28,980	3.06E-08	40.42
St.Dev.	4,860,442	1,018,966	1.04E+15	26,213	2.91E-08	13.24

In order to control for the varying firm size problem, we use a scaling approach. We adjust the total expenses by the size of the whole operation. For the first input variable, labor expenses, we use the total number of employees (EMP) as the measure of firm size. This is a common control measure for firm size in the literature (Tracey and Tan, 2001; Rust et al., 2002). Similarly, available seat miles (ASM) is an appropriate measure to identify the size of the operation and control for the operational costs (Schefcyzk, 1993; Fethi et al., 2001; Scheraga, 2004). Adjustments are done by dividing the raw cost data by the size variable of interest in each case. Inputs scores before and after adjustments are shown in Table 1 (Note 2).

3.3 Service Quality Output Measures

In most service operations, actual delivery and execution of the service take place in the presence of the customer for the service product to be fully realized (Fitzsimmons and Fitzsimmons, 2011; p. 18). Such a service delivery has many elements. In order to understand the service performance, we must first identify and articulate the elements that make up a service. In this paper, we use Roth and Menor's (2003) "Service Delivery Systems Architecture" to identify the types of service design choices. According to this model, a firm makes service design decisions in three categories: (1) structural choices such as its physical surroundings and tangible products, (2) infrastructural choices such as employees and behavioral practices, and (3) integration choices such as service supply chains and coordination.

Service standards are well established in the airline industry. We use service quality assessments from Skytrax in our model. Skytrax is a globally recognized, independent professional ranking organization that provides detailed quality analysis for over 800 different areas of product and service delivery in the airline industry (Skytrax, 2012: http://www.skytraxresearch.com/). They employ professional auditors to assess the quality of the work done in an airline, both onboard and in the airport terminals. In this study, all quality measurements that are publicly available on Skytrax website for all firms in year 2011 are included. These quality measurements are as follows: *seat comfort, in-flight entertainment, meals, cabin cleanliness, washroom cleanliness, staff service efficiency, staff language skills, staff enthusiasm, cabin presence through flight, consistency among staff, check-in, arrival service,* and *baggage delivery*.

As *seat comfort, in-flight entertainment, meals, cabin cleanliness,* and *washroom cleanliness* are all related to tangible aspects of the service provided by airlines, we categorize them as "Structural Quality" in our framework. Similarly, *staff service efficiency, staff language skills, staff enthusiasm, cabin presence through flight,* and *consistency among staff* are all related to the people aspect of the service. We categorize them as "Infrastructural Quality". This category is particularly important for us as previous studies have shown its significant influence on customer satisfaction for airlines (Babbar and Koufteros, 2008). Lastly, *check-in, arrival service,* and *baggage delivery* are all related to before- and after-flight experience and complement the service experience. Hence, we categorize them as "Service Supply Chain (SSC) Quality".

All assessments are based on a 5-star scale where five stars represent the most excellent service. We add the number of stars of a firm for each dimension to find the score in each service quality category. Hence, 25 is the maximum score any airline can get in both structural and infrastructural categories. Similarly, 15 is the maximum score any airline can get in SSC category. Output scores in our sample are provided in Table 2.

Table 2. Output scores

Airline	Structural	Infrastructural	SSC
Alaska Airlines	15.0	13.5	9.0
Allegiant Air	10.5	13.5	7.0
American Airlines	16.0	14.5	10.0
Continental Airlines	16.5	15.0	9.0
Delta Air Lines	13.5	15.0	8.0
Frontier Airlines	15.5	13.5	7.5
Hawaiian Airlines	13.3	12.5	9.0
JetBlue Airways	19.3	19.0	11.5
Southwest Airlines	10.5	14.0	8.8
Spirit Airlines	12.8	14.0	9.0
United Airlines	13.8	12.0	8.0
US Airways	14.0	12.0	9.0
Mean	14.23	14.0	8.82
St. Dev.	2.38	1.78	1.12

3.4 Normalization of the Dataset

In order to ensure that all data have similar magnitude to avoid any calculation pitfalls, we have normalized the data as suggested by Sarkis (2002). The process to mean normalization is done in two steps. The first step is to find the mean of the data set for each input and output, and the second is to divide each input or output by the mean for that specific factor. The dataset in its final form, adjusted (_A) and normalized (_N), is presented in Table 3.

Note that the standard deviations of the input scores are significantly higher than the output scores. Hence, we use a variable returns to scale approach when calculating the overall efficiencies.

Table 3. Final dataset

Airline	OPT_EXP_A_N	LABOR_A_N	Structural_N	Infrastructural_N	SSC_N
Alaska Airlines	1.063	1.387	1.054	0.961	1.021
Allegiant Air	0.644	1.279	0.738	0.961	0.794
American Airlines	0.799	0.865	1.125	1.033	1.134
Continental Airlines	0.476	0.788	1.160	1.068	1.021
Delta Air Lines	0.179	0.852	0.949	1.068	0.907
Frontier Airlines	1.439	0.746	1.090	0.961	0.851
Hawaiian Airlines	3.724	1.000	0.935	0.890	1.021
JetBlue Airways	0.823	0.941	1.357	1.353	1.304
Southwest Airlines	0.125	1.853	0.738	0.997	0.998
Spirit Airlines	1.843	0.695	0.900	0.997	1.021
United Airlines	0.461	0.759	0.970	0.855	0.907
US Airways	0.424	0.834	0.984	0.855	1.021
Mean	1	1	1	1	1
St. Dev.	0.95	0.33	0.17	0.13	0.13

3.5 DEA Assumptions Review

Inputs and outputs of a DEA model should follow three homogeneity assumptions as discussed by Dyson et al. (2001). Below is a description of how we address each assumption in this study.

- First of all, each DMU should be undertaking similar activities and producing comparable products or services. Our dataset contains only the airlines that offer scheduled passenger transportation, hence, same products and services. Moreover, since the airline industry is regulated by the U.S. Department of Transportation and closely monitored by the Bureau of Transportation, our input measures record the same costs across different firms. Similarly, our output service quality scores are assessments of a world-recognized ranking firm that applies same standards across different firms. Hence, our dataset satisfies this assumption.
- Secondly, a similar range of resources should be available to all the units. As discussed in the "Resource Input Measures" section, U.S. airline industry has varying firm sizes violating this assumption in its raw form. We follow a scaling approach and control for the size (hence, the resource availability) of each airline. In our final dataset, each input score is comparable objectively. Hence, after adjustments, our final dataset satisfies this assumption as well.
- Third assumption is that all units operate in a similar environment. Since data contains only the airlines that operate in the U.S. (in the same country) during 2011 (during the same time period), with the same customer base, and under the same economic conditions, our study is valid on this assumption.

In addition, in order to ensure a discriminatory power of the model, the lower bound of number of DMUs should be at least twice the multiple of inputs and outputs (Golany and Roll, 1989; Dyson, et al, 2001; Sarkis, 2002). In this study, number of inputs is 2, number of outputs is 3, and the dataset contains 12 DMUs. Remember that our sample covers 86% of the industry (12 out of 14 national carriers). Both low-cost carriers (Allegiant Airlines, Frontier Airlines, JetBlue, Southwest Airlines, and Spirit Airlines), and full-service airlines (Alaska, American, Continental, Delta, Hawaiian, United, and US Airways) are well represented. Hence, given the small size of the entire population, our study has an acceptable number of DMUs.

4. Model

We use Data Envelopment Analysis (DEA) to determine the most efficient airlines in transforming their resources into good quality services. As detailed in the previous section, our analysis incorporates two resource input (operating expenses and labor) and 3 service quality output (structural, infrastructural, and SSC quality) measures. Each airline is evaluated by comparing its outputs with others in the sample. As such, we compare efficiencies along multiple dimensions simultaneously. We also measure the magnitude of inefficiency of airlines compared to the best practice. As the well-known strength of DEA models, we try to make every unit as efficient as possible, give the "benefit of the doubt" to the airline's management, and identify only the truly inefficient units (Sherman and Zhu, 2006b).

To solve for multiple input-output efficiency, the DEA model developed by Charnes, Cooper and Rhodes (1978, 1984), the CCR Model, is used. The efficiency (ɵ) of each airline is obtained by solving the following CCR model:

$$Max\ h_0(u,v)= \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}$$

$$\text{s.t.} \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \ j = 1, \dots, n \tag{1}$$

$$u_r, v_i \geq 0, \qquad r = 1, \dots, s; \ \ i = 1, \dots m$$

where x_{ij} is the amount of input i to unit j (for example, x_{11} refers to the labor expenses of Alaska Airlines); y_{rj} is the amount of output r from unit j (for example, y_{11} refers to the structural quality score of Alaska Airlines); u_r is the weight given to output r; v_i is the weight given to input i; n is the number of airlines (n = 1 to 12); m is the number of inputs; and s is the number of outputs. The set of normalizing constraints (1) reflects the condition that the virtual output to virtual input ratio of every DMU must be less than or equal to unity. We solve this problem via a Charnes-Cooper transformation, for which the LP dual problem is as follows:

$$\text{Min } \theta$$

$$\text{s.t.} \quad \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{i0} \qquad i = 1, \dots m \tag{2}$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0} \qquad r = 1, \dots, s \tag{3}$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0 \qquad\qquad j = 1, \dots, n$$

The program seeks to minimize ɵ, subject to the constraints (2) where the weighted sum of the inputs is less than or equal to the efficiency adjusted input of the particular airline being evaluated, and (3) the weighted sum of the outputs is greater than or equal to the output of that airline. The coefficients λ identify the portion of the difference between the particular airline being evaluated and airline(s) on the efficient frontier. The airlines with non-zero lambda values are the inefficient airlines. These values are used to compare the specific inefficient airline with the best practice. The inefficient airlines are also identified by an efficiency rating ɵ < 1. The best practice is identified by airlines with efficiency rating of ɵ = 1 or 100%.

Our DEA model calculates a variable returns to scale (VRS) efficiency. VRS assumes that changing inputs (operations and labor costs) may not necessarily result in a proportional change in outputs (service quality scores) which is the case in this study. We also compare Constant Returns to Scale (CRS) efficiency scores against VRS scores (Avkiran, 2006) to make sure that there is a sufficient difference between the two methods to justify its use.

5. Results and Discussion

Results of the DEA applied to 12 airlines in the U.S. industry are reported in Table 4. We find that Continental Airlines, Delta Air Lines, Frontier Airlines, JetBlue Airways, Southwest Airlines, Spirit Airlines, and United Airlines are relatively efficient (Efficiency Score = 1). In other words, these airlines are located on the efficient frontier. The inefficient airlines are shown to be US Airways, American Airlines, Hawaiian Airlines, Allegiant Air, and Alaska Airlines.

Our study provides evidence that low-cost carriers have benefited from their low costs focus. Note that 80% of low cost carriers proved to be efficient, while only 43% of full service airlines operate at the efficient frontier. Note also that low costs do not mean low quality in all cases. For example, while JetBlue is a low-cost carrier, it has the highest customer service quality scores in our dataset. This is an example showing that there is room for changes in improving the perceived quality of the service, without a huge investment in costs.

"Efficiency" scores compare the inefficient airlines to their benchmarks and suggest how much input can be reduced to reach the efficient frontier. For example, for American Airlines to become efficient, it needs to reduce costs to 97%

of its current level. We note that Alaska Airlines is the least efficient airline in the U.S. airline industry (within this sample) in terms of translating operational costs into good quality customer service.

Table 4. DEA results for 12 U.S. based airlines

DMU	Efficiency	Efficiency References Set (ERS) Optimal Lambdas with Benchmarks					
Continental Airlines	1.00000						
Delta Air Lines	1.00000						
Frontier Airlines	1.00000						
JetBlue Airways	1.00000						
Southwest Airlines	1.00000						
Spirit Airlines	1.00000						
United Airlines	1.00000						
US Airways	0.99537	0.525	Continental Airlines	0.339	Delta Air Lines	0.136	JetBlue Airways
American Airlines	0.96980	0.483	Continental Airlines	0.400	JetBlue Airways	0.117	Spirit Airlines
Hawaiian Airlines	0.70791	0.135	Continental Airlines	0.865	Spirit Airlines		
Allegiant Air	0.61675	0.261	Continental Airlines	0.239	Delta Air Lines	0.500	United Airlines
Alaska Airlines	0.56207	0.911	Continental Airlines	0.089	Spirit Airlines		

Table 4 also shows λ (lambda) values and efficiency reference sets (ERS) for each inefficient airline. Efficiency reference sets indicate the efficient units against which the inefficient units were most clearly determined to be inefficient (Sherman and Zhu, 2006b). These units are known as benchmark units. The numbers show the relative weight assigned to each ERS member to calculate the efficiency rating for a given airline.

Table 5. Service quality inefficiency in allegiant air calculated by DEA

			Continental		Delta		United	Expected Quality		Allegiant Actuals		Difference
Outputs	Structural		1.16		0.949		0.97	= 1.015		0.738		0.277
	Infrastructural	0.261*	1.068	+0.239*	1.068	+0.500*	0.855	= 0.961	–	0.961	=	0
	SSC		1.021		0.907		0.907	= 0.937		0.794		0.143

We demonstrate how the reference set and lambdas are used to calculate relative inefficiencies in Table 5. For example, Allegiant Air is found to have operating inefficiencies in direct comparison to Continental, Delta and United. By multiplying the lambdas with the benchmark firms' actuals, we can calculate expected quality scores for Allegiant. When compared with the actuals of Allegiant, we see that they need to improve structural quality by 27.7% and supply chain service quality by 14.3% compared to U.S. industry averages. Remember that we include seat comfort, in-flight entertainment, meals, cabin cleanliness, and washroom cleanliness in the structural quality category; and check-in, arrival service, and baggage delivery in the SSC category. Hence, Allegiant has some room to improve on both tangible aspects and before- and after-flight experience of the customers.

Table 6. Service quality inefficiency in full-service airlines

	Alaska	American	Hawaiian	US Airways
Structural	0.082	0.083	0	0.131
Infrastructural	0.100	0.141	0.116	0.252
SSC	0	0	0	0

Among the inefficient firms, only Allegiant Air is a low-cost carrier. Remaining four inefficient airlines are all full-service carriers. Similar to Allegiant, we can calculate the inefficiencies and potential improvement levels for these firms. Results are presented in Table 6. As opposed to Allegiant, inefficient full service carriers in our sample are all delivering good quality before- and after-flight experience to their customers. When they bring down their costs, they will be as good as their benchmarks.

However, when it comes to infrastructural quality, we observe the opposite: none of the inefficient full service carriers can serve customers at expected levels. Even when they reduce their costs, they still need to improve customer service experience in terms of employee behavior measured by quality dimensions such as staff enthusiasm, cabin presence, language skills, and consistency. Average improvement needed in the sample is a substantial 15.2%.

Similarly, structural quality in the U.S. airline industry can benefit from changes. Our results suggest improvements are necessary for dimensions such as seat comfort, in-flight entertainment, meals, and cleanliness. Average improvement needed in this category is also noteworthy at 9.8%.

We graph these results for customer service quality in Figure 1. We observe that one of the major inefficiencies in the U.S. airline industry is the infrastructural quality. Four out of 12 airlines (33.3% of our sample) operates inefficiently when it comes to employee behavior. Major airlines in the industry are lacking staff enthusiasm, adequate cabin presence, and behavioral consistency. While these airlines are making adequate investments in terms of operating expenses and employee salaries, the service quality outcomes of employees are not satisfactory. These airlines should find ways to improve their employee behavior. This could be through implementing different incentive and performance evaluation mechanisms. Improving the employee training strategies should help in this dimension. Hence, both the operations managers and human resources managers are responsible for getting better at infrastructural quality. While human resources should support employees by providing better training opportunities, operations managers should pay attention how work is done at the time of actual service delivery.

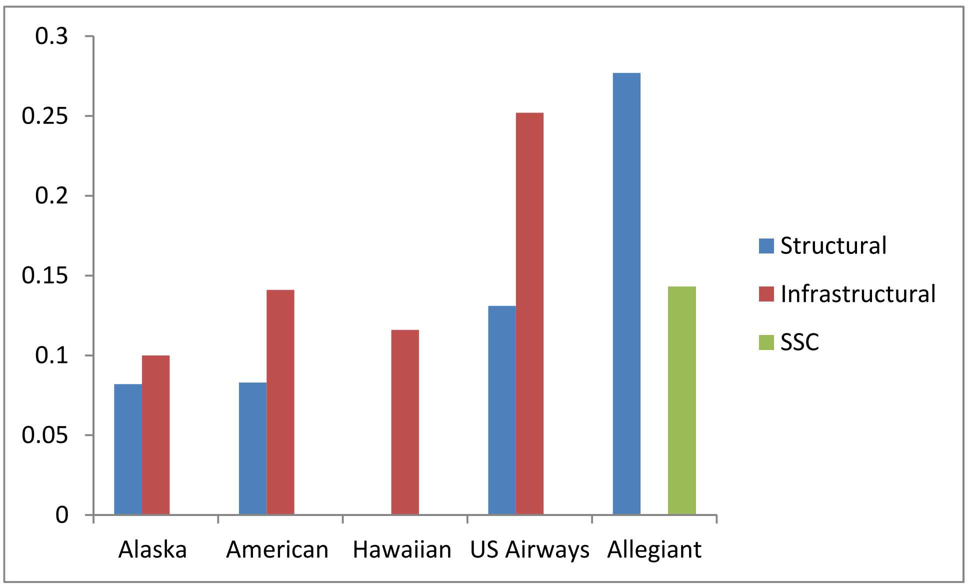

Figure 1. Service quality inefficiencies for U.S. airlines

Another important quality dimension that comes out to be inefficient in the U.S. airline industry is the structural quality. For the amount of money spent on operating expenses, 33.3% of firms in U.S. industry need to deliver more comfortable seats, better meals (if any) and in-flight entertainment (if any), and cleaner surroundings. Compared to many full service carriers' low performance, only one of the low cost carriers, Allegiant is listed as inefficient in this dimension. Note that full-service carriers perform worse than most low-cost/no-frills carriers in terms of structural quality. These full-service carriers promise to provide such services, but they do it worse than their low-cost competitors. One recommendation for these firms could be either changing their strategy from full-service to low-cost/no-frills by focusing on lowering costs or following a benchmark firm and providing better products to their customers without increasing costs.

For structural quality dimension, operations and marketing managers should work together to improve the customers' experience. While marketing managers should come up with better and affordable product designs including seats, meals, and entertainment, operations managers are responsible for delivering the food while it is fresh and making sure cleanliness is not compromised.

Finally, we note that U.S. airlines are operating quite efficiently when it comes to service supply chain choices. Only one airline, Allegiant, has room for improvement when it comes to check-in, arrival, and baggage delivery service quality. Indeed, this outcome should not come as a surprise, as "mishandled baggage" is one of the key dimensions in U.S. airline industry where firms have been competing for a long time. It has been one of the important data points all carriers would like to reduce and do better. "Mishandled Baggage Rate" data is being collected and published by U.S. Department of Transportation since 1987. Note also that most recent years have been record-breaking years to have the lowest mishandled baggage rates (Source: http://www.rita.dot.gov/bts/press_releases/dot015_13) which is reflected in our analysis.

6. Conclusions

In this paper, we investigate how U.S. airlines translate their inputs into good quality services. In particular we study how operating expenses and staff-related costs are transformed into service delivery success in terms of structural quality (seat comfort, in-flight entertainment, meals, and cleanliness), infrastructural quality (employee enthusiasm, cabin presence through the flight, behavioral consistency, staff efficiency, and language skills), and service supply chain quality (check-in, arrival, and baggage delivery).

We use a DEA model to find out potential improvement areas for U.S. airline industry. Our results suggest that low-cost carriers operate with higher efficiency than full-service airlines when we consider customer service quality. Our study provides evidence that low-cost carriers have benefited from their low costs focus. While 80% of low cost carriers proved to be efficient, only 43% of full service airlines operate at the efficient frontier. Reducing costs does not necessarily hurt the quality of services and products an airline could offer to its customers.

We find that one of the major inefficiencies in the U.S. airline industry is the infrastructural quality. Four out of 12 airlines (33.3% of our sample) operates inefficiently when it comes to employee behavior. Major airlines in the industry are lacking staff enthusiasm, adequate cabin presence, and behavioral consistency. While these airlines are making adequate investments in terms of operating expenses and employee salaries, the service quality outcomes of employees are not satisfactory.

Another important quality dimension that comes out to be inefficient in the U.S. airline industry is the structural quality. For the amount of money spent on operating expenses, 33.3% of firms in U.S. industry need to deliver more comfortable seats, better meals (if any) and in-flight entertainment (if any), and more clean surroundings. Note that full-service carriers perform worse than most low-cost/no-frills carriers in terms of structural quality.

The good news is that U.S. airlines are operating quite efficiently when it comes to service supply chain quality. Check-in and arrival services, and baggage delivery are three dimensions which we report excellent service for almost all firms in U.S. industry.

Like all studies, this study also has some limitations. We need to note that the DEA method only considers the production function of the firms under study and cannot evaluate the outside options. In our study, since the evaluation is limited to U.S. firms only, we inherently assume that the better firms in this industry are the best examples that can ever exist. This is a limitation since there could be better operating firms if we look globally. While in this study we avoided including global firms due to the differences in cost and demand structures in different parts of the world, it is a fruitful future research direction to explore which parts of the world have better service quality when controlled for operating costs.

References

Adler, N., & Berechman, J. (2001). Measuring airport quality from the airlines' viewpoint: an application of data envelopment analysis. *Transport Policy, 8*(3), 171-181. http://dx.doi.org/10.1016/S0967-070X(01)00011-7

Avkiran, N.K. (2006). *Productivity Analysis in the Service Sector with Data Envelopment Analysis* (3rd ed.). N K Avkiran, Ipswich.

Ayanso, A., & Mokaya, B. (2013). Efficiency Evaluation in Search Advertising. *Decision Sciences*, Forthcoming.

Babbar, S., & Koufteros, X. (2008). The Human Element in Airline Service Quality: Contact Personnel and the Customer. *International Journal of Operations and Production Management, 28*(9), 804-830. http://dx.doi.org/10.1108/01443570810895267

Backhaus, K., Bröker, O., Brüne, P., Reichle, F., & Wilken, R. (2011). Measuring service productivity with Data Envelopment Analysis (DEA). *Working Paper*.

Barbot, C., Costa, Á., & Sochirca, E. (2008). Airlines performance in the new market context: A comparative productivity and efficiency analysis. *Journal of Air Transport Management, 14*(5), 270-274. http://dx.doi.org/10.1016/j.jairtraman.2008.05.003

Becker, J., Beverungen, D., Breuker, D., Dietrich, H. A., Knackstedt, R., & Rauer, H. P. (2011). How to model service productivity for data envelopment analysis: A meta design approach. *ECIS 2011 Proceedings.*

Bejou, D., Edvardsson, B. O., & Rakowski, J. P. (1996). A Critical Incident Approach to Examining the Effects of Service Failures on Customer Relationships: The Case of Swedish and US Airlines. *Journal of Travel Research, 35*(1), 35-40. http://dx.doi.org/10.1177/004728759603500106

Bitner, M. J., Booms, B. H., & Tetreault, M. S. (1990). The service encounter: diagnosing favorable and unfavorable incidents. *The Journal of Marketing*, 71-84. http://dx.doi.org/10.2307/1252174

Cronin, J.J., & Taylor, S.A. (1992). Measuring service quality: a reexamination and extension. *Journal of Marketing, 56*(3), 55-68. http://dx.doi.org/10.2307/1252296

Doganis, R. (2002). *Flying off Course: The Economics of International Airlines.* Routledge, New York.

Douglas, G. W., & Miller, J. C. (1974). Quality competition, industry equilibrium, and efficiency in the price-constrained airline market. *The American Economic Review, 64*(4), 657-669.

Dyson, R. G., Allen, R., Camanho, A. S., Podinovski, V. V., Sarrico, C. S., & Shale, E. A. (2001). Pitfalls and protocols in DEA. *European Journal of Operational Research, 132*(2), 245-259. http://dx.doi.org/10.1016/S0377-2217(00)00149-1

Fethi, M. D., Jackson, P., & Weyman-Jones, T. G. (2000). Measuring the efficiency of European airlines: an application of DEA and Tobit Analysis. *EPRU Discussion Papers*.

Garvin, G. (1984). What does "product quality" really mean? *Sloan Management Review, 26*(1), 25-43.

Golany, B., & Roll, Y. (1989). An application procedure for DEA. *Omega, 17*(3), 237-250. http://dx.doi.org/10.1016/0305-0483(89)90029-7

Good, D. H., Röller, L. H., & Sickles, R. C. (1995). Airline efficiency differences between Europe and the US: implications for the pace of EC integration and domestic regulation. *European Journal of Operational Research, 80*(3), 508-518. http://dx.doi.org/10.1016/0377-2217(94)00134-X

Graham, D. R., Kaplan, D. P., & Sibley, D. S. (1983). Efficiency and competition in the airline industry. *The Bell Journal of Economics,* 118-138. http://dx.doi.org/10.2307/3003541

Han, S., Ham, S. S., Yang, I., & Baek, S. (2012). Passengers' perceptions of airline lounges: Importance of attributes that determine usage and service quality measurement. *Tourism Management*. http://dx.doi.org/10.1016/j.tourman.2011.11.023

Hanlon, J.P. (1999). *Global Airlines Competition in a Transnational Industry* (2nd ed.). London: UK, Butterworth-Heinemann.

Ho, C. T., & Zhu, D. S. (2004). Performance measurement of Taiwan's commercial banks. *International Journal of Productivity and Performance Management, 53*(5), 425-434. http://dx.doi.org/10.1108/17410400410545897

Kamakura, W. A., Mittal, V., De Rosa, F., & Mazzon, J. A. (2002). Assessing the service-profit chain. *Marketing Science, 21*(3), 294-317. http://dx.doi.org/10.1287/mksc.21.3.294.140

Lapré, M. A., & Scudder, G. D. (2004). Performance Improvement Paths in the US Airline Industry: Linking Trade−offs to Asset Frontiers. *Production and Operations Management, 13*(2), 123-134. http://dx.doi.org/10.1111/j.1937-5956.2004.tb00149.x

McClenahen, J.S. (1991). Welcome to the unfriendly skies: why business people hate to fly. *Industry Week, 3*(6), 14-16.

Metters, R. D., Frei, F. X., & Vargas, V. A. (1999). Measurement of Multiple Sites in Service Firms with Data Envelopment Analysis. *Production and Operations Management, 8*(3), 264-281. http://dx.doi.org/10.1111/j.1937-5956.1999.tb00308.x

Paradi, J.C., Vela, S., Yang, Z. (2004). Assessing bank and bank branch performance – modeling considerations and approached. In Cooper, W.W., Seiford, L.M., Zhu, J. (Eds), *Handbook on Data Envelopment Analysis.* Kluwer Academic Publishers, Boston, MA.

Parast, M. M., & Fini, E. H. (2010). The effect of productivity and quality on profitability in the US airline industry. *Managing Service Quality, 20*(5), 458-474. http://dx.doi.org/10.1108/09604521011073740

Parasuraman, A. (2002). Service quality and productivity: A synergistic perspective. *Managing Service Quality, 12*, 6-9. http://dx.doi.org/10.1108/096045202104

Parasuraman, A. A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing, 49*(4), 41-50. http://dx.doi.org/10.2307/1251430

Roth, A.V., & Jackson, W.E. (1995). Strategic determinants of service quality and performance: Evidence from the banking industry. *Management Science, 41*(11), 1720-1733. http://dx.doi.org/10.1287/mnsc.41.11.1720

Roth, A.V., & Menor, L.J. (2003). Insights into service operations management: A research agenda. *Production and Operations management, 12*(2), 145-164. http://dx.doi.org/10.1111/j.1937-5956.2003.tb00498.x

Rust, R. T., Moorman, C., & Dickson, P. R. (2002). Getting return on quality: revenue expansion, cost reduction, or both? *The Journal of Marketing*, 7-24. http://dx.doi.org/10.1509/jmkg.66.4.7.18515

Sarkis, J. (2002). *Productivity Analysis in the Service Sector with Data Envelopment Analysis* (2nd ed.). (ISBN pending).

Schefczyk, M. (1993). Operational performance of airlines: an extension of traditional measurement paradigms. *Strategic Management Journal, 14*(4), 301-317. http://dx.doi.org/10.1002/smj.4250140406

Scheraga, C. A. (2004). The relationship between operational efficiency and customer service: a global study of thirty-eight large international airlines. *Transportation journal*, 48-58.

Sherman, H. D., & Zhu, J. (2006a). Benchmarking with quality-adjusted DEA (Q-DEA) to seek lower-cost high-quality service: Evidence from a US bank application. *Annals of Operations Research, 145*(1), 301-319. http://dx.doi.org/10.1007/s10479-006-0037-4

Sherman, H. D., & Zhu, J. (2006b). *Service Productivity Management: Improving Service Performance using Data Envelopment Analysis.* E-book.

Sherry, L., Wang, D., & Donohue, G. (2007). Air travel consumer protection: metric for passenger on-time performance. *Transportation Research Record: Journal of the Transportation Research Board*, *2007*(1), 22-27.

Sissen, J. (1999, September). Charting a course. *Airfinance Journal (Supplement International Capital Markets)*, 2-5.

Soteriou, A. C., & Stavrinides, Y. (1997). An internal customer service quality data envelopment analysis model for bank branches. *International Journal of Operations & Production Management, 17*(8), 780-789. http://dx.doi.org/10.1108/01443579710175556

Soteriou, A., & Zenios, S. A. (1999). Operations, quality, and profitability in the provision of banking services. *Management Science, 45*(9), 1221-1238. http://dx.doi.org/10.1287/mnsc.45.9.1221

Tracey, M., & Tan, C. L. (2001). Empirical analysis of supplier selection and involvement, customer satisfaction, and firm performance. *Supply Chain Management: An International Journal, 6*(4), 174-188. http://dx.doi.org/10.1108/EUM0000000005709

Truitt, L. J., & Haynes, R. (1994). Evaluating service quality and productivity in the regional airline industry. *Transportation Journal*, *33*(4), 21-32.

Tsantoulis, M., & Palmer, A. (2008). Quality convergence in airline co-brand alliances. *Managing Service Quality, 18*(1), 34-64. http://dx.doi.org/10.1108/09604520810842830

Tsikriktsis, N. (2007). The effect of operational performance and focus on profitability: A longitudinal study of the US airline industry. *Manufacturing & Service Operations Management, 9*(4), 506-517. http://dx.doi.org/10.1287/msom.1060.0133

Windle, R.J. (1991). The World's Airlines: a cost and productivity comparison. *Journal of Transport Economics and Policy, 25*(1), 31–49.

Wyld, D. C., Jones, M. A., & Totten, J. W. (2005). Where is my suitcase? RFID and airline customer service. *Marketing Intelligence & Planning, 23*(4), 382-394. http://dx.doi.org/10.1108/02634500510603483

Yayla-Kullu. (2013). Capacity Investment and Product Line Decisions of a Multiproduct Leader and a Focus Strategy Entrant. *Decision Sciences, 44*(4), 645-678. http://dx.doi.org/10.1111/deci.12035

Yilmaz, Y., & Bititci, U. (2006). Performance measurement in the value chain: manufacturing v. tourism. *International Journal of Productivity and Performance Management, 55*(5), 371-389. http://dx.doi.org/10.1108/17410400610671417

Notes

Note 1. Although Continental merged with United on May 3, 2010, the two airlines remained separate until the operational integration was completed in mid-2012.

Note 2. Pink shaded airlines are full-service; others are low-cost carriers.